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AN ANALYSIS AND SUMMARY OF RESPONSES FROM FELLOWS OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES CONCERNING THE SPACE PROGRAM AS A SUBJECT FOR STUDY AND THOUGHT

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An Analysis and Summary of Responses
from Fellows of the American Academy of Arts and Sciences
Concerning the Space Program as a Subject for Study and Thought

In April 1962, the American Academy of Arts and Sciences received from the National Aeronautics and Space Agency a grant of $181,000 to conduct studies on the relationships of society to massive efforts of technological innovation, with special reference to the civilian space effort. The NASA grant to the American Academy was deliberately phrased in broad terms with the expectation that the committee administering this grant would develop a sharper conception of what was to be done.

As the Committee wished to have comments on this project from members of the Academy, a letter to some four hundred Fellows was mailed during the summer of 1962. The letter, which was drafted by an outside study group under the direction of the Committee on Space Efforts and Society, was sent to Fellows in the Academy classifications of Philosophy and Theology, Political Science, Social Relations, History, and Economics, and to all Fellows elected in 1961. The Fellows were asked to respond as experts in their respective fields and to indicate areas of knowledge outside their fields which they thought could be brought to bear on the problems which comprised the Committee's study. The Fellows were to feel free to interpret the questions in the broadest sense and, in addition, to submit questions or suggestions of their own choosing which they felt better defined the problems which confronted society relative to the entire area of space efforts and the current space program. The response was most encouraging and reflected the deep concern of the academic community with the problems raised by America's space program. Over two hundred thoughtful replies were received and have proven to be of considerable help and interest to the Committee.

Included in the two hundred replies received were a number from Fellows who disqualified themselves from commenting because of their positions, or claimed that their general lack of knowledge of the entire area made any comment superficial. Others objected to the questions as "too vague," "too general," or couched in "too much technicalese." Most of the replies, whether lengthy or brief, were carefully

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thought-out expressions of concern over a wide range of problems posed by NASA and its space program. These concerns may be summarized under the following headings, each of which will be taken up in detail in the following report:

1. On NASA's goals
2. On NASA's cost
3. On the manpower problem
4. On NASA's effect on basic research and pure science
5. On NASA's effect on the university and the teaching profession and the relationship between NASA and the universities
6. On the problems of liberal curricula and NASA's effect on the humanities
7. On the impact of technical innovations on society and culture in general
8. On the economic impact of the space program
9. On administrative problems of NASA
10. On public acceptance of NASA's program
11. On historical analogies to the current exploration of space
12. Miscellaneous concerns

On NASA's goals

A number of Fellows questioned the goals of the NASA program. Some few considered that space exploration ought not to be pursued at all. One respondent considered it an "insanely irresponsible waste" of tax dollars. Another expressed grave doubts about whether it was justified in view of comparative public needs. Several felt that the only possible justification was the advancement of scientific knowledge. One Fellow suggested that NASA set up some sort of office within which every other agency should have its devil's advocate to question space goals.

The question of whether NASA's activities should be motivated in whole or in part by military or defensive concerns, by concerns of national prestige and by its propaganda value in the Cold War, found the Fellows divided. A significant minority felt that there was legitimate justification for NASA activities. One conceded that we were engaged in a race in space and time with Russia in which the values of our nation were at stake; some felt that we should concentrate chiefly on those space activities and expenditures which would strengthen our military or defensive position. Others felt that while national security and cold-war concerns must be taken into consideration, they should not be overemphasized. One Fellow felt that the opportunities for integrating the NASA program with other areas of human worth would be broadened enormously if the competitive aspects could be lessened. The Antarctic exploration agreements were cited as a case in point. A great many felt, however, that all investigation of outer space should be completely divorced from military objectives and the spirit of nationalistic competition. They looked toward an ideal of greater international cooperation and control of space activities and a pooling of scientific knowledge.

What then would be the goals motivating the space effort? And who should assess them? Several letters stressed the fact that the assessment of the goals and

purposes of NASA must come from outside the scientific community and the group directly involved in the space effort. John Courtney Murray thinks that we must make ourselves explicitly conscious of our own intentions in the exploration of space and that NASA policy and objectives must somehow find their roots and rationale in our own society and must serve to enhance the range of values we consider basic to the American way of life. Erik Mollo-Christensen says that NASA's mission should, "among scientists at least, be understood to be scientific. The purpose should be to find out more about the world beyond the atmosphere of the earth." Amos N. Wilder feels that massive, rationalized scientific and technological activity should be basically motivated by humane, i.e., universal goals: "the extension of knowledge, the exploration of nature, the alleviation of human toil and suffering ...other motivations should be repudiated: the impulse to power for its own sake, short-sighted exploitation of nature or profanization of the creation, pride or hubris in technical mastery which seeks to escape wider controls...." He warns that damage to society could arise in connection with publicly interpreted motivation of anxiety or prestige factors as opposed to the large and generous attitudes that governed our participation in the geophysical year.

George Boas insists that if the NASA program concealed military objectives they should be explicitly stated. M. A. Biot feels that the space program in the United States receives popular support mainly because of the incentive of nationalistic competition and while this may not be an ideal goal from a humanistic standpoint, it provides "an important outlet for a productive capacity and social forces which might otherwise be deflected into more ominous channels." David Riesman in a somewhat similar vein sees the exploration of space as an outlet for American energies which has to be undertaken if the resources of our society are to be fully employed. Ernst B. Haas, on the other hand, says that if the object of the space program is to engage in a prestige race with Russia, we should cut our losses now because we have lost that race. He urged the advancement of scientific knowledge as the justification for the space program. But this need not be done "in a competitive manner and at breakneck speed, since our survival would not seem to depend on space colonization." Carle Zimmerman suggests that there may be motives and mechanisms behind the space program that are largely unconscious. For example, one mechanism could be a function of forgetting the past so as to turn to a new future. George Buttrick states that the problem is how we come by new motives.

On NASA's cost

A great many Fellows expressed concern over the enormous cost of the NASA program in terms of dollars, human effort and manpower, especially when this expenditure was viewed in relation to other human endeavors which they considered of equal or superior benefit to the welfare of mankind. Ernest H. Swift asks if the methods by which the decision is made to initiate such a massive undertaking as the space program include "adequate consideration by intelligent, informed, and unbiased people of the relative value of such a program as compared with other programs, or combination of programs, that might be carried on with an equal expenditure of national resources." Derk Bodde is concerned lest the enormous

4

resources devoted to space travel may seriously detract from the efforts made to solve many other problems which he sees of more pressing human concern, "matters like mental health, the conservation of natural resources, the population explosion, automation, and countless others--to say nothing of the basic question of world peace...." Roland Bainton, asserting that it is all a matter of relative values, asks "were it not better to banish Mars from the earth than to make a contact with his planet?" Arthur Cole warns that the cost of the NASA program could become so great that social and political consequences might follow. He foresees the possibility that the full program could be carried through only at the cost of autocratic government. George Boas feels that one of NASA's key problems is convincing the public that its program is more important than anything else.

On the manpower problem

The fact that in the United States today the reservoir of talent available for scientific research of any kind is not unlimited was a subject of great concern to many Fellows. Fletcher Watson posed the problem this way. "We are aware that the present very large and rather rapidly expanding activities of NASA is consuming an increasing quantity of highly specialized personnel.... NASA is in vicious competition for people with very particular capabilities.... Apparently from the considerable amount of publicity and expenditure being provided by NASA, there must be other major areas of human endeavor of equal or even greater social importance that are running short of manpower." He notes that large government projects are demanding that schools produce more people of technical competence; yet there is little government support for the complex and prolonged educational activities required. Leo Gross notes that when funds for specific goals are available, they may stimulate superficial interest which may bring about a serious diversion of talent and interest which may have an adverse effect on educational institutions. Charles W. Cole insists that the recruiting of scientists from teaching institutions which are already desperately short of good teachers must be avoided, and John Courtney Murray, in the belief that the prime source of future able scientists is the influence of the devoted teaching scientist, says that the major problem in enlarging the national pool of scientific manpower will be to enhance the role of the teaching scientist as against the contract-getting one.

Frederick Seitz believes that an agency such as NASA "must help determine the extent to which its own program may be depriving wider sections of the economy of suitable technical manpower." He suspects that this deprivation, although hard to demonstrate, may not be trivial. Benjamin Lax sees our inability to train an adequate number of scientists and engineers and our waste or poor management of qualified technical people in research and development in government, industry, and academic institutions as major national problems. He believes that under the present disorganized system of managing our educational and scientific resources, we cannot attain supremacy in space without doing damage to society and the educational and academic research enterprises which are the backbone of the space effort.

Evsey Domar sees a tremendous waste of talent in the present methods of selection of future scholars and scientists and says that we must catch the promising students prior to high school in order to help and guide them to the full development of their potential abilities. A non-Fellow who happened to reply to the inquiry notes that a number of people prominent in the electronics industry share a common background of the MIT Radiation Labs in World War II. Since this is a recent sampling and a number of alumni of the Radiation Lab are participating in the space program, he believes that a tracing of the careers of a selected sample might prove a fruitful study for a committee concerned with the personnel problem. Conyers Herring is interested in "the extent to which our national productivity in science could be improved by widening the opportunities for women scientists."

On NASA's effect on basic research and pure science

A number of letters from scientists and non-scientists alike were concerned that the emphasis on technology and applied science resulting from the impact of the NASA efforts might result in a neglect of basic research and pure science on which the space program, the technology, and indeed the scientific advancement of the nation as a whole ultimately depends. Many Fellows urged that basic research in all the sciences, not just those relevant to the space program, be encouraged and supported. A number of specific suggestions for implementing this financial support were given. Gilbert Stork proposed that monies for fundamental research activities by such organizations as the National Science Foundation be earmarked as an actual fixed percentage of total space efforts. Benjamin Lax suggested that NASA must form an agency to "bear its share of support of the training program and basic research. Some of this support should be specifically in the form of scholarships, fellowships, and educational support pertinent to the training of scientists and engineers, and perhaps first-class scientific administrators. The establishment of well endowed academic chairs in universities and grants for basic research programs of interest to NASA and the academic institutions would be steps in the right direction.

Robert F. Goheen, suggested steps in which NASA could aid colleges and universities. Included in his recommendations were the following: (1) a substantial program for financing basic research in all areas underlying the technological and research interests of NASA on a project basis; (2) an institutional grant program, perhaps patterned after those already adopted by the National Science Foundation and the National Institutes of Health, to provide a certain amount of "free money" which the institutions can use at their discretion to build up new areas, to undertake research of modest proportions, and to the support of facilities and services; (3) recognition of the importance of integrating basic research with graduate education and fostering graduate education through fellowships with matching grants to help finance educational costs; (4) provision of facilities and equipment for expanding programs of research and graduate education in areas of NASA's interest; (5) reimbursement of the full costs of NASA sponsored projects and programs so that the universities will not be forced to divert funds from other areas to participate in NASA work; (6) continuity of support by providing funds in advance for periods of several years; (7) provision of an institutional allowance over and above costs which universities can use to build up a reserve or endowment against risks involved in increasing the number of faculty appointments to accommodate NASA work.

R. M. MacIver submitted the following questions for consideration. "Should an advisory planning committee be organized to propose and advance effective division of research inquiries between colleges, universities, and institutes of technology on the one hand and governmental agencies on the other--in such a manner that fundamental research would remain primarily the function of the former? Should there be a plan for short-term internships in agencies like NASA for younger university and college professors so that they can return to their institutions with new perspectives on the relation between applied and fundamental research. And how can assurances be set up so that the constant pressure to advance immediate projects will not curtail the prior demand of more fundamental research?"

Erik Mollo-Christensen believes that if NASA would like to increase its support for research in universities and contribute more intensively to the education of research in universities and contribute more intensively to the education of research workers, it will have to "modify its policies and perhaps slightly redefine its mission or at least reinterpret its definition." He also suggests that since NASA will not be able to employ the top scientists in space and planetary science, as these will remain at universities and observatories, these scientists must be allowed the use of NASA. He proposes the following program:

1. NASA support to education and small scale thesis research
   a. Training grants (fellowships to predoctoral and postdoctoral students)
   b. Counterpart funds to the institution to pay expense per graduate student enrolled
   c. Funds for small scale research performed by students and faculty members.

2. Grants in support of university research
   These should be handled by a separate branch of NASA or by NSF for NASA. The total amount for supporting university research should be a given percentage of the NASA appropriation for "Research, Development, and Operation," i.e., one-third of one percent.

3. Support for orbiting and terrestrial observatories
   This support should be given in terms of an object, rather than piecemeal per satellite or instrument package.

4. Choice by university of programs to support

Mollo-Christensen suggests that the funds for item 2 be distributed using the same or similar machinery as is now used by NSF and that the funds for item 3 must be separated in the appropriation bill from funds for development and commercial satellites, otherwise "there may be room for administrative decisions which may postpone many doctoral theses."

J. A. Pierce warns that government support of incompetent work can damage the field of science and technology by encouraging the bad at the expense of the good. Victor Butterfield posed the following questions for the Committee's consideration. Shouldn't government agencies give heavy and primary support to research programs within university contexts rather than setting up isolated and powerful research teams

7

in cloisters that reach few if any students or feel the impact of other cultural and intellectual forces? And shouldn't these agencies do more to give the most gifted scholars a greater sense of freedom to pursue learning as their own curiosity may indicate? He suggested that granting some funds with few if any strings attached might strengthen basic science. Several Fellows shared Butterfield's concern with the freedom of the scientist to pursue research he thought important. R. Smoluchowski warns that the "safe" research contract, chosen because there is a reasonable guarantee that the reported data will be impressive and the contract renewed, is "particularly disastrous in true basic research." He insists that "it is essential for the expert to choose the field of work according to his own taste and his own feeling of strength and creativity... the more basic, the more long-range, the more speculative and risky the research, the less it should be tampered with by those who control the funds." The only guarantee, according to Smoluchowski, that a major space effort will not adversely influence other research is "a broad support of basic, not developmental or applied research in all fields." H. Burr Steinbach suggests that NASA should not embark on a "project support program... but rather whole programs should be supported based on men and not what they say they will do." NASA could probably manage "bricks and mortar" support in such a fashion that in the future the buildings could be diverted to other scientific uses of the university's choosing. John M. Clark poses as a problem the possible impact of the bureaucratic tendencies and organization on the scientific independence of the participants in the space program.

On NASA's effect on the university and the teaching profession, and the relationship between NASA and the universities

A significant number of letters touched upon the problem of the relationship between NASA and the universities. John Courtney Murray thought that the present tendency for NASA to ignore the smaller universities may leave important scientific resources untouched. He also was concerned about what happens to the so-called private university when it is tied to government by enormous subsidies for scientific research. He posed the "not entirely remote" danger of a sort of New Feudalism "with the university as the liegeman of government, and government not necessarily... bound in loyalty to the ideals and best interests of the university, but bound only to the furtherance of its own current policies." Similarly, Amos N. Wilder feels that the health of the university itself would be threatened if the motivation of the space efforts conflicts with the proper ideals of the university. He points out that the integrity of science should encourage the common action of the university's servants in "continually redefining the conscience of their community over against any and every pressure from the state or the public which would exploit their skills unworthily, or against any tendencies in the scientific community itself toward an unconscionable autonomy of action."

George Boas feels that universities with large government contracts accentuate the applied sciences to the detriment of non-scientific students. Fletcher Watson suggests that the Committee might want to commission a paper dealing with the impact of the NASA activities upon the structure and operation of the curricula in the schools, especially science, mathematics and the social studies.

Victor Butterfield is concerned about the impact of huge government agencies such as NASA on education, and fears that they will greatly intensify competition among universities for gifted scholars and teachers, accelerate the trend toward specialization, especially technological specialization in the sciences and social sciences; and will increase the growing discount on the importance of teaching and the growing divorce between teaching and scholarship. He suggests that perhaps most fellowships to younger scholars should insist on some teaching. He feels that at the present time the financial and academic rewards go mostly to those who do not teach and that this degrades the profession and leaves teaching to less able scholars.

Kenneth Boulding suggests that some attention be paid to the role of the educational system in limiting the agenda of the human personality and hence in destroying his creativity. Erik Mollo-Christensen makes the point that a long-term commitment of a large fraction of the staff and facilities of a college to a single task such as a large research project might make the college richer but educationally poor. And M. A. Biot calls attention to the fact that "engineering as a professional craft requiring high skill, natural talent, and deserving high social standing should be restored to its proper place in the field of higher education."

On the problems of liberal curricula and NASA's effect on the humanities

A number of Fellows expressed their concern that with the inevitable emphasis on science and technology resulting from a massive NASA effort, liberal education, liberal arts and cultural values will tend to be de-emphasized to the detriment of society as a whole. George Boas commented that society is damaged when more taxes go into engineering projects and nothing is given to humanities. Clifford Shipton feels that the development of scientific knowledge is "forcing the humanities and social sciences out on the periphery with the study of music and the fine arts."

Stephan Kuttner fears that in marshalling research activities on the scale required by the space effort, a latent danger is the possibility that technology's joining hands with an "engineering" approach to social developments will lead to a neglect of cultural values and traditions. What, he asks, will be the place of the humanities, including the philosophical, moral, and theological disciplines in preparing society for the requirements of the technological future? What will be the place of the human individual in this society and what the meaning of the cultural past?

Lynn White remarks that there is a tendency for cultures to get badly out of equilibrium in the amount of energy they invest in certain interests as compared with others, and that overemphasis in one direction "usually leads after some generations to compensatory overemphasis in another direction." He is fearful that unless the present almost frantic investment in technology and in the science needed to sustain technology is balanced by the active sustaining of activities devoted to understanding the human phenomenon, then our science and technology may in the long run pay the price of a reaction. He points out that NASA is today building a tradition but with inadequate regard for the long range interpretation of its activities as part of American life and thought. He suggests therefore that NASA strengthen its historical section to keep

the record well documented and seen as a whole for the motivation and inspiration of future generations and the recruitment of future able minds.

Stephen C. Pepper believes the main problem in achieving optimum efficiency in terms of NASA goals is that of "balancing on one side the national efforts toward technological efficiency and on the other side, the encouragement of extensive cultural values in the arts, in intellectual understanding, in community living...." He advocates strong emphasis on broad liberal arts programs and encouragement, in terms of funds and time, of research in history, philosophy, anthropology, languages, literature and the visual arts. He adds that the activity of science as a social institution, not solely a technology, needs emphasis and proposes that it would be wise to increase activity in the history and philosophy of science. Robert E. L. Strider suggests that a broad cultural background makes a technician a better technician as well as a generally wiser person, and believes that educators ought to see to it that as many of the future NASA personnel as possible are liberally educated human beings.

Victor Butterfield feels that the central questions for liberal learning and education are "whether and how we might recapture the balance of these concerns or ideals in our liberal colleges and universities." He thinks that in undergraduate education we will have to rely more heavily on developing cultivated breadth out of our disciplines through more varied intellectual considerations of those disciplines and through the study of areas of knowledge that have a natural and relevant relationship with the central discipline. As to education in problems involving values or policy questions, he feels that "we may have to move in the direction of involving students in some understanding of the actual problems that professions face or the decisions that they have to make." Butterfield suggests that since the problems of liberal education will become increasingly acute, the committee establish a subcommittee to address itself to them and adds that unless scholars do so as against educators and educational administrators "there isn't much chance that college and university faculties will pick up the problems and help resolve them."

On the impact of technical innovation on society and culture in general

The impact of a massive technological effort on American society was a subject to which many of the Fellows addressed themselves. Crane Brinton suggested that "a few well-chosen case histories should throw some light on the way major technological changes and their effects get accepted in our culture." And S. L. Washburn pointed out that anthropologists have studied the effects of new technologies on peasant people, the essence of their method being to find the way new innovations change human behavior and whether these changes are in accord with already existing goals or upset them. The results of this kind of investigation clearly show "that many of the apparent stresses are unnecessary. Problems spring from lack of understanding on the part of the human beings involved, and that where there are real problems, these may frequently be minimized by bringing the actual issues into sharper focus." Leo Gross, however, remarks that from an empirical point of view, there is little foundation for assuming that advance planning for coping with problems resulting from space technology would make any appreciable dent on set ways of doing things.

Hannah Arendt believes that political science and political philosophy should attempt an "evaluation of the 'value' of innovation in human society as such." In her view the main source of conflict with technology arises from the fact that innovation in human life and in politics is "bound up with birth, with the constant self-innovation of mankind by virtue of which new beings keep invading a world which necessarily precedes them and therefore with regard to them is stable.... What happens to this specifically human innovation process through birth," she asks, "that presupposes worldly stability, under the impact of modern technology through which this world becomes subject to constant change?" Are there limits to innovation on principle? And is it possible to find out about them?

David Riesman cites the immense cultural gap developing in the U. S. between people living on a parochial level and those living on a planetary or even trans-planetary level of thought and feeling. He sees the need of a cross-cultural study of adult education in all forms "to see how people can be kept from feeling angry at the modern world, deracinated, unprepared, unskilled and unadaptable--and therefore often so angry that they are prepared politically to make a world that is more comprehensible for them." What are the ways of easing tensions between the cosmopolitans and the home guard who have fewer and fewer "reservations" other than those that take direct political form?

There were several suggestions as to the best method of easing the impact of technological change. One was that all large research grants, such as in the space program, automatically include an allotment for research on the social and economic consequences of the changes that the research will produce in society. Ernst B. Haas urged the necessity for projecting the social consequences of technological innovation before research and development on the innovation has gone very far. He proposed "that NASA's work be supervised by a distinguished body of scholars, scientists and philosophers, whose job would be routinely the making of social projections of technological innovations." This council he envisages as something like the General Advisory Committee of the AEC, except that the membership should be more general and its authority greater. Its recommendations should be made public and should form the chief element in the President's decision to go ahead with a specific piece of government-sponsored research.

Erik Mollo-Christensen thinks there is an opportunity for the government to utilize our capability for technological innovations created by the space program, in other fields and for purposes in accord with our stated policies. "We need to incorporate this possibility of a release of facilities and manpower into our planning for education, foreign aid, and public transportation, for example...." He feels that besides planning to use new technology for social purposes, we should also seriously consider using them for other scientific purposes. He cites as an example the fact that the capabilities we have developed for quantitative observation and measurement of physical quantities in connection with the space effort can be very useful in the earth sciences, medicine, physiology and biology.

C. P. Kindleberger wonders if the conditions for generating technical changes are best brought about by vertically integrated firms or through the competition of small component manufacturers whose efforts are only finally brought together by an assembler responsible for only a small part of value added. He is struck by the fact

in British economic history that technical innovation proceeded rapidly for a time under the method of myriad small component manufacturers brought together in organized markets, but that after a time it became necessary to achieve vertical integration to enable technical change to continue. He poses the question of which is the better system.

Carle Zimmerman remarks that right now we are in a vast transition of leadership in our society from the Mercantilist classes to the Intelligentsia. He feels that the space effort will facilitate this change as well as discipline the American people as a body politic. This vast change has to be almost finished within one generation.

On the economic impact of the space program

A number of the responding Fellows posed a wide range of economic questions for the Committee's consideration.

Frederick C. Mills submitted the fact that economic needs are satisfied in industrial economies today through the workings of mixed systems that combine free market forces and centralized government controls. "The 'mix' in these systems is changing with time. For world economy the tempo of such changes may be expected to accelerate as political and social orders react to the pressures of world revolution. Our knowledge of the operating characteristics of such mixed economies still falls far short of the demands we make of it." He felt that we must expand and improve both our conceptual instruments and our empirical data if we are to reduce the gap between the body of our knowledge in these fields and the snowballing increase of our needs. He stated that if economists could define more sharply the factors shaping economic growth, and if they could learn how to reduce the wide productivity gap between the developed and the underdeveloped national economies, they would contribute mightily to a stable and peaceful world order. According to Mills, the major question we seek to answer may be put in these terms: "How may we attain the optimum combinations of economic freedom and governmental direction in seeking to achieve the objectives of economic growth?" The criteria we may emphasize will change as social and cultural conditions change. Always present, however, are the following: (1) overall productivity; (2) the impact of growth (and its concomitants of technological change) on the human factors in production and consumption; (3) immediate and prospective needs of national defense; and, (4) an instrumental factor of continuing concern: the flexibility and adaptability of the operating economy under the impact of technological and social change. We must look beyond the immediate effects of such change to their long-term influence upon the ability of economic systems to respond promptly and effectively to the pulls and pressures of changing industrial techniques.

R. M. MacIver sees the more significant issues as: (1) excess productivity of various commodities in technologically advanced countries alongside scarcity in the less advanced, creating problems relevant to the economist and the political scientist. Among such problems are questions of marketing and tariffs, of the application of technologies to backward countries for the development of their natural resources, of international cooperation in the developmental process, of the extent and the manner of the export of capital and of the inter-organization of national

currency systems so as to facilitate the advancement of the internal economy of the undeveloped countries; and (2) lags and shifts of employment, calling for retraining of workers, relocation of workers and of industrial units, temporary fill-in work--jobs for unemployed groups, etc. These are problems for the economist and for public authorities and also for industrialists.

Kenneth Boulding conceives the economist's main task in an enterprise of this kind is that of "continually asking where in a complex administered enterprise, the price system may be introduced as a check and as an organizer; where decentralization is preferable to centralized authority; and where external economies and diseconomies are likely to arise. I would like to think of the economist in this connection as a kind of watchdog for human welfare."

Edward H. Levi believes that a broad question involved in the space program is "whether it is wise to use in an intentional way the interest in space development as a means for government subsidies and intervention along a broad front of the economy, and whether wise or not, whether this is going to be done, and if done, how it should be controlled."

John M. Clark wonders "whether this is one of the biggest steps we have taken away from old-fashioned private enterprise in industry and research and how far our 'mixed economy' is destined to go in developing a 'socialistic' emphasis in the mixture; and how the essential values of the private element can best be preserved in the face of the inevitable expansion of collective activities."

M. A. Adelman states that the principal question the Committee ought to puruse is "whether and to what extent the space program is serving as a draft on our current output of knowledge and to what extent it is serving as a contribution or addition to that output."

Charles M. Haar submits as a suggestion for defining the points at issue an examination of the effect of planning and of how the reactions of the market will modify or avoid its intended effects.

James C. Bonbright raises two problems that come within an economist's scope: "the problem raised by interest conflicts in space research such as that involved in the exploitation of Telstar by a corporation of a profit-making character, the stock of which is to be distributed among groups or individuals of very different financial and political interests....In the second place...the problem related to business-cycle theory and to secular industrial development that will be created, not just by the increased scale of technological innovations but also by probable changes in the timing of these innovations." Bonbright suggests that the Committee consider calling a meeting of about ten economists from the leading graduate schools in order to canvass their views.

On administrative problems of NASA

The dissemination of information about the space program and the maintenance of contacts between scientists, between scientists and scholars in other disciplines,

and between scientists and decision makers, emerged in the opinion of the Fellows as the most significant organizational problems facing the NASA administration. Edward H. Levi insisted that some means must be found to formalize the dissemination of information about the program and suggested the creation of a large council of representatives of various disciplines chosen along geographic lines which could be used as a sounding board for information and could be given funds to commission special continuing studies. Along with this central group he suggested regional groups organized along the same lines. Both groups would include representatives of the formal disciplines and of scientists, industry, and interested groups.

R. Smoluchowski believes that personal visits and information sessions between well-informed "space" men and the members of various academic centers of solid-state research should be promoted. He stresses the tremendous value of having the theoretical solid-state physicist well aware of the space problems, and feels that we badly need a better contact between all sciences as far as space is concerned.

Conyers Herring would like to see a continuing operational research group attached to every organization, large enough to have a major effect on our national pattern of scientific and technological creation. "Ideally such a group should contain from one to several men of top-notch scientific ability, who have pursued research careers in some technical field for enough years to have acquired some perspective and judgment in evaluating research trends, patterns of organization, and individuals." With regard to the dissemination of scientific information, Herring feels that in addition to the types of questions which have been studied in the past, questions such as the following should be studied: "How rapidly and how efficiently do good ideas spread? How can scientists be made aware of ideas which would be of value to them but which they would never think of searching for?"

Other administrative problems were brought out. Kenneth Boulding addressed himself to what he called the "Gilbert and Sullivan problem," e.g., the fact that it is frequently chance combinations of individuals that produce truly creative efforts. He would like to see the Committee give some attention to the problem of how the organizational structure of NASA could facilitate the coming together of creative groups. A related problem is "how do creative individuals and groups obtain the financial resources which enable their creativity to flower?" However, Boulding sees as the main sociological and administrative problem of NASA the fact that it is likely to be dominated by engineers and "that unless some countervailing power is organized the engineering mode of thought is likely to contribute markedly to the inefficiency as well as to the success of the enterprise."

R. M. MacIver raises three questions: "Is there sufficient overall planning to prevent undue duplication of projects and to permit effective division of labor between agencies, first on the national scale and then on the international scale? Should there be a top-level advisory board to formulate proposals for bi-lateral, multi-lateral, and world-wide cooperation on appropriate problems? To what other fields might the example of the International Geophysical Year be applied?"

Several persons mentioned the problem of who controls NASA. Marianne Moore says that there is a need to keep authority concentrated in as few persons as possible and that NASA should avoid red tape, tentativeness and protocol. Quincy Wright mentions two lines of study for the Committee to consider: "the relations between the military and the civilian agencies of government, and the relationship between natural scientists and decision-makers in government."

On public acceptance of NASA's program

A few Fellows devoted some consideration to the problem of the public's reaction to the NASA program. One thought that the only significance it had for the average man was in his role as a taxpayer. Crane Brinton felt that emotionally, the man-in-the-street hopes for all sorts of achievements in 'space,' but that the "problem of getting a democracy to accept the very great financial sacrifices for space exploration" was a difficult one. He suggested that arctic and antarctic exploration might be worth looking into since "apart from the Northwest Passage business, it was almost impossible to claim any direct economic gain from such exploration."

W. A. Paton raised the question of how the American public "can be dragooned or kidded into giving up a big slice of their prevailing or potential standard of living so that it may be possible to absorb a substantial part of our productive power in a space program. Especially, how can we keep them working harder and for longer hours than they do now in the face of determined efforts to increase featherbedding and cut the work week still further?" And Alex Inkeles feels that we know almost nothing about the critical aspect of the space program referred to in the Committee's letter as "the psychodynamics of public attitudes on the adoption of novel operations." He suggests that the Committee collect information on questions such as the following: "How much do our people know about the objectives, extent and costs of our space program? How much do they 'understand' what they 'know'? Do they approve? What price are they willing to pay for what objectives? What, if anything would they rather have? What feelings (aggression, fear, pride, etc.) are aroused by the successes and failures of space programs? What does all this 'mean' for citizens' conceptions of their present lives, their future prospects, and those of their children?"

On historical analogies to the current exploration of space

Two or three Fellows felt that interesting analogies could be drawn between other historical periods and the space age. Lewis Mumford saw a resemblance between the space age and the pyramid age, and commented that the pyramid age came to an abrupt end. Myron P. Gilmore suggested that many interesting problems might emerge from a comparative study of European exploration and the present exploration of space: in particular, (1) a study of the problems of establishing jurisdiction over newly discovered areas; the role of the papacy in the 15th century and the negotiations between Spain and Portugal leading up to the treaty of Tordesillas, dividing the newly discovered areas; (2) interesting questions on how previously unknown forms of human as well as other life can be fitted into the traditional legal and ethical systems suggested by the debates which took place before Emperor Charles V in the 16th century on the status of the inhabitants of the New World; (3) the character of the recruitment of those who undertook 16th century exploration and colonization.

One non-Fellow who had been queried believes that a fruitful analogue for the Committee to investigate is the history of Portugal at the time of their explorations along the West Coast of Africa, since at the time these explorations were going on, "the unknowns, the variables, the risks, and the financial hardships were very similar to those that we encounter today in NASA's exploration of outer space."

Miscellaneous concerns

There were a number of miscellaneous concerns raised by individual Fellows. Carleton S. Coon remarked that NASA research will have non-military results of a technological nature, the most important of which with regard to human relations will be in the field of communication. Society will be aided or hurt by the ways in which the new media are used. He suggests that what is broadcast on global television be checked for accuracy by some international agency. He sees a problem of commercials, and of mere entertainers pontificating on matters of importance. He fears the creeping homogenization of culture which mass media foster, and feels that apathy, a slowing down of progress in research and independent thinking are predictable results of global communication unless it is carefully planned and kept clear of sham and politics.

Nicholas Milas proposes that the Committee study the effect of ionizing radiation on human space travellers.

Quincy Wright thinks that experts in the field of international law and international relations should "seek to clarify existing international law, particularly by criticizing current incidents from the point of view of international law, should seek to develop international law in adaptation to rapid technological and other changes taking place in the world; and should seek to examine the relations of defensive and provocative actions in the realm of space and nuclear activities...."

Another non-Fellow, writing at the request of a Fellow who had been queried, claims that successful space efforts will have to take advantage of the experts' knowledge of international affairs and that this area of knowledge could make a significantly greater contribution "if efforts were made to increase our basic understanding of the distinctive features of those international relations involving subjects with major technical or scientific components as compared with those that do not have these components." He states that "successful space efforts on the scale contemplated will involve persons specially trained in international affairs, and also some administrative, engineering and scientific personnel who have received special instruction in international affairs." He fears a special strain on the existing training facilities and suggests that useful lessons might be learned by studying the "impressive size of...the AEC 'State Department'; the sort of work done by its staff members here and abroad and their actual or preferred training in international affairs." He points out that "space efforts along with similar technological efforts are changing the specific arrangements and even the very character of international affairs.... The fact of such changes requires that special efforts will have to be made if some of the functions performed in the past by scholarship and expert professional practice in international affairs are to be sustained. To avoid damaging the character of existing enterprises in this area and to provide maximum benefit to them, it will be necessary to develop channels for the rapid and penetrating interchange of ideas and information between the planners of space efforts and the community of scholars concerned with international affairs."

16