Footnotes For

Proposed Studies on the Implications of Peaceful Space Activities For Human Affairs

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With the Collaboration of:

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Prepared for the Committee on Long-Range Studies of the National Aeronautics and Space Administration by the Brookings Institution, December, 1960

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A Report Prepared for the COMMITTEE ON LONG-RANGE STUDIES
of the NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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December 1960

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1. INTRODUCTION: GOALS AND METHODS

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1. See introductory discussion to Chapter 7, "Attitudes and Values." For a general discussion of the impact of innovation, see also Homer G. Barnett, Innovation: The Basis of Cultural Change, McGraw-Hill (1953).

2. "Although a program by program analysis is the best way to make reasonable forecasts of trends, such an exercise contains a built-in bias that none of us can correct. How many of us just 20 years ago regarded missiles and rockets -- unmanned aircraft -- as more than comic strip fantasy? Who of us had any comprehension of atomic energy and the influence it would have on the budget? With our limited perspective we tend to project only problems and programs that we either have now, or can reasonably imagine, and hence most of us are bound to misrepresent or underrepresent the great changes that probably will take place in future budgets." Samuel M. Cohn, "Problems in Estimating Federal Government Expenditures," Journal of the American Statistical Association, Vol. 54 (December 1959), p. 719.

   See also Senate Study No. 2 (prepared at the request of the Committee on Foreign Relations by Stanford Research Institute), Possible Nonmilitary Scientific Developments and Their Potential Impact on Foreign Policy Problems of the United States, 86th Congress, First Session (September 1959). A summary of the expected future environment is to be found in Senate Study No. 9 (prepared at the request of the Committee on Foreign Relations by The Brookings Institution), The Formulation and Administration of United States Foreign Policy, 86th Congress, Second Session (January 1960). Note especially Appendix A, "The Prospective Environment for Policy-making and Administration," by Harrison Brown. For other aspects of this problem, see also Robert L. Heilbroner, The Future as History, Harper (1960).

3. As an example of the range of study pertinent to even one aspect of the range of research aspects implicit in this report, see Robert J. Smith, "Comparative Studies in Anthropology of the Interrelations Between Social and Technological Change," Human Organization, Vol. 16 (Spring 1957), pp. 30-36.

4. This approach to stimulating additional research ideas and proposals, in contrast to an exhaustive listing herein, should be understood in the light of the NASA research capability discussed in Chapter 2.

5. See, for example, the whole issue of the American Psychologist, Vol. 10 (October 1955).

2. COMMENTS ON THE ORGANIZATION AND FUNCTIONS OF A NASA SOCIAL SCIENCE RESEARCH CAPABILITY

There are no footnotes in this chapter.

3. IMPLICATIONS OF SATELLITE-BASED COMMUNICATIONS SYSTEMS

Footnotes

1. Key questions concerning television program content and the contingent relationship between audience and broadcaster were at issue on a CBS-TV program, "The Great Challenge," April 10, 1960. Moderated by Howard K. Smith of CBS, the panel included Marguerite Higgins, of the New York Herald Tribune; Frank Pace, Jr., former Secretary of the Army; Fred W. Friendly, director of CBS television programs; Leo Rosten, author and Look magazine consultant; and Gilbert Seldes, Director, Annenberg School of Communications, University of Pennsylvania. Central to the discussion was the following question: Should programs be permitted to be reduced to the lowest common denominator, or should an effort be made to provide leadership in raising standards? Some of the panel members were adamant in maintaining that television's role was to entertain and perhaps inform, but not to educate; it might not be proper to create a climate adverse to science and education, but it was equally improper to attempt to tutor an adult public.

   The Spring 1960 issue of Daedalus contained a symposium on "Mass Culture and Mass Media." From the views expressed, three basic positions emerged on what mass media is doing to mass society--optimistic, pessimistic, and ameliorative--the last based on the view that what happens depends upon social response to the media challenge. Some vital questions of political responsibility were also raised; for example, if freedom is an active responsibility, what role may the networks play in presenting political questions?

   See also Charles R. Wright, Mass Communications: A Sociological Perspective, Random House (1959), Chapters 4 and 5.

2. "There has been a significant lack of official comment by Soviet officials as to their plans for communications satellites, but U.S.

scientists who have had private conversations with Soviet space experts report keen interest in this subject and considerable evidence of work in this area. Soviet scientists indicate that they are centering their attention on synchronous (24-hr.) satellites in a 22,000 mi. high orbit, which are particularly suited to global coverage. They also speak of new types of passive reflectors which could be more effective than the metalized balloons that the National Aeronautics and Space Administration plans to launch." Robert Hotz, "Global Television Program," Aviation Week and Space Technology, Vol. 73 (August 8, 1960), p. 21.

3. The professional literature on this point is vast. For a good bibliography on the matter as well as an excellent summary of what is and is not known, see Raymond A. Bauer and Alice H. Bauer, "American Society and the Mass Media of Communication," to be published in the Journal of Social Issues early in 1961.

4. For greater detail about the systems, see House Hearings Before the Committee on Science and Astronautics, Satellites for World Communication, 86th Congress, First Session (March 3-4, 1959); and House Staff Report of the Select Committee on Astronautics and Space Exploration, "Satellites as Communication Relays," Space Handbook: Astronautics and its Applications, 86th Congress, First Session (1959), pp. 202-204.

5. "For instance, for useful satellite communication systems and for planetary probes one needs electronic equipment, in some cases microwave tubes, with years of assured (not average) life. Even life on the ground cannot in the end be sufficient, but it is at least necessary." John Pierce, "Space Fantasies," IRE Transactions, January 1960, pp. 3-5.

6. See UNESCO, World Communications, 3rd edition (1956), where the world need for 350 million radio receivers is discussed; and George A. Codding, Broadcasting Without Barriers, Mouton & Co. (UNESCO, 1959).

7. Technical data derived chiefly from the following: Joint Technical Advisory Committee, "Propagation Characteristics of the Radio Spectrum," Radio Spectrum Conservation, McGraw-Hill (1952); Senate Report (prepared by Edward Wenk, Library of Congress) for the Committee on Aeronautical and Space Sciences, "Technical Considerations in Radio Frequency Selection," Radio Frequency Control in Space Telecommunications, 86th Congress, Second Session (1960). See also "Radio Propagation Characteristics,"

pp. 12-14, and "Factors Affecting Frequencies for Space Use," pp. 44-45, of preceding publication.

8. Directional gain refers to the definition of signal and is rated in "decibels" (dbs.). Local radio stations normally have a 30-40 db. gain. The directive gain factor of 20 dbs. at 30 mc/s increases to 40 dbs. at 3,000 mc/s and goes to 50 dbs. at 30,000 mc/s. Directional gain can be achieved at either or both the transmitting or receiving ends through antenna design. With directivity comes a narrowing radio beam width, which must then be zeroed-in upon for reception.

9. "The problems of international agreement would initially appear imponderable, considering the many conflicting and competing demands for radio service, the finite limits to the spectrum itself, the technical difficulties in monitoring and policing the airwaves, the global character of radiowave propagation, the consequent international aspect of frequency control, and the large number of different administrations concerned with frequency allocation." Radio Frequency Control in Space Telecommunications, p. 23 (see Note 7 for complete citation).

10. Based on an interview with a Federal Communications Commission official. On September 29, 1960, a press release from the Commission stated that "the Commission took into account the filings and oral testimony which resulted from its Order of May 16, 1960, that reopened the record for receiving new data. It held that, in view of present uncertainties, specific allocations for space communication cannot be made at this time. In so doing, it pointed out that its separate Notice of Inquiry (Docket 13522) calls for comment by March 1, 1961, as to space communication needs on a longer range basis and this information will assist the Commission in preparing the United States position for future international conferences on the subject." ("Nonbroadcast and General Actions," Report No. 751, Federal Communications Commission, September 29, 1960.)

    For another attitude on this matter, see Jay Holmes, "FCC Move May Kill World TV," Missiles and Rockets, Vol. 7 (October 17, 1960), pp. 10-11.

11. "A passive satellite system which might be considered for commercial communication purposes is really not as good as an active repeater

system because it is susceptible to use by encroaching outsiders. In other words, if Nation A establishes a series of space balloons as part of a basic reflector system and licenses some private organization to charge for messages or charge other nations and individuals on a per-message basis, there is nothing to stop Nation B from utilizing the balloon satellites to transmit messages without any payments therefor--unless agreed to by international regulation...this point...reflects a real problem in the question of public versus private ownership on the one hand, against international ownership on the other." (Correspondence with Aaron B. Nadel, Defense Electronics Division, General Electric Company.)

12. In Europe, broadcasting systems generally evolved as an extension to the airwaves from ground telecommunication networks. Thus, France, Portugal, Germany, Italy, and Luxembourg have licensed concessions comparable to their telephone and telegraph systems. Some European countries--namely, Finland, Belgium, Switzerland, and the United Kingdom--have set up public service monopolies with certain operational autonomy. In Belgium, the governing council includes representatives of the two major national groups, the Walloons and the Flemish, in addition to political and religious representation. Understandably, national representation is also characteristic of the Swiss policy control group. France, Denmark, and Norway have each set up a legal status similar to government departments with advisory policy bodies. In Great Britain, the Postmaster General has veto power to prevent the BBC from becoming a state within a state; it prohibits controversial topics, editorial opinions, political broadcasting, and commercial advertising.

Freedom of expression and laissez-faire are fundamental principles in United States broadcasting. The Federal Communications Commission may not restrict the free expression of licensees, provided the "public interest" is not violated. Views differ as to the proper balance between public service and private prerogative. In legal jargon, the very broad question of just what "public service" constitutes remains to be resolved within the authority vested in the Federal Communications Commission.

Most of Latin America has commercial broadcasting similar to that of the United States. Varying regulations emphasize the suppres-

sion of such abuses as libel, subversion, and the spreading of alarm or despondency. In Cuba profanity or slang is forbidden. In Colombia unofficial reports on earthquakes are banned, and in Mexico at least one-fourth of the programs must be dedicated to Mexican music.

Canada's mixed system of private groups operating under public authority is somewhat similar to the situation in Britain; the system is based upon an ideology to maintain cultural levels and provide service to minorities. Private broadcasting has been authorized to provide local service to remotely dispersed audiences under licenses that attempt to prevent cultural inundation by the United States networks. The description of systems in Europe and the Americas is summarized from George A. Codding, Broadcasting Without Barriers, Mouton & Co. (UNESCO, 1959), pp. 38-44 .

See also Charles R. Wright, "Alternative Systems of Mass Communications: Selected Case Studies, "Mass Communications: A Sociological Perspective, Random House (1959), pp. 18-23. Drawing from H. D. Lasswell on the structure and function of communication in society, Wright comes up with the functional categories of (1) surveillance of the environment, (2) interpretation and prescription, and (3) transmission of culture, including entertainment. In broad terms, national philosophies may be viewed as falling into one of three groups: (1) the public trust --those that place emphasis upon insuring a positive influence for the common good, as in the British and Canadian systems; (2) laissez-faire --those that are content to permit broadcasters to pursue their own paths as long as they are not contrary to the public good, as in the United States; (3) instrument of state control--those that seek to achieve conformity by social restructuring, as in the Communist countries.

13. Case studies may be appropriate for better understanding the nature of this problem. What was the rationale of TVA in providing low-cost power for regional development? How did TVA determine cost factors in selling electricity? On what basis is AEC power technology being developed in terms of costing power to eventual private consumers?

14. At issue between the government and the privately owned networks is the definition of "in the public interest." Supreme Court Justice Felix Frankfurter ruled in the 1943 NBC chain broadcasting case that the Federal Communications Commission is charged with securing the maximum

benefit to all of the people. See Fernand Terron and Lucien Solal, Legislation for Press, Film, and Radio, UNESCO (1951). The 1956 FCC report, Public Service Responsibilities of Broadcast Licensees, has apparently never been seriously implemented by enforcement authorities, according to an interview with a highly placed member of the Federal Communications Commission.

15. See paper by Seymour Melman, Associate Professor of Management Engineering, Columbia University, on "The Impact of the Patent System on Research," reprinted in House Hearings Before the Subcommittee on Patents and Scientific Inventions, Property Rights in Inventions Made Under Federal Space Research Contracts, 86th Congress, First Session, (August-December 1959), pp. 913-974.

16. The 1950 Report of the President's Communications Policy Board recognized that special political, social, and economic factors pertained to the telecommunications field, since the rapid pace of growth and change in technologies affected the competitive position of the industry constituents, and investments were conditioned by both public and private considerations.

17. Senate Report of Proceedings, Hearings Held Before Committee on Interstate and Foreign Commerce, A Bill to Amend the Communications Act of 1934, as Amended, to Permit Consolidations or Merger of International Telegraph and Marine Carriers, and for Other Purposes, 86th Congress, First Session (March 20, 1959). The issues at the hearings were particularly pertinent to questions of technology and free competition, in each of which the national interest shares a stake. The international telegraph carriers argued that in order to compete for a fair share of the international communications market, new and expensive radio transmission techniques would have to be financed and developed. The Attorney General's Office, contrary to most other government agencies, argued that the best environment for technological innovation was a free competitive one. Pros and cons of merger also appeared in the 1950 Report of the President's Communications Policy Board.

18. The three major sources of broadcast financing are (1) sponsored advertisement, (2) a listener's tax on receiving sets, and (3) direct state subsidy. These sources of financing act as major determinants in broad-

cast philosophy and program content. Commercial television is compelled by financial considerations to adopt a style of program that will attract a large, steady, predictable, average audience. Public-supported broadcasting, on the other hand, has an obligation to appeal to the fuller range of varied interests of many types of audience.

Gerald Beadle, Director of the television service of the British Broadcasting Corporation, speaking in New York, January 26, 1960, in comparing BBC with the commercially financed Independent Television Authority, stressed the issue of social force. With private commercial sponsorship, the competition for popularity is likely to prevail; where public interests control the media, the obligations to reflect national culture and to enlighten tend to predominate.

19. Sometimes "irrational" factors are determinants. According to George A. Codding, who is the author of a history of the International Telecommunications Union, nationalism influenced the spread of French transmitter nets from Paris to the Belgian and Swiss borders before internal nets were installed. As for "rational" factors, the number and dispersion of transmitters and receivers are chiefly conditioned by geography, ownership, and frequency allocation.

Great Britain was forced by radio interference from the Continent to seek an early international agreement on broadcast frequencies. Being limited to two high-power wave lengths for national coverage and recognizing the vital social, economic, and political consequences of the broadcast media, it was then decided to entrust both frequencies to a public corporation. After 1945, Germany found itself limited to the higher frequency band widths for radio and TV broadcasting. Conversion of transmitters and receivers to high-frequency FM was mandatory, but it has given Germany a good quality reception which has more than offset the high cost of conversion. See Charles R. Wright, Mass Communications: A Sociological Perspective, Random House (1959), p. 35.

20. The International Telecommunications Union is scheduled to hold a special plenary session on satellites and space communications in 1963. The conference was to be held earlier, but the USSR asked for postpone-

ment until it knew better which type of communication satellite would prove operative. (From an interview with George A. Codding.)

21. "The International Telecommunications Union, some might think, should be able to provide the needed forum for policy-making and administration. The ITU for more than a century has been developing integration in technical standards, operating procedures, and rates of common carriers of communications by wire and radio. It also administers the policy on allocation of radio frequencies which is determined periodically by its more than 100 member nations. It is the United Nations' special agency for telecommunication affairs. It maintains close relations both with the UN and with other special agencies such as UNESCO, as well as with such regional organizations as the European Broadcasting Union and the International Radio Organization. It may well be that within the experience of the ITU and its associated organizations there may be found the elements of organization and policy which might be extended to the world-wide arena as a means of solving the present international problems of broadcasting.

"The ITU, however, does not have the jurisdiction to tackle these problems in the use of radio frequencies once allocated....It is important to note that...the part to be played by the ITU in the use of outer space will be limited to technical and operational aspects of the new telecommunications means to be developed. As regards the possible purposes for which these means are used, the ITU is not responsible for contemplating any regulation or control." Dallas W. Smythe, "Space-Satellite Broadcasting: Threat or Promise?" Illinois Business Review, Vol 17 (June 1960), p. 7.

22. In the United States the prevailing standard is 525 lines/60 frames per second; in the U.K. 405/50; in most of continental Europe 625/50; in France 819/50. Kinescope 35 mm. recording suggests an alternative for interchange in place of TV tapes; the quality is not as good as TV tapes, but it costs only $60 per hour as compared with $290 per hour for tape. Standards are constantly being improved and the conversion factor does not seem to be a foreseeable barrier with the advancing state of the art. The demand for rapid relay of TV video-tape has led to new techniques in converting tapes from one national system to another.

A communications satellite would conceivably obviate the kind of routing that was necessary to transmit TV coverage on the Eisenhower arrival in Europe last December. From Paris, using the French television standard of 819/50, pictures traveled over the Euravision circuit, across the English Channel via radio, thence over BBC's super-high frequency TV, and from there the pictures were converted on BBC equipment to American television standards of 525/60. The picture signals were then sent by radio to London Airport, where they were recorded on video magnetic tape and integrated with sound signals fed in from Paris. Resulting tapes were then flown to New York for direct transmission over the American networks.

It is pertinent to note that, even if it is feasible to receive U.S. TV signals on private receivers in the United States, present technologies require more lines to the inch for good reception than present receivers are designed for. It is not clear, of course, whether the perceived advantages of satellite reception would provide sufficient demand for new receivers to make the whole operation profitable.

23. According to a United Press dispatch in the Washington Post and Times Herald (October 20, 1960), "Year-Old Explorer Won't Take Exit Cue." The satellite was supposed to go silent after one year; however, the silencer failed to operate and Explorer went on "braying its way around the world."

24. Interviews with appropriate persons in the United States Information Agency and the International Cooperation Administration indicate that research on the semantics of local languages is very necessary if communications programs are to be effective. Some sense of the magnitude of this problem is indicated by the following description of audiences in an African nation, as provided by a respondent from the Voice of America:

    1. The intellectuals: university graduates, classified as "the erudite," speaking English; listen to the BBC Third Program. Estimated audience, 200, including 15 Africans.
    2. The educated: high school graduates, speaking English and the vernacular; listen to public affairs programs and both western and native music. Estimated audience, 1 million Africans.
    3. The literate: primary school education, speaking only the ver-

nacular; interested in and perhaps listen to world news, how-to-do-it programs, and native music. Estimated audience, 4 million Africans.

4. The illiterate: Bush people without education, speaking only the vernacular, but difficult to communicate to even in vernacular; listen to tribal music only. Estimated audience 16 million Africans.

25. Remarks of Jean D'Arcy as quoted in Dallas W. Smythe, Report to the President on Sabbatical Study, July 1959-January 1960, Institute of Communications Research, University of Illinois, pp. 15-16.

26. Moving across cultural lines is a major obstacle in extending commercial broadcasting abroad, making it difficult to correlate sponsors and audience markets and to formulate suitable broadcasting material. CBS indicated that only one and a half hours of direct programing from the United States to Cuba has taken place in the last four years over the AT&T hookup between Miami and Havana. The question of commercial sponsorship in a Cuban market and language barriers seem to be major obstacles. Even in Canada, only four out of the eighty hours of weekly broadcasting are supported by American sponsors.

27. "One possible communications system designed to conform to general human patterns of work and recreation would have a single programed multi-channel broadcasting and 'Courier' type active satellite with considerable storage capacity. This satellite would be positioned so as to maintain a 'dawn-dusk' orbit, thus passing near almost every point on earth at least once at the beginning of the local working day, when it might transmit general news and deliver privately addressed messages sent on passages over all parts of the world during the previous 24 hours; and again in the evening, when it might receive accounts of news generated during the day and messages to be relayed to addressees and transmit news and entertainment as appropriate. A single central command station located in one of the polar regions would be able to program the satellite appropriately at the start of each circuit round the earth, taking into account the particular centers of population or offices along the route and the messages to be delivered in the course of the forthcoming circuit.

"Such a system would not provide instant world-wide communications and, because signals would be stored and not repeated instantaneously, the capacity would be limited. Nevertheless, it might well handle a sizable number of those commercial messages, news items, or routine information services such as weather reports, which either are needed or are prepared at the beginning or end of the working day or during the evening entertainment hours and involve very broad or long-distance distribution. Standard radio, television, or facsimile receivers at any point on earth would be able to receive the information broadcast directly as the satellite passed within range in the morning or evening, and, with appropriate equipment, government agencies, service industries, businesses, or individuals could send or receive suitably addressed messages. Such a system thus illustrates the possibility that new technology could not only be made to conform to man's prevailing behavior patterns but might permit a reintroduction of routines now regrettably lost (according to some critics), but first developed when all long-distance communications were received or dispatched with the arrival and departure of the mail train, the packet boat, or the postman proceeding on his appointed rounds." (Correspondence with Christopher Wright, Executive Director of the Council for Atomic Age Studies, Columbia University.)

28. Bell Laboratories now has under development, as an alternative to high-capacity/low-cost communications, a "waveguide" pipe capable of transmitting 200 TV or 200,000 voice channels; this system may eventually prove more economical than radio relay, and it is uninhibited by the natural phenomena limiting both atmospheric and space transmission.

29. "With radio and magazines (which get incredible distribution in the most remote places) and movies (ditto), to say nothing of television, we are getting into a completely new set of circumstances -- where the most uneducated people who speak no modern world language have nevertheless a picture of the world far from home and a sense of the <u>style</u> of different national or regional communication patterns and ideas for which they are by <u>no</u> means dependent on the views of educated people in their own country, or certainly not necessarily so, and whose judgment and sophistication about these matters may hardly be known to the educated who have little contact with rural or backward or tribal peoples in their own country. This is an unprecedented situation,

where one has no way of knowing what is known, what the gaps are, what the interpretations are from any easy method of inspection. I suspect also that one would run into many variations of the problem we have here in interviewing and observing the so-called uneducated." (Correspondence with Dr. Rhoda Metraux, Associate Director of Project on the Factor of Allopsychic Orientation in Mental Health, American Museum of Natural History.)

30. A good statement of this attitude and the arguments for the use of communications satellites is to be found in "World-Wide Communication with Earth Satellites," by Dr. Henry Busignies and Louis Pollack, Signal, Vol. 14 (June 1960), pp. 32ff.

31. See, for example, Norbert Weiner, The Human Use Of Human Beings: Cybernetics and Society (revised ed.), Houghton Mifflin, 1954. Also see Louis J. Halle, "The Natural History of Man's Emergence Into Space," in International Political Implications of Activities in Outer Space, Joseph M. Goldsen, ed., RAND Corporation Report R-362-RC (1960), pp. 193-208.

32. Long-time observers of the U.N. frequently point out that there is a definite tendency, especially at the Secretariat level, to become increasingly more identified with others from other nations working on the same problem.

33. As an example of remote data processing technology today, consider the following from the AT&T 1959 Annual Report: "Data-Phone service enables machines to talk to machines, using suitable parts of the same network over which people talk with people. Connections are put through just as telephone calls are, and equipment provided by the telephone company converts the signals from the business machines into a form which can be sent over the telephone network. Even the largest high-speed computers can exchange information in this way....In addition to carrying data over the regular telephone network, we also use special 'broadband' circuits to send great quantities of data at high speeds. One such circuit today, for example, directly connects computer centers in different plants of a missile manufacturer; it will transmit as much information in 45 seconds as will be found in a 50,000-word book. There are also many military needs for transmitting data very fast." "Data Processing,"

AT&T Annual Report 1959, pp.7-9. See also Alfred R. Zipser, "Machines Talk to Each Other Over the Nation's Telephones," New York Times, October 16, 1960, F1.

34. Some of the research being conducted by the Boston firm of Itek Corporation should provide good case study material on the possibilities for a library search code permitting creative scholarship.

35. The techniques developed by the American Management Association for "gaming" complex industrial and business decisions, using top businessmen as the players, might well be applied to this problem. See Elizabeth Marting, ed., Top Management Decision Simulation: The AMA Approach, American Management Association (1957).

36. See, for example, Margaret Mead, New Lives for Old, Morrow (1956), especially Chapter 18; and Margaret Mead, ed., Cultural Patterns and Technical Change (UNESCO), Columbia University Press: International Documents Service (1953); reprinted by Mentor Books (June 1955).

37. "The secular evolution of a participant society appears to involve a regular sequence of three phases. Urbanization comes first, for cities alone have developed the complex of skills and resources which characterize the modern industrial economy. Within this urban matrix develop both of the attributes which distinguish the next two phases -- literacy and media growth. There is a close reciprocal relationship between these, for the literate develop the media which in turn spread literacy. But, historically, literacy performs the key function in the second phase. The capacity to read, at first acquired by relatively few people, equips them to perform the varied tasks required in the modernizing society. Not until the third phase, when the elaborate technology of industrial development is fairly well advanced, does a society begin to produce newspapers, radio networks, and motion pictures on a massive scale. This, in turn, accelerates the spread of literacy. Out of this interaction develop those institutions of participation (e.g., voting) which we find in all advanced modern societies. For countries in transition today, these high correlations suggest that literacy and media participation may be considered as a supply-and-demand reciprocal in a communication market whose locus, at least in its historical inception, can only be urban." Daniel Lerner, The Passing of Traditional Society, Free Press (1958), p. 60.

38. See Cultural Patterns and Technical Change, Margaret Mead, ed., prepared for UNESCO and reprinted by Mentor Books (June 1955). Many organizations are doing work in these areas, including the Phelps-Stokes Foundation and the Society for the Investigation of Human Ecology.

39. See Note 1; also see Joseph T. Klapper, Effects of Mass Communications, Free Press (1960), Carl I. Hovland, "Effects of Mass Media of Communication," in Gardner Lindzey, ed., Handbook of Social Psychology, Addison-Wesley Press (1954), Part II, pp. 1062-1103, and Leo Bogart, The Age of Television, Ungar (1956).

40. "It is not hard to visualize the impact on peoples of the world of being able to watch on-the-spot deliberations of the United Nations, the U.S. Congress, the British Parliament, or the Supreme Soviet in hours of crisis. A global television system would also enable a nation to actually show the fruits of its economic system and its culture to millions of people scattered around the globe." Robert Hotz, "Global Television Program," Aviation Week and Space Technology, Vol. 73 (August 8, 1960), p. 21.

    This is a typical statement of hope or assumption about the impact of TV. The fact is, of course, that it is very hard to "visualize the impact." In connection with this, see the issue of the Public Opinion Quarterly referred to below (Note 42), especially the section entitled "Images, Definitions, and Audience Reactions in International Communications."

41. On the complex problem of changing biases through exposure to facts see Milton Rokeach, The Open and Closed Mind, Basic Books (1960), and Leon Festinger, Theory of Cognitive Dissonance, Row, Peterson (1957).

42. As an example of the power of communications under the right circumstances to alter authority patterns, see Daniel Lerner, "The Grocer and the Chief: A Parable" in The Passing of Traditional Society, Free Press (1958). Also see the special issue of Public Opinion Quarterly, Vol. 20 (Spring 1956), devoted to "Studies in Political Communication," with Ithiel de Sola Pool as guest editor.

43. When this matter was discussed in some detail with two members of the Economic Development Institute of the International Bank for Recon-

struction and Development, they ventured the opinion that closed circuit international TV could expand the type of activity presently under way in which EDI invites senior ministerial officials from the underdeveloped areas for a six-month period of seminars designed to provide an integrated approach to economic development problems.

44. In this regard, it is interesting to note the growing sentiment that national nomination conventions may have outlived their usefulness because of the several effects of television on the purposes and consequences of convention activities.

45. The research of such people as Alex Bavelas, particularly his studies conducted when he was at MIT and at the Bell Telephone Laboratories, the work of Harold Guetzkow and associates at Northwestern University, and research of the kind conducted by Robert F. Bales at the Department of Social Relations, Harvard University, would be most pertinent to a better understanding of these problems.

Footnotes

1. Interviews with Dr. Jack Thompson, Executive Assistant, Technical Planning, U. S. Weather Bureau, and with Dr. Helmut E. Landsberg, Director, Office of Climatology, U. S. Weather Bureau.

2. See especially House Report of the Committee on Science and Astronautics, Serial B, Panel on Science and Technology, First Meeting, 86th Congress, Second Session (May 4, 1960), pp. 41-42 (which is a part of a paper by Dr. Sverre Petterssen entitled "Expected Developments in Meteorology During the Coming Ten Year Period"). Here are summarized the many non-space activities which must be undertaken in conjunction with space and satellite studies in order to develop an adequate theory of weather.

3. Interview with Dr. Jack Thompson. See also Morris Neiburger (Chairman, Department of Meteorology, University of California, Los Angeles), "Utilization of Space Vehicles for Weather Prediction and Control," lecture prepared for the series "Peacetime Uses of Space" held at the University of California, Los Angeles, 1960; pp. 6 and 7 are of particular interest here.

4. See Walter Sullivan, "U. S. Project Studies Tornadoes With Radar Planes and Rockets," New York Times, May 9, 1960, p. 31.

5. "The conclusions of the past ten years of experimentation emphasize that only through fundamental research in atomospheric science can answers be found to the complex questions involved in weather modification.... Research and evaluation will be conducted by the best scientific talent, using the tools of physics, chemistry, mathematics, engineering, and meteorology to solve the problems. The search will

in the main be characterized by its long term fundamental approach, and practical results should not be anticipated until a score of new discoveries in the laboratory and in the field has accumulated." National Science Foundation, Weather Modification: First Annual Report, 1959 (Publication 60-24), p. 15. Also: "...there is no known way to affect the weather and climate of an area. Attempts at prevention of hail and lightning and at influencing the formation or movement of tropical storms have so far been unsuccessful. Proposals for modification of larger scale aspects of the weather have taken the form of vague suggestions...which would require much further analysis before their feasibility could be evaluated." Morris Neiburger (see second citation in Note 3), p. 19.

6. For a review of the present situation, which informants tell us has not changed significantly since the article was published, see Francis Bello, "Forecast for Weather Control: Brighter," Fortune, Vol. 57 (May 1958), pp. 144-147, 166, 169, 173-174.

7. Reported by John W. Finney, "Waste Is Feared in Space Probes," New York Times, Sept. 25, 1960, p. 27. Even in the United States there are organizational problems connected with weather study and development, as is evidenced by the summary of the factors affecting the establishment of the National Center of Atmospheric Research. See John W. Finney, "U. S. Plans Center to Study Weather," New York Times, June 27, 1960, p. 5. A clear summary of some of the data processing and communication problems connected with a weather satellite system is to be found in Dr. Isador M. Levitt, "Satellite Problems Will Become Acute," Newport News, Virginia, Daily Press, June 19, 1960.

8. Memoranda of arrangements stipulating that the United States will provide weather observation equipment and resident technicians and train indigenous personnel, while recipient nations furnish employees and carry out the observations, have been signed with Colombia, Peru, Ecuador, the Dominican Republic, Chile, the West Indian Federation, France, the Netherlands, the Antilles, Cuba, and Mexico.

9. A highly placed international official, familiar with the impact of innovation on tradition-oriented societies, felt that the prospects of disruption of traditional agricultural production and tenors of life from such technological advances as 3 to 6 month forecasts would warrant the setting of technological motivation schedules and timing which scientists should not be allowed to exceed or accelerate. He proposed that in underdeveloped areas of the world research should be directed toward establishing what forecast lead-time was necessary to prevent flood and crop losses within existing social and economic structure, and that only forecasts that prevented such losses should be developed. He felt that the scientist should not be allowed to thrust on the world forecasts which it does not immediately need which would be disruptive.

10. Exchanges of weather information now occur between the United States and Red China, through the offices of the USSR, and apparently such exchanges took place even during the Korean War. However, there are profound limitations to these exchanges, as the operations of the World Meteorological Organization indicate. See Philip C. Jessup and H. J. Taubenfeld, Controls for Outer Space and the Antarctic Analogy, Columbia University Press (1959), p. 90.

11. The U. S. Air Force hypothesizes meteorological blackouts over large areas in the event of hostilities and this hypothesis, of course, might be extended to a "hot" cold war situation. See R. M. White, R. F. Myers, and F. W. Ward, "General Design for Weather Observing and Forecasting System 443L," Geophysics Research Directorate, Air Force Cambridge Research Center, Air Research and Development Command (AFCRC-TN-57-609), December 15, 1957, pp. 7-12. (ASTIA Document 133846, Library of Congress Reference PB 144602).

12. As precedent and pattern for the development of cooperative regional computer centers, there may be some relevant experience in the extra-national support of the so-called International Meteorological Institute at Stockholm, which has received outside support for research from various sources, including grants from the U. S. National Science Foundation, Weather Bureau, and Office of Naval Research (according to

Dr. Helmut E. Landsberg). Since by its covenant WMO is restricted to reporting and coordination between national organizations, and is specifically precluded from operations, the covenant would have to be amended to allow WMO direct administrative purview. If this could not be done, regional, continental, or international organizations might be created to administer the centers, or the regional meteorological authority could be added to existing regional organizations such as the Pan-American Union.

13. The history of the IGY might provide substantive parallels and suggest some of the organizational specifications that might be required to attain and maintain accurate, reliable, long-range, and short-range forecast capabilities on a world-wide basis. Under the IGY arrangements, sovereign nations agreed to exchange data gained from specific explorations undertaken by each as its contribution to the IGY program. Thus each nation took upon itself the responsibility for funding, carrying through, and delivering the findings of its own projects for the duration of IGY. It would be most fruitful to examine the IGY history, to identify the motivations of participating nations and their capacities to conceive and carry through significant parts of the undertaking and to share their findings. Such an analysis might well reveal experience that would be applicable to plans and organization of a permanent international, or at least multinational, weather reporting system. Documents related to the "administration" of IGY are now being collected and studied by John Truesdale, of the IGY Office of the National Academy of Sciences/National Research Council of Washington.

14. If, as appears likely, the United States continues to be a major, if not the major, contributor of satellite facilities for the development and application of advanced weather theory, it will be very necessary to assess the implications for foreign relations of a vacillating posture regarding what we claim we will make unrestrictedly available to the world, and what we subsequently restrict for military reasons.

The world-wide reactions of significant publics to our alleged restriction of the Tiros data and then our later claim to have released all of it, would make a worthwhile pilot study on this problem.

15. Interview with Dr. Jack Thompson. See also "Research and Education in Meteorology" (An interim report of the Committee on Meteorology to the National Academy of Sciences, National Research Council: January 25, 1958), included as Appendix A of National Science Foundation/University Committee on Atmospheric Research, Preliminary Plans for a National Institute of Atmospheric Research, National Science Foundation (February 1959). According to this report, "Salaries paid for meteorologists are comparable with those paid other scientists, and are at the top, on a par with salaries of physicists, for those with doctor's degrees....In view of the high salaries paid to meteorologists having doctor's degrees, it is surprising that there are not more of them." (p. A-29) However, as the report also states, "It is well known that careers in the military and civil government services are unattractive to a majority of young scientists." (p. A-18)

16. See House Report of the Committee on Sciences and Astronautics, Serial B, Panel on Science and Technology, First Meeting, 86th Congress, Second Session (May 4, 1960), p. 39 (which is part of a paper by Dr. Sverre Petterssen entitled "Expected Developments in Meteorology During the Coming Ten Year Period").

17. "Research and Education in Meteorology."

18. Major Fields for Graduate Study Leading to the Ph.D. Degree: A Supplement to A Guide to Graduate Study, Washington, D. C., American Council on Education (1958), pp. 8-9.

19. That machine learning of this type of phenomena is by no means impossible is evident in the on-going research on the perceptron. See Philip J. Klass, "Perceptron Shows Its Ability to Learn," Aviation Week, July 4, 1960, pp. 72-73, 75-77, 80.

20. Some sense of the subtlety of this problem is conveyed by the comments of qualified observers that in some countries the appellation "official"

renders any statement ipso facto untrue. In such areas it would obviously not make a weather prediction authoritative to claim that it came from official weather sources as an official prediction.

21. The experiences of organizations such as the System Development Corporation, Santa Monica, in designing large man-machine data processing systems and the appropriate training methods should be valuable for such studies.

22. "Today, vast beehives of scientists are mobilized and organized, under the auspices of governmental bureaucracies that dispose of the resources of whole nations, for the advancement of applied science and technology. Tomorrow, it appears, the resources of the whole world will have to be mobilized by the governments to carry out single 'space projects.' The implication for human society is plain. Individuals will have to be brought together in beehives that will have to be combined, in turn, to form super-beehives -- until at last, perhaps the whole of mankind is brought within one centralized organization that operates the civilization of the future, maintaining and regulating the artificial environment that it provides." Louis J. Halle, "The Natural History of Man's Emergence Into Space," in International Political Implications of Activities in Outer Space, Joseph M. Goldsen, ed., RAND Corporation Report R-362-RC (1960), p. 201.

23. The quick history of the rise and fall of the Discomfort Index is told in headlines of articles in the New York Times, June 14, 16, and 17, 1959, pp. 23, 37, and 37 respectively. As of the last date, under pressure from the New York Commerce and Industry Association, the New York Weather Bureau dropped the term.

24. The term "product raisers" as used includes farmers, commercial fishermen, herders, and all those whose activities involve food, fibers, and other raw products growing in a natural weather environment.

25. Gerhard Colm of the National Planning Association was informed while visiting in Japan that in some areas of southern Japan three rice crops per year are now produced by covering the seedlings with plastic sheets, a technique developed at the University of Hokkaido as a means of making more effective use of irrigation techniques. Southern areas that do

not need to irrigate but which have been using the plastic sheets have produced so much rice that, according to information given Colm, the Japanese have been able to cut down their rice imports radically.

26. Food-raising habits are of course also profoundly affected by habitual and traditional factors concerning eating habits. In underdeveloped countries with highly traditional diets and large portions of the population at poverty levels, unfamiliar food substitutes, particularly if their cost is higher than that of the customary staples, cannot be quickly introduced and distributed. Among such countries, many have the climatic conditions and single-crop economies that would make diversification in agriculture most rewarding, if tradition did not work against it. In India and related areas, for instance, many of those who die during famines do so because they come from a rice tradition and will only eat rice even if it means starving to death in the presence of sufficient wheat.

Consumer habits, even in the "developed" West, are rigid regarding food. The British, for instance, would not accept the available supply of cranberries to meet the serious Vitamin C deficiencies due to a combination of dollar shortages and inadequate crops of Haifa citrus fruit even in a period following conditioning to wartime food substitutes. And in the United States complex techniques needed to be developed during World War II to shift eating habits. See, for example Kurt Lewin, "Group Decision and Social Change," in Theodore M. Newcomb and Eugene L. Hartley, eds., Readings In Social Psychology, Holt (1947), pp. 330-344. See also Margaret Mead, "Cultural Contexts of Nutritional Patterns," in Centennial: Collected Papers Presented at the Centennial Celebration, Washington D. C., American Association for the Advancement of Science (1950).

27. "Time and again, the unwillingness or inability to look at a whole operation, to take all the parts into consideration, has been fatal; and then, all too often, the glib judgement of 'too backward' or 'too resistant for cultural reasons' has glossed over the problem of inadequate approach. Or, where we have concentrated on training a very few specialists (with, incidentally, no special preparation for the

problems that exist where they will work), we have later wondered why they have accomplished so little when they got home or why some of them, who were eager learners and sympathetic students, later became very hostile to our schools and/or American life and the United States. I am thinking here of my own experiences in working with highly trained Chinese; also the comments of a few people who have real access to intellectual Latin Americans in various countries; also the difficulties (and ultimate failure) of more than one international project, of which UNESCO's Pilot Project in Fundamental Education in Haiti is a small but telling example; also the hostilities that sometimes developed among Germans after foreign-trained German specialists returned home; also the ambivalent, often openly hostile, attitudes of the French....Unpublished materials I have read on the Burmese experience with American aid indicate some of the kinds of difficulties both sides get into -- that then can be translated into all sorts of political tangles -- when the initiator-receivers do know very well what, in general, they want but are not sufficiently technically competent to work out the full dimensions or to judge the adequacy of a plan that is submitted to them when the responder-donors are perfectly competent to devise an overall, technically excellent plan but have no notion of what the dimensions of its application are -- so no one on either side ever really understands what was the nature of the hitch. The repercussions of such a failure may seem minimally important at the time (in some countries); in others there may be tremendous snowballing effects." (Correspondence with Dr. Rhoda Metraux, Associate Director, Project on the Factor of Allopsychic Orientation in Mental Health, American Museum of Natural History. See Note 30.)

28. Organizations such as the Bureau of Social Affairs of the United Nations and various offices in the International Cooperation Administration are acutely aware of these factors, and either have under way, or would like to have under way, detailed studies clarifying the social aspects of economic and technological change. See, for example, Isabel Kelly, "Technical Cooperation and the Culture of the Host Country," prepared for the Community Development Division of I.C.A. (June 1959). Of particular interest are the Cornell University studies in "Culture and

Applied Science," including the deliberate and controlled experiments in introducing technological innovation into a farming community 250 miles northeast of Lima, an Indian area of Peru, at the hacienda of Vicos. See J. Collier and M. Collier, "Experiment with Applied Anthropology," Scientific American, Vol. 196 (January 1957), pp. 37-47.

29. Human Relations Area Files should be especially useful for answering many of these questions -- or at least getting first approximations to answers. For example, long-range weather forecasts, albeit non-scientific, may be relatively frequent in nonliterate cultures or undeveloped areas. After all, we ourselves have the tradition of Ground Hog Day, and in many parts of the country the thickness of the covering on "woolly bear" caterpillars is considered an authentic indication of how cold the following winter will be.

30. "However the weather predicting system is worked out -- whether through a series of nationally supported centers, regional centers, internationally controlled and supported centers, or some combination -- this is clearly a multi-cultural problem. In the last twenty years, anthropologists have developed considerable skill and have accumulated a large amount of experience in working on problems of this kind. Very careful cultural studies of some of the complex societies involved are available and could be used as a basis for the specialized studies necessary here, and highly qualified personnel could be found who would know how to study in detail the process of large-scale, complicated change." (Correspondence with Dr. Rhoda Metraux and Dr. Margaret Mead). See also Margaret Mead and Rhoda Metraux, eds., The Study of Culture at a Distance, University of Chicago Press (1953).

31. The following remarks are pertinent when considering the cost and benefits problems involved: "All peasants, and in fact all farmers in all countries, are subject to two risks: one on the production side, and one on the demand side. The risk on the demand side arises due to the impossibility of predicting the price which their crop will fetch. and this uncertainty can be mitigated or eliminated by governmental price-support or price-guarantee programs. The risk on the supply side is mainly due to uncertainties of the conditions under which agricultural

production is carried on, and here the chief factor is the weather. Other things being equal, the more primitive and technologically backward a given agriculture is, the more important will be the influence of the weather on a given crop. This follows from the fact that the more highly developed the agricultural technology, the more substitute factors of production in lieu of land inputs -- and it is to the land input that weather is tied. Some superficial surveys have yielded in fact that whereas in the United States land inputs account by value for less than 1/4 of total non-human inputs in farming, in India the corresponding proportion is around 80%. (More than superficial surveys are not available presently, especially not for India).

"Although I assume that there will be technological improvement in Indian farming, given the density of rural population, and given the low level of available capital, it is doubtful whether by 1975 Indian agriculture will be on a technologically very much more advanced level than it is now and the most important non-human input will be land. Hence I anticipate that the relative importance of weather predicition in India in 1975-1980 is likely to be considerably greater than in the United States. But since weather constitutes one of the major uncertainty factors on the production side in agriculture, any improvement in long-range weather forecasting is likely to be of relatively greater importance in a farm economy such as that of India as compared with, say, the United States, simply because the proportion of inputs whose productivity depends upon weather is going to be relatively much greater than in technologically more advanced agricultures." (Excerpt of letter from Dr. Bert F. Hoselitz, Director, Research Center in Economic Development and Cultural Exchange, University of Chicago.)

32. Interviews with Dr. Sherman E. Johnson, Chief Economist, Agricultural Research Service, U. S. Department of Agriculture, and Consultant to the Ford Foundation, India food resources project, and with Dr. Melvin L. Upchurch, Assistant Chief, Agricultural Adjustments, Research Branch.

33. Interviews with Drs. Johnson and Upchurch.

34. For a general description of the economic problems of U. S. agriculture and its ability to fend for itself politically, and the governmental mechanisms underpinning these activities, see Kenneth E. Boulding, The Organizational Revolution, Harper (1953), chapter on "The Farm Organization Movement," pp. 109-130.

35. In the words of Richard L. Meier: "As populations increase in the poorer parts of the world there is an increasing dependence upon marginal water supplies. The third Five Year Plan of India, recently released, must depend heavily upon multiple cropping of land (requiring a broader distribution of water and fertilizer) for increased food production and much less upon improved seed, pesticides, etc. Snow cover in the Himalayas and the strength of the monsoon, both major phenomena that depend upon world-wide meteorological conditions, will more and more affect Indian food supply.

"The failure of a monsoon to bring a significant amount of rain, which may occur as frequently as once a decade in some regions, will certainly cause increasing distress as population increases. Two such disasters in a row would exceed world relief capabilities and so result in very large scale loss of life, the breakdown of government, and so create political crises. In these circumstances long-range weather prediction may uncover economic and even political emergencies. Increasing population depending upon more marginal supplies of water make these large scale catastrophes more and more likely."

The sequence of events anticipated for smaller areas afflicted with exploding populations is taken up in Richard L. Meier's book, Modern Science and the Human Fertility Problem, Wiley (1959), Chapter 3.

36. For statistics regarding the involvements of governmental credit institutions in American agriculture, see U. S. Department of Agriculture: Agriculture Research Service, The Balance Sheet of Agriculture, 1958 (Agriculture Information Bulletin No. 201) (November 1958), pp. 17-25, and U. S. Department of Commerce: Bureau of the Census, Statistical Abstract of the United States: 1959 (eightieth edition) (1959), Tables 559, 561, 562, 563, 828, 832, 837.

37. See House Committee on Foreign Affairs, Subcommittee on National Security and Scientific Developments Affecting Foreign Policy, Relative to the Establishment of Plans for the Peaceful Exploitation of Outer Space, 85th Congress, Second Session (May 20, 1958), p. 4. Also see J. C. Thompson and G. W. Brier, "The Economic Utility of Weather Forecasts," Monthly Weather Review, Vol. 83 (November 1955), pp. 249-254, and U. S. Department of Commerce, Weather Bureau: Agricultural Weather Forecasting Service Pilot Project for Mississippi's Delta Area, Report of Implementation and Initial Operation During 1958 (Submitted as requested in the report of the U. S. Senate Committee on Appropriations, 85th Congress, Second Session): USCOMM-WB-DC (April 1, 1959), pp. 1-2.

38. There is already in existence in the U. S. and various other countries a considerable amount of research that is related or can be used in findings that bear on these matters. In the United States, the Department of Agriculture has for some years been conducting four regional "Cooperative Interregional Projects" in cooperation with the Agricultural Experimental Stations and Land Grant Colleges of the Mountain States, the Great Plains area, the North Central, and the Northeastern States. Weather data, including air and soil temperature readings, rainfall, humidity, etc., are being recorded over a period of years to enable valid daily probability projections for weather factors to be made on the basis of historical weather averages. The data are being correlated with others on the effects of weather variation on many aspects of plant, animal, insect, and disease development, and now constitute a significant part of the information required to establish lethal and optimum conditions for various agricultural products, as well as a climatological atlas for the United States regional climates. See Internal Unpublished USDA Documents, Annual Reports of Cooperative Regional Projects, Agricultural Research Service, USDA, for 1959, 1958, 1957, 1956. Somewhat comparable studies are being undertaken elsewhere around the world; the final result could be an international agricultural climatological atlas.

To establish what kinds of weather information American farmers needed, and also to determine how this information could be best

interpreted and communicated to them in their terms, the "Delta Project" was undertaken in 1958. An area-wide teletype circuit was established, linking Weather Bureau facilities with farm broadcasters and telecasters and other mass outlets, and a reporting network was established to provide detailed information on such matters as wind direction and velocity and soil temperature. Two trained agricultural weather forecasters were added to the Weather Bureau's local staff to interpret meteorological information and couch forecasts in terms understandable to farmers, and Agricultural Extension workers were trained to counsel and advise farmers on what to do about forecast weather.

The program proved to be of considerable aid to farmers growing a very weather-vulnerable crop, cotton, in a high weather-risk area. See U.S. Department of Commerce, Weather Bureau, etc., as cited in the last section of Note 37.

39. The increase in travel and outdoor recreation and the rise in the standards of facilities expected have been notable since the end of World War II. Marion Clawson, of Resources for the Future, Inc., estimates the demand for outdoor recreation facilities as increasing significantly faster than population growth and the rise in national income. See his Statistics on Outdoor Recreation, Resources for the Future, Inc. (1958), p. 7.

40. See Footnote 23. See also Senate Hearings Before the Subcommittee of the Committee on Appropriations on H. R. 7349, Department of Commerce and Related Agencies Appropriations, 1960, 86th Congress, First Session, pp. 463-469.

41. Here input-output analyses may be especially useful.

42. Bruce C. Netschert and Sam H. Schurr, Atomic Energy Applications with Reference to Underdeveloped Countries, Johns Hopkins Press (1957). See also Sam H. Schurr and Bruce C. Netschert, Energy and the American Economy, 1850-1975, Johns Hopkins Press (1960), and the statement by Dr. Homi J. Bhabha to the Atomic Industrial Forum Annual Conference, November 3, 1959, Washington, D. C.

43. See, for example, Gilbert F. White, "Industrial Water Use: A Review," Geographical Review, Vol. 50 (July 1960), pp. 412-430. Dr. White is quoted in the New York Times, July 3, 1960 ("Scientist Doubts Water Scarcity," p. 25) as saying: "The data currently at hand suggests that

growth in industrial water use need not be as large as predicted and may be smaller....Water supply is clearly of growing importance in the economic life of market economies, but it is not necessary or even often a decisive factor in industrial location. Its part in limiting present or future economic growth in most areas is doubtful."

44. See Edward A. Ackerman and George O. G. Lof, Technology in American Water Development (Published for Resources for the Future, Inc.), Johns Hopkins Press (1959), pp. 237-251.

45. An example of the application of hypothesized better weather information to fuel-supply planning is found in "Weather Information Applied to Fuel-Supply Planning," by Charles P. Smith, a paper presented to a session on weather forecasting sponsored by the Advisory Committee on Fundamental Research on Weather Forecasting of the American Petroleum Institute, 36th Annual Meeting, Chicago, November 12, 1956.

46. For stylistic simplification, the rest of this section will refer only to the consequences of fuel shortages in excessively cold periods, although it is recognized that, with the growth of population and the increasing use of air conditioning, excessively hot periods also present critical fuel production and utilization problems.

47. See Charles E. Fritz and Harry B. Williams, "The Human Being in Disasters: A Research Perspective," Annals of the American Academy of Political and Social Science, Vol. 309 (January 1957), pp. 42-51. See also Jeannette F. Rayner, "Studies of Disasters and Other Extreme Situations: An Annotated Selected Bibliography," Human Organization, Vol. 16 (Summer 1957), pp. 30-40; and Martha Wolfenstein, Disaster: A Psychological Essay, Free Press (1957).

48. Two of the many examples available will illustrate this assertion: "The city authorities of Ocean City did not consider the storm in itself particularly dangerous. The state police and Coast Guard perceived the storm as a potential agent for the loss of life and property. The possibility of the transient population leaving a particular storm and their exodus terminating in a panic was perceived by all in authority....Of the ten interviewees, not in official positions, six defined the situation as not serious. All six had had previous experience with storms, and had suffered no loss in previous storms. All six rejected the authorities' appraisal of the situation. That

is, they did not change their minds and decide the situation was serious. They chose not to leave. For five of the six, economic factors, such as the need to remain with property or fear of a subsequent financial loss if evacuation occurred, seemed to exert considerable force in the decision against evacuation." From Hurricane Barbara: a study of the evacuation of Ocean City, Maryland, August, 1953, published by the Committee on Disaster Studies, National Academy of Sciences, National Research Council (Dec. 1, 1953).

"Typhoons have a characteristic pattern. First, warning is always there, but it is difficult to predict just how bad the typhoon will be.... When the warnings are fairly clear, the probability is that it is not just a bad storm. The village chief will usually instruct the magician or magicians available to go to the sacred places of the village to try to contact the supernaturals involved, and to ask that the typhoon be halted. Such action is a public responsibility of the village chief and the village magicians. At the same time, chiefs and magicians at the district level, having more prestige and more powerful magic, will be concentrating their efforts to the same end." From "Typhoons on Yap," by David M. Schneider, published in Human Organization, Vol. 16 (Summer 1957), pp. 10-15.

49. In connection with (a) see Harry Bixler Williams, "Some Functions of Communication in Crisis Behavior," Human Organization, Vol. 16 (Summer 1957), pp. 15-19.

50. "Even with reliable knowledge about a probable danger, however, it is difficult to effectively warn a large population which cannot directly perceive the danger of a disaster. First there is the question of whether the warning should be issued or not; next, if the answer is affirmative, of how it should be given. The official who makes these decisions worries about what people will do if he has warned them and the disaster does not occur; conversely, he worries about what will happen if he does not warn them and the disaster does occur." Charles E. Fritz and Harry B. Williams, "The Human Being in Disasters: A Research Perspective," Annals of the American Academy of Political and Social Science, Vol. 309 (January 1957), p. 43.

51. For example, it might be in the interest of one forecast source to reduce the amount of food grown in a particular season in another region. Thus,

one forecaster might predict no payoff from marginal land farming, even though his data in fact indicated a good likelihood that such farming methods would be profitable that season. Given the extra effort and investment involved, the very fact that two forecasts differed might dissuade farming of the marginal lands and hence less food would be produced. Since for at least part of the period under consideration it is unlikely that the predictions will be highly accurate, a "mistaken" prediction need not permanently disenchant the "loser" nation about the forecasts of nations on which they acted.

Footnotes

1. See, for example, House Report of the Committee on Science and Astronautics, Pursuant to H. R. 133 (Serial I), The Practical Values of Space Exploration, 86th Congress, Second Session (July 5, 1960), pp. 17-28.

2. A good example of the dependence of technology on non-technological factors is the very limited use of new fabricating techniques and new construction materials in private housing. See Arthur M. Watkins, "A Good House Nowadays Is Hard to Find," Harper's Magazine, Vol. 220 (February 1960), pp. 37-43.

3. As an example of the methods which might be used for detecting and determining the by-product payoff of space technology see Herbert E. Striner, R. U. Sherman, et al., "Defense Spending and the U. S. Economy," Vols. 1 and 2, ORO Staff Paper, ORO-SP-57, Operations Research Office, The Johns Hopkins University, June 1958.

4. Organizing and maintaining such a group and implementing its functions could be one of the special continuing activities of the in-house NASA research organization described in Chapter 2.

5. See Mitchell Gordon, "Telemetry's Rise. Companies Step Up Use of Data Transmitter Employed in Satellites," Wall Street Journal, Oct. 10, 1960.

6. Monitoring selected aspects of human behavior has, until recently, been largely in the form of laboratory studies for determining the adequacy of techniques and in the development of physiological and psychological understanding. Specific physiological characteristics have been observed through the electrical impulses discharged by particular systems. Some years ago a research team at the Naval Medical Research Institute developed the instrumentation and the radio equipment which was able to

pick off and transmit to ground receivers a variety of physiological measures taken from an operating aircraft pilot. Data processing was also accomplished by ground-based equipment; however, the processing was limited, and further analyses were done in the laboratory. The purpose of the study was to examine behavioral response to physiological stress in a dynamic situation as it was occurring.

In May 1958 the National Research Council sponsored a symposium on the utilization of earth-circling satellites for biological research. Several of the discussions indicated that physiological monitoring devices would be necessary to record and transmit immediately to competent observers on the ground information on the state of health of biological subjects, especially humans, so that any undesirable changes manifested could be reacted to immediately in the interest of safety. Recommendations for types of variables to be utilized included measurements from the electrocardiogram, the electroencephalogram, respiration, heart rate, knee jerk, and a number of others. Subsequent satellite experiments which used mice and monkeys were able to incorporate these techniques and provide continuous monitoring through the data received from capsules carrying animals.

7. The New York Times (July 24, 1960), in an article entitled "Coronary Attack Held Predictable," reported that "the polygraph machine, commonly known as a lie-detector, shows possibilities as a detector of candidates for heart attacks." According to Dr. Meyer Friedman and Dr. Ray H. Rosenman, in the Journal of the American Medical Association ("Association of Specific Overt Behavior Pattern with Blood and Cardiovascular Findings"), Vol. 169 (March 21, 1959), pp. 1286-1296, "Results of the test showed... that the heart disease victims responded in a manner clearly differentiating them from the normal patients and from seven other participants who suffered from non-organic disorders of the heart and blood vessels."

Dr. Albert F. Ax, Director of the Psychophysiology Laboratory of the Lafayette Clinic in Detroit, has been feeding 29 physiological measures into a new computer system operating on data processing and correlation techniques developed by him and his associates. Although not using telemetering equipment, Professor Ax feels that it would expand and enhance the new understanding being provided by the computer capability and multiple physiological measures now available.

8. See, for example, Albert F. Ax, "Physiological Differentiation of Fear and Anger in Humans," Journal of Psychosomatic Medicine, Vol. 15 (1953), pp. 433ff.

9. A careful examination of the arguments and their sources regarding the use of subliminal stimulation on TV or movie screens should be most revealing about the kind of legal and ethical problems arising when some Americans perceive their privacy to be invaded or their volition interfered with. See also Raymond A. Bauer, "N / 1 Ways Not to Run a Railroad," American Psychologist, Vol. 15 (October 1960), pp. 650-655.

10. One indication of this interest is the facilitating support from the U. S. Air Force for travel and equipment for Dr. Marion A. Wenger of the University of Iowa, to conduct in India an exploratory investigation of the physiological control mechanisms of yogis.

11. For an excellent summary of the factors affecting the development of these devices as well as their characteristics, see George A. W. Boehm, "Exotic Power Packages," Fortune, Vol. 62 (June 1960), pp. 124ff.

12. See Leo Steg and George W. Sutton, "The Prospects of MHD Power Generation," Astronautics, Vol. 5 (August 1960), pp. 22-25, 82-86.

13. The precision navigation available to Polaris submarines over a three-month period testifies to the fact that it is within the state of the art to provide such a guidance capability. However, the equipment used on Polaris is elaborate and not immediately transferable to smaller working environments.

14. According to Richard L. Meier, "wherever innovations need to be adopted by tightly knit organizations that are no longer growing, the immediate social costs tend to prevent the realization of long-range gains. It is only recently that R & D has been given sufficient status and leverage in large organizations so that they adapt to change continuously and with a minimum of discomfort." Case studies having to do with institutional adjustment to automation in the transportation field might well be relevant to the development of better means for making transitions from human to machine control. The many studies of the Survey Research Center at the University of Michigan on the impact of automation are pertinent, too. See Floyd C. Mann and Lawrence K. Williams, "Dynamics of a Change to Electronic Data-Processing Equipment," Administrative Science Quarterly, Vol. 5 (September

1960), pp. 217-256; and George P. Shultz and Arnold R. Weber, "Technological Change and Industrial Relations," in Herbert G. Heneman, Jr., et al., Employment Relations Research, Harper (1960), pp. 190-221.

Footnotes

1. Throughout this chapter the government organization and personnel matters discussed are those involving space activities for peaceful use unless otherwise specified.

2. The possibilities and procedures for such interorganizational circulation of personnel might be explored from the standpoint of the experiences of the Canadian Defense Research Board, which does circulate its professional personnel between agencies.

3. In some senses the Public Health Service operates in this way. Its professional personnel can divide their time between government service and their private professional activities.

4. One of the nation's best qualified judges of these matters has stated in private conversation that, for the military at least, independent, nonprofit organizations such as Aerospace Corporation are mandatory if there are to be personnel and facilities for judging from the standpoint of national interests the value of space projects proposals made by industry.

   Consider, too, the following excerpted editorial: "Complicating the problem is the fact that many in the military are not really competent to judge the merit of these rosy promises hard-sold by reputable companies. This is no reflection on the abilities of the buyer; he just cannot be as technically up-to-date as the men who have researched pet ideas in laboratories for years. Somewhere along the line the buyer must accept the word of the man who should know." Clarke Newlon, "Let's Be Daring But Not Ridiculous," Missiles and Rockets, Vol. 6 (March 7, 1960), p. 50. As civilian space programs enlarge, analagous problems may confront NASA.

5. For some of the most current information on this problem, see Senate Committee on Government Operations, Organizing for National Security: Mobilizing Talent for Government Service, Part 3, Hearings for the Subcommittee on National Policy Machinery, 86th Congress, Second Session (May 11, 12, and 13, 1960); also see Association of the Bar of the City of New York, Special Committee on the Federal Conflict of Interest Laws, Conflicts of Interest in the Federal Service, Harvard University Press (1960).

6. "It is possible for new institutions to work out new and ingenious methods for exchanging personnel. An excellent example, that cannot apply directly to NASA's relations with industry, but is nevertheless highly suggestive, comes from Puerto Rico's Operation Bootstrap.

"In that case a new agency, the Economic Development Administration, established close relations with new industries on the Island founded by outside entrepreneurs, being instrumental in finding sites, personnel, services, and in clearing away red tape. It was aware of the labor-pirating tendencies of these firms and therefore tied their industrial promotion officers to long term contracts. However,when the firm offered a substantial enough increase in pay over government, and a suitable level of responsibility, a release was granted. By this means the new industry has been taken over by Puerto Rican management in record time and this management has been thoroughly indoctrinated in the over-all program of economic development and what constitutes the 'national' interest. It is, of course, perfectly proper for the government to get a man back, if it wishes, by offering sufficient status and salary, or by short-term borrowing, but it must consider what this will do to the industry it is fostering. Industries, of course, may try to hold on to their people with profit-sharing and stock options. Shared experiences bring about a high degree of cooperation between agency and industry." (Correspondence with Richard L. Meier based on his personal observations in Puerto Rico.)

7. Congressional Record--House, March 7, 1960, p. 4335. For a comparison with the NASA figures, the U.S. Civil Service Commission cites an average turnover rate of 5 per cent for 1958 for professional scientists and engineers (medical doctors, physical scientists, engineers, and psychologists) in nine agencies (Agriculture, Commerce, Interior,

Air Force, Army, Health, Education & Welfare, Atomic Energy, NASA, and Veterans Administration). The percentage covers those leaving because of retirement, death, or leaving government, but it does not include those going to other agencies. The NASA figure of 7.2 per cent includes only research and development personnel for the year 1959. (Engineers doing supporting work and also mathematicians come under another figure of 6.3 per cent, which also includes some nonprofessional personnel.) The 7.2 per cent includes people leaving to go to other agencies, but qualified informants indicate that the percentage of personnel doing so is negligible. The bulk leave to accept higher paying jobs in private industry.

8. From June 1959 to May 1960 NASA offered jobs to fifty-five new Ph.D.s; two accepted. From June 1960 to November 1960 offers were made to fourteen new Ph.D.s; none accepted.

For a summary of pertinent information on the motives of government science personnel see Earl W. Lindveit, Scientists in Government, Public Affairs Press (1960), pp. 30-62.

9. "Practitioners in the recruitment field have found that amenity and esthetics have a lot to do with the movement of high grade scientists and engineers from one activity to another. What is the utopia for the kinds of persons being attracted /to space activities/? How many are willing to live around Dayton, or in Alabama, or at Cape Canaveral? How many want to play in amateur string quartets, to hobnob with artists and poets, go to the theatre, ski, sail, skin dive, climb mountains, etc.? Or is it gardening, church work, community politics, boy scout leading, golfing, motorboating, fishing, etc.? There is another group that wants to read, barbecue on the back lawn, gadgeteer, and perhaps develop a few close friendships. Each of these utopias is /probably importantly/ associated with an attitude toward research and development.

"The attitudes incorporated within the NASA organization are just now being crystallized. The 'in-house' activities will be determined by them, as will the personnel selection. Whatever is left out can still be handled through contracts with firms that have other characteristics, some of them highly traditional, some avant garde. If the over-all effect is to emphasize and capture those who harbor utopian predispositions that are still rare and advanced, then change in American society

would be accelerated because this pattern is reinforced. These individuals at the working scientist level make up groups of their own kind, promotion is fast, power accumulates. The alternative is striving in obscurity, or compromise. These are matters /for research since/...they have practical applications when deciding upon personnel policy, community design, location of facilities, etc." (Correspondence with Richard L. Meier.)

10. Under the National Aeronuatics and Space Act, NASA does not have authority for supergrade positions as such, aside from a small number transferred to it from the Army Ballistic Missile Agency. Employees above the GS-15 level, therefore, are placed in excepted positions, as specified in the Space Act, the lowest salary of which, as set by NASA, is $14,000. Although in the Second Session of the 86th Congress government employee salaries were raised by approximately 7 1/2 per cent, the increase did not apply to NASA excepted positions because they are not regulated by the Classification Act. Thus, while the second through fifth within-grade salary steps in the GS-15 category prior to the pay raise ranged from $13,070 to $13,970, they subsequently ranged from $14,055 to $15,030. All of these became higher rates of pay than the beginning rate of $14,000 for the excepted positions. The Administrator of NASA has authority to adjust the excepted position salary structure, but he cannot raise the statutory ceilings of $19,000 and $21,000 respectively, and any general pay raise within the structure would compress salaries at the higher level and discriminate against those employees who are at the $19,000 and $20,000 salary level.

11. See Eldon Sweezy, Management of Laboratory Organizations, to be published in 1961 by Wylie.

12. See Lee E. Danielson, Characteristics of Engineers and Scientists, University of Michigan Bureau of Industrial Relations, Report No. 11 (1960); also see the following articles by Herbert A. Shepard: "The Value System of a University Research Group," American Sociological Review, Vol. 19 (August 1954), pp. 456-462; "Patterns of Organization for Applied Research and Development," Journal of Business, Vol. 29 (January 1956), pp. 52-58; "Basic Research and the Social System of

Pure Science," Philosophy of Science, Vol. 23 (January 1956), pp. 48-57; "Superiors and Subordinates in Research," Journal of Business, Vol. 29 (October 1956), pp. 261-267.

13. See Donald C. Pelz, Human Relations in a Research Organization, and Interpersonal Factors in Research, University of Michigan Press (1954).

14. For a review and interpretation of progress in understanding factors influencing creativity in research, see Herbert A. Shepard, "Major Researches in Creativity," Research Management (published by the Industrial Research Institute), Vol. 2 (Winter 1959), pp. 203-220.

15. U. S. Department of Labor, Our Manpower Future, 1955-65 (1957).

16. "Equipment and material costs and scientific salaries represent integral factors in the R & D index based on national indices applicable to R & D that was prepared by the Department of Defense in March, 1958....Scientific salaries show the greatest relative increases of any of the DOD selected indices" between 1950 and 1958. See Ellis A. Johnson and H. S. Milton, "A Proposed Cost-of-Research-Index," Operations Research Office, staff paper, ORO-SP-142 (April 1960), p. 12.

    See also House Committee on Post Office and Civil Service, Manpower Utilization Subcommittee, Personnel Procurement Costs of Selected Defense Contracts for Recruitment of Engineers and Scientists, Fiscal Year 1959, 86th Congress, Second Session (1960). According to an article by Frank C. Porter reporting on the document in the Washington Post and Times Herald, October 5, 1960, "Recruitment Costs Draw Fire. Defense Firms Spend $1022 per 'New Hire.'"

17. The methods used in World War II to reduce the construction of aircraft to a series of sub-tasks that could be handled by old and young women might provide some insights into analogous means for introducing inexperienced people into space activities.

18. Ewan Clague, "Occupation Statistics: A Tool for Determining Manpower Needs," Annals of the American Academy of Political and Social Science, Vol. 325 (September 1959), p. 21.

19. House Committee on Science and Astronautics, Scientific Manpower and Education: Deficiencies in the Tabulation and Study of Scientific Manpower, 86th Congress, First Session, House Report No. 1180 (1959), p. 18. The report

stated in part: "Congress' 1950 directive, which requires the National Science Foundation to develop informational programs covering all the Nation's scientific and technical personnel, has not been adequately met as of this date. Meanwhile, with the Space-Atomic Age upon us and with the need for scientific manpower growing daily, the need for a superior manpower tabulation is likewise accelerating rapidly. It must also be kept in mind that America's stature in the international community is becoming increasingly dependent upon her scientists, engineers, and technicians. Knowing who they are, where they are, and what they can do is thus becoming crucial."

20. Because of the inability of any central agency in the federal government, such as the Civil Service Commission, to provide a management system to understand and deal effectively with the retention of scientific personnel, individual agency efforts have of necessity been undertaken. One of the most significant of these in terms of relationship to space programs is the CATE (Current ARDC Technical Efforts) program of the Air Research Development Command of the Department of the Air Force. The CATE program is an information system for providing rapid identification and location of scientific personnel working in technical fields of interest to the Air Force; in reference to ARDC research and development contracts, it also promotes the interchange of information between government, industry, and universities. Its effectiveness suggests that the program would serve as a valuable case study, since a similar approach might be undertaken with great benefit by other agencies involved in space activities.

21. Richard Meier has pointed out that various fields of science and technology have had their fashions as glamorous careers and then declined, even though the fields themselves have flourished and expanded.

22. Some indication of the amount and depth of adolescent interest in space is provided by the American Rocket Society's estimate that 10,000 teenagers may be actively engaged in amateur rocketry, of whom possibly 10 to 15 per cent are capable and conscientious, with an intellectual curiosity to learn more about rocketry. A recent newspaper article indicated that NASA receives from 100 to 150 letters a day, approximately 90 per cent of its total, from children who are interested in space. K. Scheibel, "Space Applications Soar--From U.S. Small Fry," Binghampton Press, April 13, 1960.

The Department of Defense issued a directive (No. 5410.9) on June 25, 1958, "Cooperation with Amateur Scientific Groups." To implement this directive the Department of the Army issued Army Circular 360-5 (July 29, 1958) and has undertaken an active youth rocket program at various military installations. Seventy schoolboys gathered recently at Army Camp A. P. Hill in Virginia to take part in a regularly scheduled week-end rocket shoot. Ten of the seventeen rockets built and launched by the teenaged rocket enthusiasts rose to between 1,000 and 20,000 feet. The largest rocket, a 700-pound three-stage vehicle, rose to 5,000 feet. See "Young Scientists Lauded by Army at Rocket Shoot," Washington Post and Times Herald, June 6, 1960.

Several bills have been introduced in Congress relating to amateur rocketry; a recent one (H.R. 8334, July 22, 1959) purposed: "To amend the National Aeronautics and Space Act of 1958 to encourage participation in amateur rocketry, particularly among young people, by establishing facilities for study and experimentation in rocketry and related fields throughout the United States," with the expressed goal of providing "a reservoir of pretrained young people for work in rockets, missiles, and satellites by promoting study and experimentation."

In November 1959 the Board of the American Rocket Society passed unanimously a motion directing the ARS Education Committee to "encourage responsible youth organizations to undertake, on their own, educational programs along safe lines" in amateur rocketry. The Education Committee is now engaged in a pilot program of technical advice, the Explorer Scout Space Science Program.

23. See Donald N. Michael, "The Scientist Through Adolescent Eyes. What We Need to Know; Why We Need to Know It," Scientific Monthly, Vol. 84, (March 1957), pp. 135-140. Also see Eugene Gilbert, "Teen-Agers Think U.S. Should Speed Man-In-Space Program," (Huntsville, Alabama) Times, March 3, 1960.

24. See Margaret Mead, "The Newest Battle of the Sexes," Air Force Magazine/ Space Digest, Vol. 43 (July 1960), pp. 77ff.

"In connection with the whole question of the selection of science as a career in its relationship to space, there is need to do studies of women and girls. Not that they are going to get involved themselves (few of them want to be involved in any kind of career, irrespective of

talent), but because with the present expectation of very young marriage, their ideas are extremely influential in even the early interest-choices boys make as well as their later career choices; and what they are willing to do, what risks they are willing to take, where they are willing to go, how much schooling they are willing to undertake, and so on. For material at the high school level, see article cited.../in Note 25 below/, in which it was found that in the general high school population, boys as well as girls-for-boys want careers that will keep them close to home, doing something 'safe' with a good income that left plenty of time and energy for togetherness with family and friends unrelated to work." (Correspondence with Dr. Rhoda Metraux.)

25. "At the high school level, when students describe what they like or dislike about scientists, it is revealing that a whole class will give a personalized and vivid picture of a disliked teacher, but where the teacher has been successful in catching the imagination and interest of the students, one gets no picture of the teacher; instead the students write with some enthusiasm about subject matter. Similarly, in discussing well-known scientists, it is the work of scientists who are admired and the more personal characteristics of scientists toward whom a student feels antipathy that are likely to be recalled." See Margaret Mead and Rhoda Metraux, "Image of the Scientist among High School Students," Science, Vol. 126 (August 30, 1957), pp. 384-390.

26. See, for example, Max Weber, From Max Weber: Essays in Sociology, Oxford University Press (1946), pp. 196-244; Robert K. Merton, Social Theory and Social Structure, Free Press (1949), pp. 151-160; and Herbert A. Simon, Administrative Behavior, Macmillan (1949), pp. 198-219.

27. Consider one scientist in NASA who was also a member of a committee on the Space Science Board. He pointed out that NASA (governmental) was careful to avoid any membership on COSPAR (nonpolitical). However, he also said later that the Space Science Board (as a function of the National Academy of Science) has quite a bit to say in COSPAR, and that there are COSPAR people on many committees of the Space Science Board.

28. In response to questions concerning communication problems among scientists and men in politics one nontechnical respondent said they got along

fine with the purely technical people, but they sometimes had communication difficulties with the legislative liaison people who work between technical agencies and groups. (Correspondence with C. Barker, See Note 44.)

29. Public Law 85-568, National Aeronautics and Space Act of 1958.

30. Senate Committee on Aeronautical and Space Sciences, NASA Authorization for Fiscal Year 1960: Part II, Program Detail for 1960, 86th Congress, First Session, p. 799.

31. Ibid., p. 798. There have been indications that NASA's favorable salary position is a means of "raiding" other agencies. However, it has been suggested by persons familiar with these matters that, given present organizational rigidities, "raiding" may have some over-all functional advantages. It may stimulate specific government research organizations to provide more attractive working opportunities, thereby perhaps attracting better personnel to government research, as well as reducing the opportunities for organizations to become merely self-perpetuating. See J. Cramer, "NASA Raiding Is Subject of Secret Report," Washington Daily News, April 14, 1960.

Concern over whether NASA would use additional excepted authority for other than scientific personnel was included in the floor debate in the House of Representatives over a bill to authorize appropriations to NASA for the fiscal year 1961, which also provided for an increase in the number of excepted positions allowed NASA. See Congressional Record -- House, March 7, 1960, pp. 4333-4360.

32. The National Academy of Sciences-National Research Council established a sixteen-member Space Science Board on August 3, 1958, "to survey in concert the scientific problems, opportunities, and implications of man's advance into space." The Board, supported financially by the National Science Foundation and NASA, is advisory to government agencies involved in space programs, but its activities are limited primarily to serving its sponsoring agencies. It also engages in international scientific cooperation through the Committee on Space Research of the International Council of Scientific Unions. Other activities include space research proposals, reviews of space research programs, space symposia, and preparation of reports on various aspects of space science. The members of the Board panels are representative of universities, private research

institutions, and the federal government. The Board is generally recognized as a powerful and valued adviser to NASA.

33. A major recommendation in a recent report of the National Academy of Sciences to the Secretary of Commerce was that the U.S. Weather Bureau be recognized by the National Aeronautics and Space Administration as a participant in the federal space program. It was suggested that this action be formalized through an agreement by which the heads of both agencies could "establish a framework of relationships that insures the full benefits to be realized to meteorological science and to the Weather Bureau from this large federal space science program....In particular, the Weather Bureau scientists should now participate in the planning of experiments and in the evaluation of results applicable to meteorology. With the Bureau's limited funds, its present participation is perhaps limited to this. With the expansion of funds, its participation might well be expanded to development of new instrumentation for meteorological observation." See National Academy of Sciences-National Research Council, The Role of the Department of Commerce in Science and Technology, (1960), p. 155.

Compare this position with the reported situation as of August 1, 1960: "Weather forecasting by satellite is in danger of being washed out by a budgetary jurisdictional ruling. The Budget Bureau has turned down a Weather Bureau request for $5 million to capitalize on the Tiros program -- claiming NASA should put up the money. But NASA officials contend they haven't the funds -- either -- since the space agency's job is just R & D, not the establishment of an operational system for another government bureau. The Budget Bureau action has inspired top NASA officials to re-examine the agency's mission -- with an eye toward changing FY budget requests due in October." See "Budget Thunderhead," Missiles and Rockets, Vol. 7 (Aug. 1, 1960),p. 7.

34. In this regard, it is interesting to note that, whereas NASA was telling its Industry Program Plans Conference (Washington, D. C., July 28-29, 1960) that manned moon landings were not contemplated before the 1970's, the Army was reported in the August 14, 1960, New York Times as claiming that such a landing could be made within ten years. "U.S. Surveys Moon to Pick Locations for Army's Bases," p. 1. See also Robert Hotz, "Gathering Storm Over Space," Aviation Week, Vol 73 (Nov. 7, 1960), p. 21.

35. On August 31, 1960, NASA and the Atomic Energy Commission announced the establishment of the joint AEC-NASA Nuclear Propulsion Office to consolidate the work previously carried out by each agency to develop nuclear energy for space missions, including the Project Rover nuclear powered rocket developmental programs of the AEC. The new office is under the direction of the Chief of Nuclear Propulsion for NASA, and reportedly he can make decisions that formerly required agreements between NASA and AEC; thus, this section has been interpreted by some as meaning that NASA has gained control of Project Rover.

36. Senate Committee on Aeronautical and Space Sciences, Space Research in the Life Sciences: an Inventory of Related Programs, Resources, and Facilities, Staff Report, 86th Congress, Second Session (1960).

37. It is worth noting that for some NASA personnel it is a matter of annoyance that NASA shoots at Cape Canaveral are essentially under the regulation of the Air Force, since the Air Force controls range safety and no rockets lift off until the Range Safety Officer approves.

38. House Committee on Science and Astronautics, To Amend the National Aeronautics and Space Act of 1958, 86th Congress, Second Session (1960), pp. 90-91.

An incident that indicates a past lack of utilization by NASA and the Defense Department of the CMLC may be found in the development of Project Vega. On December 11, 1959, NASA announced that the Vega Space Vehicle Program had been canceled because of program schedule delays; the Air Force Agena-B vehicle, with a similar restart-in-space capability, would be used by NASA during the interim period until development of the next successive major vehicle, the Centaur, was completed. Reportedly, about $16 million was lost on the Vega program, and remaining program funds were to be applied to the Centaur program and to the purchase of Agena-B vehicles from the Air Force. For further information, see House Committee on Science and Astronautics, The Production of Documents by the National Aeronautics and Space Administration for the Committee on Science and Astronautics, 86th Congress, Second Session (1960), pp. 132-136. Also see "Mixup on Missile Cost 16 Millions," New York Times, June 12, 1960; and Paul Means, "Vega-Agena-B Mixup Cost Millions," Missiles and Rockets, Vol. 6 (June 20, 1960), p. 19.

39. See, for example, Vannevar Bush, Science, the Endless Frontier, Government Printing Office (1945); John R. Steelman, Science and Public Policy, Government Printing Office (1947); and National Science Foundation, Basic Research: A National Resource (1957).

40. A most revealing, if whimsical, discussion of this matter is found in Warren Weaver, "Report of the Special Committee," Science, Vol. 130, (Nov. 20, 1959),pp. 1390-1391.

41. That the Special Assistant to the President for Science and Technology, George Kistiakowsky, is aware of the fluidity of definition assigned to space activities is evident in the following quotations:

"Obviously, no distinction is made between science and technology. We see this every day, also when the marvelous accomplishments of the rocketeers are described as scientific achievements." ("The White House Assignment," address in Wilmington, Delaware, Oct. 21, 1959.)

"This consideration of the now very fashionable activities in outer space leads me to a general conclusion: It is essential to be aware of the distinction between science...and technology" ("Science and Technology," address in New York City, Dec. 2, 1959.)

"...unfortunately it is the technological spectaculars which tend to be used...as the sole measure of scientific as well as technological prowess...Achievements in outer-space activities are, of course, the prime example of this." ("Science and Foreign Affairs," address in New York City, Jan. 29, 1960.)

42. A good example of basic research conducted for applied purposes is the work under way on plasmas, spurred by its implications for thermonuclear fusion and for space drives.

43. While the literature in this field is limited, some case study possibilities could be obtained from an examination of the 1958 National Science Foundation Report, Scientific Activities in Six State Governments, initiated by the Foundation to explore the role of the states in the nation's total scientific research effort.

44. Many of the problems to be discussed have been illuminated through an independent study conducted by Curtis Barker, with Lincoln Bloomfield of the Center for International Studies, Massachusetts Institute of Technology. To isolate key issues that he and others have speculated

upon, Mr. Barker interviewed a number of people selected in one or more of the following situations: a political agency, but dealing with space matters; a space agency, but dealing with political matters; a scientist in a political agency; and a political expert in a technical agency.

Many of those interviewed were participants in the UN ad hoc Committee on the Peaceful Uses of Outer Space, the technical talks at Geneva, or the International Geophysical Year operation. The interview was of the type where the respondent was encouraged to respond freely to the questions rather than choose pre-selected alternative responses. For each area a checklist of points to be covered was used; if these points were not specifically alluded to in the respondents' comments, they were specifically asked about.

There are insufficient data to verify or repudiate the positions taken in the respondents' statements. However, actions are often taken and decisions made on the basis of such opinions and expressions of values, without adequate evidence as to their validity. Thus discovering the opinions is the first step to understanding their implications for space activities; systematic research concerning them is the next step.

45. Neither group, however, viewed the scientific community as just another interest group looking out for itself; both recognized the role of our science policy as more than that. The implications of the difference between these views are illustrated by two other responses: some said that the office's position outside of the political process (with immunity from congressional investigations, etc.) was proper, while others felt that the office should not be insulated from becoming involved in the political process, since they believed involvement to be a prerequisite for the effective utilization of science in on-going political problems.

This same dichotomy was expressed in other ways; some looked upon the office as the only "objective" government-scientific agency; others felt that its unique position in the Executive Branch was a "helpful bias" for putting science to work in the political arena. While some said it was important for the President's scientific advisers to keep to their own field (not because of political incompetence, but because the scientific role demanded it), others felt the advisers needed to "play the political game" to be effective.

46. One non-scientist cited the UN ad hoc Committee on Outer Space as an example of good organization because the legal specialists and the technical specialists were separated respectively into two subcommittees. He felt it extremely important for the groups to be separate at the working level, to better influence each other at a higher level. Another respondent (with the same professional background) volunteered that the ad hoc Committee was very wrong to separate the two -- since this prohibited the necessary interaction at the working level.

47. While there was general agreement that success in such intercommunication is a highly individual thing depending on specific personalities, backgrounds, and talents, some responses implied that it was easier for a scientist to understand such matters as "political and social factors" than for a non-scientist to understand technological matters. However, other respondents felt that "superficial" knowledge of nontechnical affairs gave the scientist a dangerously false sense of security in a value system that was very foreign to him.

48. See, for example, Harold H. Kelley and John W. Thibaut, "Experimental Studies of Group Problem Solving and Process," Handbook of Social Psychology, Gardner Lindzey, ed., Vol. 2, Addison Wesley (1954), pp. 735-785; Don K. Price, Government and Science, New York University Press (1954), pp. 124-159; Chester I. Barnard, The Functions of the Executive, Harvard University Press (1938); Alex Bavelas, "A Mathematical Model for Group Structures," Journal of Applied Anthropology, Vol. 7 (1948), pp. 16-30.

49. Roughly half of the interviewees were sure that any scientist who steps into this dual role loses much of his identification with the scientific community -- thus seriously hampering his effectiveness as a technical adviser. Some felt that such men would be unrespected or even feared by both the scientific and the political community, yet others believed not only that these "dual-types" (alternately called "two-headed monsters") would retain their identification with the scientific community, but also that the field of politics would expand to include these new "experts," who would thereby gain the respect of both communities.

Some of the group favoring the dual-types had very strong feelings against the emergence of the so-called "new breed," stating that if the dual-types are to retain their value as scientists, they must emerge from

the scientific community only as they acquire new skills. Still others felt it was most important that "dual-types" be recruited also from the political community to develop competence in the technical field.

50. Curtis Barker has cited the difficulty a scientist had in getting the State Department "to see the full importance of prestige-type space exploits. His view was that while such exploits are not sufficient in themselves, they are indeed necessary in order to create the national image upon which our over-all political strength depends -- that image which is required to induce the rest of the world to look to the U.S. for the purchase of computers, for the education of their technical specialists, etc. He felt that the mechanisms which turn the eyes of other nations toward such a 'leader' nation are political, social, and economic, as well as scientific; consequently, we must address ourselves to such non-scientific factors, as well.

"It is significant to note that the very office...with which this scientist had been 'trying' to communicate expressed the feeling that scientists do not appreciate the non-technical implications of space exploits.

"A second example of this particular communication problem involved a scientist who said he has been unable to persuade anyone, in the legislative or executive branches of government, to evaluate technical developments in other than operational terms ('How well does Tiros take pictures of cloud cover?' etc.). He could not get them to understand that the full utilization of the relationship between technical advances and national welfare also involves the capacity of our nation to absorb the <u>many</u> technical advances into our society and economy. For example, he said, our space program has produced advances in lubricants which can be utilized in every corner of our civilian life. The strength of our nation lies in the fact that this absorptive capacity of the U.S. is greater than that of any other nation, and, he went on, we must develop this advantage through positive planning.

"The failure to be understood on this point was cited, by the respondent, as the most frustrating thing in dealing with non-technical people." (Correspondence with Curtis Barker.)

51. See, for example, Eugene Hartley and Ruth Hartley, <u>Fundamentals of Social Psychology</u>, Knopf (1955), which discusses the "Image of the Other" in

Section 21; stereotypes in communication, p. 119; and context as a frame of reference, p. 124.

Credibility as a more conscious factor is discussed by Carl I. Hovland, Irving L. Janis, and Harold H. Kelley, eds., Communication and Persuasion, Yale University Press (1953), Chap. 2. Particularly relevant is a passage on p. 45, concerning a discrepancy or inconsistency between content and source, and the resulting dissociation between content and the credibility which would otherwise attend the perceived role of expertise.

52. A scientist may feel a deep conflict about his role when, for example, as an agent of a federal department he might be asked to call a military space vehicle a "scientific satellite," in the interests of national security. Should he be a free agent with science as his only master, or must he always remain a representative of his country, regardless of his scientific role, behaving in a manner consistent with the interests and policies of his country? Respondents defended both sides of this issue with conviction.

53. "There is a tendency to take the attitude of a few distinguished scientists, usually physicists, as representing the scientific community. There is reason to believe that there is a vast difference between the attitudes of a few men of genius whose lives have generally been in the best sort of academic milieu and the attitudes of the general run of scientists in different disciplines. We have noted that technology has become so complicated that the scientists must personally be brought into the processes of policy decision since nobody else can effectively advise on the utilization of modern instruments. In this process the prestige of the scientist rises, he becomes absorbed into the political elite, perhaps he brings some of his universalistic values with him and perhaps he abandons some as he identifies more fully with the power structure of which he is a part. These are questions that need examination and exploration. We want to know how far scientists have been assimilated into the decision process itself, in both of the power blocs, and we also wish to know how far under such circumstances they may be counted upon to retain a value orientation characteristic of science itself and how far do they become indistinguishable from other decision makers. Is the introduction of scientists into the decision process a

means to humanize and make more intelligible that process or does it simply politicize the scientist, or is it a little of both, and if so, under what circumstances do we find each result?" Ithiel de Sola Pool, Research on Communication and Values in Relation to War and Peace (a report prepared for the Institute for International Order, to be published in 1961), p. V 4-5 of the draft copy.

Footnotes

1. The circumstances described and speculated about in this chapter derive in part from interviews with top management, engineering, and research personnel at: Aerospace Corporation, Aerospace Industries Association, Air Research and Development Command, Aviation Week, Boeing Airplane Company, Convair Astronautics Division of General Dynamics Corporation, Douglas Aircraft Company, Jet Propulsion Laboratory, Lockheed Aircraft Corporation, McKinsey and Company, National Aeronautics and Space Administration, North American Aviation, Inc., The RAND Corporation, Resources for the Future, Stanford Research Institute, Thompson Ramo-Wooldridge, Inc., Systems Corporation of America, and Technical Operations, Inc. In spite of the wide-ranging experience of the persons interviewed it is likely that some important aspects of the problem have been overlooked or looked at in too limited a perspective. In part, of course, this is due to the ambiguity of the concept of "firms involved in space activities," an ambiguity sensed and shared by all our respondents. However, there was enough congruity of opinion and examples to indicate that, while not all of the pertinent problems may have been covered, certainly an important portion of them were.

2. For background, see W. Paul Strassmann, Risk and Technological Innovation, Cornell University Press (1959). The author extends earlier speculations of Thorstein Veblen and Joseph Schumpeter on the impact of innovation upon our economy. Entrepreneurial initiative and risk are treated in a modern context applicable to space enterprise.

3. Space firms have been loud and clear in their complaints that they have been forced to reinvest an increasing portion of company profits to finance the accelerating rate of technological development. Dr.

Murray L. Weidenbaum, in an address on "The Economics of the Aircraft Industry" (prepared for the Northwest Education Workshop, Boeing Airplane Company, Renton, Washington, July 8, 1959), pointed out that the aircraft industry was plowing back 62 per cent of its profits -- and faced a prospect of increased expenditure upon space vehicles. Elsewhere a corporation official estimated that his company spent $1 million on a government contract for which they were awarded $50,000. A leading space firm claims it is reinvesting one half of its profits into company-financed exploratory research. See also Aircraft Industries Association (now Aerospace Industries Associated of America Incorporated), "Statement to the Secretary of Defense -- Summary" (internal mimeographed document), Jan. 22, 1958, pp. 5-7; and Aerospace Industries Association of America Incorporated, AIA Annual Report, pp. 16-17. For a presentation that ties profit to adjustment problems, see Charles J. V. Murphy, "Business Strategies for the 1960's: The Plane Makers Under Stress," Fortune (June and July 1960).

Certain space firms contend that a recent Air Force ruling disallowing overhead costs on precontract research further trims narrowing profits. See "Services Apply R & D Cost Restrictions," Aviation Week, Vol. 73 (Nov. 7, 1960), pp. 28-29.

4. The scientific research laboratory established at Boeing within the last two years is an example of this trend among large space firms. The laboratory's scientists and technicians are engaged in an array of problems related to the natural sciences: high energy conversion principles in electronics, radiation effects upon organisms, general relativity theory, the geophysical aspects of the inner planets, and a number of other space-oriented studies. Basic research programs are company financed and tend to avoid classified contracts. Boeing objectives are to do original research in areas of probable future importance to the firm and to establish a link with the scientific community here and abroad. (See Boeing 1959 Annual Report, p. 17.)

5. For background on aspects of corporate diversification particularly appropriate to the space industry situation, see H. Igor Ansoff, "So You Want to Diversity?" (DTFR-136, mimeographed paper presented before the Los Angeles Chamber of Commerce, June 23, 1960).

6. The difficulties of small firm survival are argued in a paper delivered

to the American Rocket Society (Sept. 28, 1960) by the vice president of the Atlantic Research Corporation, M. Lee Rice, "Business Aspect of Sounding Rockets." Rice concludes that "development of rockets for potential sale for sounding purposes by using corporate capital is, at best, a very risky enterprise." Prohibitive development and testing costs risk dollars and reputations. Since proposed cost-sharing on rocket development "is largely dependent upon the total volume of business of any company, severe disadvantages are experienced by small companies under these conditions."

7. Consider the following example of one small firm's difficulty in realizing a profit from a technological development. It developed a special-purpose electronic component, and the government financed a $15 million production plant to provide the "profit base." This forced electronic design engineers into unfamiliar areas of production and business management. In this kind of complication, large corporations can afford to be more or less cooperative, since they can recoup excess research costs in profit renegotiation on other government contracts -- whereas small firms tend to be "uncooperative" because they have a very limited renegotiation base. (Based on an interview with a senior staff analyst of the RAND Corporation.)

   Existing legislation which waives certain antitrust provisions to allow for the pooling of small firms for research and development activity may in practice be inappropriate or, realistically, inadequate to space enterprise. See Small Business Administration, Joint Small Business Research and Development Pools, Government Printing Office (1959).

8. For a discussion of the problems and issues in government contracting see J. Stefan Dupré and W. Eric Gustafson, "The New Public Administration: Problems and Benefits for the Contractor in Government by Contract"; and Victor K. Heyman "Problems and Benefits for the Government in Administration by Contract" (papers delivered at the 1960 Annual Meeting of the American Political Science Association, New York, Sept. 8-10, 1960). A classical essay on the contract system -- particularly with a view toward the social implications -- is contained in Don K. Price, Government and Science, New York University Press (1954), Chap. 3, "Federalism by Contract."

9. For a discussion of these and related aspects see Charles J. Hitch and Roland N. McKean, The Economics of Defense in the Nuclear Age, Harvard

University Press (1960), Chap. 12, "Institutional Arrangements to Promote Efficiency."

10. A good example of the difficult problem of deciding on the social value of a space proposal is embodied in the Bell Aircraft Company's argument for "the economic justification and sociological desirability of intercontinental travel by rocket ship. The progress and prestige of our nation depends upon our ability to find peacetime uses for the technological breakthroughs resulting from our multi-billion dollar space program." The Bell proposal justified travel at speeds of 7,000 m.p.h. in terms of the growing interdependence among nations and the rocket ship's contribution to enduring world peace. See Leston Faneuf, "Application of Space Science to Earth Travel" (paper prepared for the lecture series "Peacetime Uses of Space," University of California, Los Angeles, March 23, 1960), Bell Aircraft Corporation (1960); note especially the Introduction (by Dr. Walter R. Dornberger) and pp. 15-16.

    Those firms interested in the development of hypersonic craft also contend that the government should support the requisite research and development costs.

11. For the "government explore -- industry exploit" thesis, see Ralph J. Cordiner, "Competitive Private Enterprise in Space" (paper prepared for the symposium Peacetime Uses of Space, University of California, Los Angeles (May 4, 1960), General Electric Company, 1960). Reservations about this thesis in the light of historic experience are contained in Merle Fainsod and Lincoln Gordon, Government and the American Economy, Norton (1959), pp. 101-105, 657-658, 855-857. See also Clarke Newlon, "The Things We Stand For," Missiles and Rockets, Vol. 6 (April 18, 1960), p. 50; and see W. Allen Wallis, "Economic Growth: What, Why, How" (address given at the Loeb Awards Presentation Luncheon in honor of business and financial journalists, New York City, June 8, 1960), especially pp. 5-12 wherein reference was made to the British Government's sharing technological risk with contractors.

12. See Mark Massel, "Business Reserves for Post-War Survival" (Planning Pamphlets Nos. 19 and 20), National Planning Association (April 1943),

Chapter 4, "Policy Issues," and particularly pp. 35-36. Corporate accounting structures and postures may be influenced by any of the following: contract relationships, tax structures, government regulatory functions, tariff considerations, labor relations, congressional relations, stockholder relations, potential competition, and an array of other economic and political factors. Corporations can adjust out-of-pocket and capital expenditures to show favorable cost and profit pictures in accord with the foregoing considerations.

13. A recent study contains a detailed analysis of how research chemists spend their time for scientific activity and scientific communication. See Case Institute of Technology Operations Research Group, An Operations Research Study of the Scientific Activity of Chemists, Case Institute of Technology (1958). Similar studies might afford a means of measuring efficiency in the allocation of scientific activities and permit an appraisal of space/non-space activities chargeable and not chargeable to government accounts.

14. The RAND Corporation and the Operations Research Office, Johns Hopkins University, are particularly active in this area. Many offices in the Department of Defense are working on aspects of the problem, too.

15. See Herbert A. Shepard, "Social Change in Science and Engineering" (paper delivered at the Eighth Annual Engineering Management Conference held in Chicago, Illinois, Sept. 15-16, 1960).

16. In connection with this, see House Committee on Post Office and Civil Service, Manpower Utilization Subcommittee, Personnel Procurement Costs of Selected Defense Contracts for Recruitment of Engineers and Scientists, Fiscal Year 1959, 86th Congress, Second Session, Committee Print. According to an article reporting on the document (Frank C. Porter, "Recruitment Costs Draw Fire," Washington Post & Times Herald, Oct. 5, 1960), job changing has become rife among technical companies because they tend to stockpile scientific talent in anticipation of contracts and to freeze salary levels. Trade shows have become a mecca of disgruntled employees seeking better jobs and hungry recruiters trying to steal competitors' talent.

17. See "Migration of Top Engineering Talent to U.S. Alarms Foreign Governments," Product Engineering (Aug. 22, 1960), pp. 15-16. Reports from Japan, Formosa, and England indicate that key projects are suffering delay because top engineering talent is being lured abroad.

18. Much of the information in this section is based upon a series of discussions with members of the Brookings Institution staff. Suggested works relating to the area include: Robert A. Dahl and Charles E. Lindblom, Politics, Economics, and Welfare, Harper (1953); Marver H. Bernstein, Regulating Business by Independent Commission, Princeton University Press (1955); Merle Fainsod and Lincoln Gordon, Government and the American Economy, Norton (1948), Part 3, "Government as Regulator in the Public Interest"; Emmette Shelburn Redford, Administration of National Economic Control, Macmillan (1952).

19. For a discussion of law as means rather than ends in our political economy, see Eugene V. Rostow, Planning for Freedom: The Public Law of Capitalism. Yale University Press (1959), pp. 3-9. The goals of legal action -- to fit a viable society -- are summarized on pp. 361-376.

20. See Merle Fainsod and Lincoln Gordon, Government and the American Economy, Norton (1948). Impetus of agrarian demands led to improved transport in roads and canals, and eventually to a land grant policy in railroad development (pp. 855-857). The transition from public aid to regulation in railroad, waterway, and airline development is briefly sketched on pp. 101-105, and the grounds and scope of public enterprise are outlined on pp. 657-658. Government subsidy to enhance commerce and public welfare -- particularly in the transport and power fields -- goes back to Alexander Hamilton. This involvement in the economic development of transport and power has inevitably led to regulatory measures in one form or another.

21. For a discussion of the legal problems involved in damages and liability, see Philip C. Jessup and Howard J. Taubenfeld, Controls for Outer Space and the Antarctic Analogy, Columbia University Press (1959), pp. 241-250.

22. The history of the Muscle Shoals dam is indicative of the case studies that might be undertaken. Government development of nitrate technology in the 1920's and 1930's created active efforts on the part of industry to take over and operate the facilities. See Merle Fainsod and Lincoln Gordon, Government and the American Economy, Norton (1948), pp. 658, 705-713.

Similarly, the Atomic Energy Commission has developed technologies, which it is charged by law to turn over to private enterprise as soon as a firm shows it is capable of taking over an industrial process and is able to sell at a "reasonable price." According to AEC officials, negotiations on take-over have taken place, but no transfer has been effected to date because of the very sticky economic problems involved. See the study by John Corham Palfrey, "Atomic Energy: A New Experiment in Government-Industry Relations," Columbia Law Review, Vol. 56 (March 1956), p. 368. The airlines and the Federal Aviation Agency may provide worthwhile analogies in terms of the regulation of safety, traffic control, and subsidized service and airport sites.

23. Senate Study No. 15 of the Subcommittee on Patents, Trademarks, and Copyrights of the Committee on the Judiciary (prepared by Fritz Machlup), An Economic Review of the Patent System, 85th Congress, Second Session (1958), p. 79. A number of pertinent issues are also raised by Seymour Melman, "The Impact of The Patent System on Research," reprinted in House Hearings Before the Subcommittee on Patents and Scientific Inventions of the Committee on Science and Astronautics, Property Rights in Inventions Made Under Federal Space Research Contracts, 86th Congress, First Session (August-December 1959), pp. 905-974 .

24. Spokesmen for the space industries have pressed hard for proprietary rights in patents as an essential factor in commercializing technologies. See Aircraft Industries Association (now Aerospace Industries Association of America, Inc.), "Statement to the Secretary of Defense: Summary," (internal mimeographed document; Jan. 22, 1958), pp. 5-7. See also the article defending industry's position by Congressman Erwin Mitchell (Chairman of Subcommittee on Patents and Scientific Inventions of the House Science and Astronautics Committee), "Patent Rights -- Path to Progress," Aerospace (Journal of the Aerospace Industries of America), August 1960.

The issue is also a major one for Congress. "How is the Constitutional mandate to promote science and the useful arts to be implemented under present conditions of the production of knowledge in nonprofit institutions and in industry?" See Senate Study No. 11 of the Subcommittee on Patents, Trademarks, and Copyrights of the Committee on the Judiciary, The Research and Development Factor in Mergers and Acquisitions, 85th Congress, Second Session (1958), p. 60. The diverse patent policies of federal government agencies reflect in a sense the "growing disharmony between the efficient production of new technological knowledge and the effort, through the patent system, to treat that knowledge under property relations." Ibid., p. 61.

25. It has been argued that the Russian economy benefits from a higher rate of technological payoff because invention is applied to an entire economic sector rather than a single company. This point is made in an introduction by Dr. Wassily Leontief of Harvard University, pp. 1-8 in Leonard S. Silk, The Research Revolution, McGraw-Hill (1960). Dr. Leontief considers the patent question an important element restricting the spread of technology in our economy. Under the patent system, the market structure is affected by a diminished area of benefit, i.e., patents restrict the diffusion of new technology. Leontief says it is as if we had tolls on all our national highways.

26. These and related points were made by Richard L. Meier, drawing on his own experience as a research chemist in the synthetic rubber and plastic industries. See also Norbert Wiener, The Tempter, Random House (1959). The novel deals in good part with some forms of industrial patent warfare and is based on Wiener's extensive experience and knowledge of these matters.

27. A recent conference on space patents states as its purpose: "With the recent rapid developments in the field of space technology, it has become increasingly important to have answers to such questions as: How do you recognize a patentable invention? How do you protect it? What are the special requirements involved in patenting an invention useful in space? How do you manage and develop a patent?" (From a dittoed announcement by the University of California, Los Angeles, Conference on Space Technology, Discovery Identification, and Protection of New Ideas, September 30-October 1, 1960.)

28. For a comparative analysis of federal agencies' patent policies, see G. D. O'Brien and Gayle Parket, "Property Rights in Inventions Under the National Aeronautics and Space Age of 1958," reprinted in House Hearings Before the Subcommittee on Patents and Scientific Inventions of the Committee on Science and Astronautics, Property Rights in Inventions Made Under Federal Space Research Contracts, 86th Congress First Session, (August-December 1959) pp. 789-811 .

29. See Ralph J. Cordiner, "Competitive Private Enterprise in Space" (paper prepared for the symposium "Peacetime Uses of Space " University of California, Los Angeles, May 4, 1960), General Electric Company (1960), p. 9. Cordiner also argues (p.11) for extension of the voluntary agreements provision to cover space enterprise. (See Section 708, VOLUNTARY AGREEMENTS, of The Defense Production Act of 1950 as amended August 1, 1955, prepared by the General Counsel's Office, Office of Defense Mobilization.) For other proposals on mergers and pooling to develop rocket transport, see Leston Faneuf, "Application of Space Science to Earth Travel," (paper prepared for the lecture series, "Peacetime Uses of Space," University of California, Los Angeles, March 23, 1960), Bell Aircraft Corporation (1960), p. 14.

30. For a discussion of the Supreme Court's "rule of reason," see Merle Fainsod, et al., Government and the American Economy, Norton (1959), pp. 455 ff.

The Department of Justice, Antitrust Division, has taken the view that technological innovation is better assured under competition than under monopoly. See "Government-Sponsored Industry Research," Part I of the Report of the Attorney General, November 9, 1956, included as Appendix VI of House Hearings before the Subcommittee on Patents and Scientific Inventions of the Committee on Science and Astronautics, Property Rights in Inventions Made Under Federal Space Research Contracts, 86th Congress, First Session (August-December 1959), pp. 888-904.

The issues at Senate hearings held last year are particularly pertinent to questions of technology and free competition. At these hearings the Attorney General reiterated his views in testifying that the international telegraph operations could find other ways and means

to compete effectively without merging. See Senate Report of Proceedings, Hearings Held before the Committee on Interstate and Foreign Commerce, A Bill To Amend the Communications Act of 1934, As Amended, To Permit Consolidations or Mergers of International Telegraph and Marine Carriers, and for Other Purposes, 85th Congress, Second Session (March 20, 1959). Pertinent material on the monopoly issue is contained in U.S. Congress, Congress and the Monopoly Problem; Fifty-Six Years of Anti-Trust Development, 1900-1956 (84th Congress, Second Session), and Mark S. Massel, "Competition and Monopoly," Economics and the Policy Maker: Brookings Lectures, 1958-1959, Brookings Institution (1959), especially pp. 146-148.

31. For a full discussion of problems and issues, including government-industry contract relations, see J. Stefan Dupré and W. Eric Gustafson, "The New Public Administration: Problems and Benefits from the Contractor in Government by Contract" and Victor K. Heyman,"Problems and Benefits for the Government in Administration by Contract." (See Note 8 for full citation.)

32. See U.S. vs. Swift & Co., 286 US106,116 (1932). Justice Cardoza enunciated the doctrine in the Swift case: "Size carries with it an opportunity for abuse that is not to be ignored when the opportunity is proved to have been utilized in the past." The Court also said in 334 US131,174 (1948): "Size itself is an earmark of monopoly power. For size carries with it an opportunity for abuse."

For a discussion of parallel issues in atomic energy development, see Walter Adams, "Atomic Energy: The Congressional Abandonment of Competition," Columbia Law Review, Vol. 55 (February 1955), p. 158.

33. See Bernard Poirier, "Though Tariffs Are Tricky...U.S. Firms Find Bonanza in Europe," Missiles and Rockets, Vol. 7 (Aug. 8, 1960), pp. 12-14.

34. Space probe rockets are being sold to Italy, for example. For a summary article on the potential markets in sounding rockets, see "Market is Growing at Home and Abroad," Missiles and Rockets (Oct. 3, 1960), pp. 20-22.

35. See Igor Oganesoff, "Yen for Invention: Japanese Firms Step Up Original Research, Aim to Lift Export Sales," Wall Street Journal, June 14, 1960, pp. 1 and 24. According to this article, it was the Sony Corporation in Japan that developed the tunnel diode -- a smaller, more efficient transistor. A Tokyo University scientist has also developed an inexpensive replacement for electron tubes known as a "parametron." Both of these devices are usable in space satellite telemetry.

36. See Howard Simons, "World-Wide Capabilities for Production and Control of Nuclear Weapons," Daedalus, Summer 1959, pp. 385-409; and William C. Davidon, Marvin I. Kalkstein, and Christoph Hohenemser, "The Nth Country Problem and Arms Control," (A Statement by the National Planning Association Special Project Committee on Security Through Arms Control and A Technical Report) Planning Pamphlet No. 108, National Planning Association (January 1960).

37. See Robert Solo, "Research and Development in the Synthetic Rubber Industry," Quarterly Journal of Economics, Vol. 68 (February 1954), pp. 61-64; and Senate Monograph No. 1: A Study Made for the Subcommittee on War Mobilization of the Committee on Military Affairs, Economic and Political Aspects of International Cartels, 78th Congress, Second Session (1946), pp. 58-60.

8. GENERAL IMPLICATIONS FOR INTERNATIONAL AFFAIRS AND FOREIGN POLICY

Footnotes

1. Klaus Knorr, "On the International Implications of Outer Space," World Politics, Vol. 12 (July 1960), p. 579.

2. Washington Center of Foreign Policy Research, The Johns Hopkins University, Developments in Military Technology and Their Impact on United States Strategy and Foreign Policy (prepared for the Committee on Foreign Relations of the United States Senate as United States Foreign Policy Study No. 8; 1959), p. 83.

3. One area of the revolutionary implications of space activities in the international context seems likely to arise from military equipment and capabilities such as missiles and reconnaissance systems. In keeping with this report's commitment to examine the implications of peaceful space programs, specific research has not been suggested on these associated "hot war" implications.

   Among research organizations, the RAND Corporation is perhaps in one of the best positions to identify the strategic implications in relation to planned defense systems. Evaluation of the implications in terms of international relations is a concern of university research organizations such as the Center of International Studies at Princeton University (Klaus Knorr, Associate Director) and the Washington Center of Foreign Policy Research (The Johns Hopkins University) whose study mentioned in Note 2 includes some lucid remarks on the problems of assessing technological changes (Part C, Chapter 2) as well as discussions of various missiles, reconnaissance satellites, and other space products as contributing to or detracting from a stable strategic power situation. Other university centers experienced in

studying relations of military technology to international affairs include those at the University of Chicago, Columbia, Harvard, and Massachusetts Institute of Technology.

4. Urgent suggestions that space should be used only for peaceful purposes have been offered by the President of the United States, the Congress, the General Assembly of the United Nations, and various private groups of interested scientists and engineers. The following paragraphs provide a brief selective outline of early preparations for international space activities.

The launching of Sputnik I on October 4, 1957, was part of the International Geophysical Year (IGY) program which achieved remarkable results in international cooperation among scientists acting to a great extent on their own initiative or that of their private professional societies, often generously supported by their national governments. Dr. Detlev Bronk, President of the National Academy of Sciences, has said of the IGY: "I think it is fair to say that the international significance of the program, as its name bears out, has been of greater significance than even the very important discoveries which have been made . . . At times when we are torn asunder by ideological differences and by selfish national attacks upon the freedom we stand for, it is heartening to find that there are some things that people can do together with common amity." See House Hearings Before the Subcommittee of the Committee on Appropriations, 86th Congress, First Session, Report on the International Geophysical Year (February 1959), p. 3.

Although possible military aspects of space activities other than the development of ballistic missiles were recognized by Congress, the resolution of the House, in which the Senate concurred, not only stated that the United States should strive to ban by agreement the use of outer space for military purposes, but also that it should seek joint exploration of outer space, joint cooperation in exploiting the results, and the peaceful settlement of related disputes should they arise. See House Concurrent Resolution 332 (June 2, p. 958), which was agreed to by the Senate on July 23, 1958. Congress indicated its

awareness of the non-defense international aspects of space activities by the creation of NASA as a civilian agency, the explicit inclusion of provisions for international cooperation in the National Aeronautics and Space Act of 1958, Sections 205 and 102(7), the active search for peaceful uses of space (Section 102:c, 4, 5), and designation of the Secretary of State as a statutory member of the National Aeronautics and Space Council. NASA has an Office of International Programs. In 1960, President Eisenhower recommended that the Council and the Civilian Military Liaison Committee established in this act be abolished; changing interpretations of the desirable military and peaceful uses of space appear to have been partly responsible for the recommendations. See House Hearings Before the Committee on Science and Astronautics, on H.R. 9675 (March, April 1960).

The National Academy of Sciences, which was the U.S. participant in the IGY, established a Space Science Board with an International Relations Committee operating under it, and Congress provided that NASA coordinate its activities with such private, as well as other public, agencies and organizations (Section 203:8). The International Relations Committee of the Space Science Board includes "liaison members from all interested government agencies, so that the National Academy's delegation to COSPAR may be responsibly informed as to the national space program and the opportunites which it presents for cooperative effort in collaboration with COSPAR." See testimony of Lloyd V. Berkner, Chairman of the Space Science Board, House Hearings Before the Subcommittee of the Committee on Appropriations, 86th Congress, First Session, Report on the International Geophysical Year (February 1959), p. 180.

In a resolution sponsored by the United States, the United Nations established an ad hoc committee on the peaceful uses of outer space to consider how the United Nations could further the peaceful uses by coordination and other organizational means and could help to identify legal problems. See General Assembly, Official Records: Thirteenth Session, Supplement No. 18 (A/4090), Resolution 1348 (adopted December 13, 1958, by a vote of 53 to 9 with 19 abstentions). Thirteen members of this committee of eighteen met and issued a report despite a boycott by the Soviet Union and some other members.

On December 12, 1959, the General Assembly created a new Committee on the Peaceful Uses of Outer Space and requested its twenty-four members to review or study and report on a somewhat more restricted set of topics than that assigned to the ad hoc committee. See General Assembly, Official Records: Fourteenth Session, Supplement No. 16 (A/4354), Resolution 1472. The resolution also took cognizance of the "success of the scientific cooperation programme of the International Geophysical Year in the exploration of outer space and the decision to continue and expand this type of cooperation."

The quasi-nongovernmental planning and coordination of rocket and satellite programs undertaken by national scientific groups were first carried out by a special committee of the International Council of Scientific Unions (ICSU), established in 1953 to plan the IGY. In October 1958 the General Assembly of ICSU first established the Committee on Space Research (COSPAR) "to further on an international scale the progress of all kinds of scientific investigations which are carried out with the use of rockets and rocket-propelled vehicles." See ICSU Review, Vol. 1, No. 2, p. 109. Stress was placed on the principle that COSPAR was to be concerned with fundamental research and not normally with such technological problems as propulsion, construction of rockets, guidance, and control.

Engineers and scientists particularly concerned with problems affecting the design of rockets and astronautical equipment and techniques have for many years been associated through such organizations as the American Rocket Society. In 1950 some of these societies joined in the first Congress of the International Astronautical Federation (IAF). The American affiliates of IAF include the American Rocket Society and the American Astronautical Society, neither of which has the same degree of national official status as does the National Academy of Sciences, which is the American member of COSPAR. Although the relative amount of official interest in IAF and COSPAR varies from nation to nation, as does the expertise and freedom of expression of the individual participants, it is possible to characterize the free-world membership in the United Nations Committee, COSPAR, and the IAF as being respectively

official and politically interested, semiofficial and technically experienced, and private and technically interested. For the Soviet Union and the satellite nations it would appear that each of these organizations is used directly, but with varying degrees of priority and importance, for official expression of national policy. National pride and military security have affected the organization of each of these groups. The Soviet Union has tended to use its prestige in space as a means to assert parity or impose a check on international space activities and deliberations.

The importance of missiles for strategic deterrence and the lack of immediate prospects for arms control in this area have thus far restricted full international discussion of space activities and hardware.

5. The abortive technical discussions on means to prevent surprise attack, in which the United States and the Soviet Union participated in 1958, were supposed to consider missiles as well as bomb-carrying aircraft. See United Nations General Assembly Report of the Conference of Experts for the Study of Possible Measures Which Might be Helpful in Preventing Surprise Attack and the Preparation of a Report Thereon to Governments, UN Document A/4078-S/4145 (Jan. 5, 1959).

6. This duality is reflected in COSPAR. American scientists made it clear that space activities of the Department of Defense were not part of the U.S. program for the IGY and that therefore, by implication, information about them would not be presented to COSPAR. See Report of the Third COSPAR Meeting, Appendix D2, p. 4. The Johnson Island and "Argus" experiments in the fall of 1958, involving nuclear explosions in outer space, were of interest to the advancement of basic scientific knowledge and were also of immediate importance to national security planners. For the latter reason the experiments were conducted in secret and some results remain secret. A scientific satellite participating in the IGY studies contributed to this experiment.

7. Much of the congressional comment and testimony of the Hon. Livingston T. Merchant (Under Secretary of State for Political Affairs) and George V. Allen (Director of the U.S. Information Agency) before the House Committee on Science and Astronautics (January-February 1960, House Hearings, Part I) was devoted to the question of peaceful propaganda and its importance.

A radio message from President Eisenhower was received, recorded, and transmitted by the Project Score satellite launched by the United States on December 18, 1958. Apparently this satellite was the first one with no instruments specifically included for making scientific measurements. This project may, however, have contributed to the design of communication systems of military significance. Some major Soviet and United States space efforts appear to have been timed in part to coincide with planned political events, such as political meetings or anniversaries, or with international technical meetings connected with the IGY, COSPAR, or the IAF.

There are no absolute criteria for comparing the importance of contributions to science. As indicated elsewhere herein, the development of a broad space program may well expose and force the reconciliation of differences in interests and opinion among scientists with different trainings.

8. See Hugh Odishaw, "International Geophysical Year," Appendix II in House Report of the Committee on Interstate and Foreign Commerce (Feb. 17, 1958), p. 59.

9. The letter of March 14, 1959, from the U.S. Delegate to COSPAR stated that NASA would "undertake to launch an entire payload to be recommended by COSPAR." The January 1960 report to COSPAR on United States activities referred only to the offer to launch mutually agreeable scientific experiments or complete instrument packages prepared by scientists of other nations, with COSPAR kept fully informed and consulted for advice and comment.

10. New York Times, Aug. 16, 1960.

11. The design of the Tiros I meteorological satellite launched by NASA as a peaceful experiment on April 1, 1960, illustrates the opportunities, problems, and surprises confronting the designer who wishes to maximize the return of relevant scientific data and minimize possible military, political, economic, or other consequences of the enterprise. The need for world-wide coverage involved the automatic storing of pictures taken when the satellite was beyond the range of our receiving stations and

their subsequent transmission to U.S. stations on command. The two cameras aboard differed in the width of the area covered but were designed to disclose cloud cover rather than ground details. See Science, Vol. 131 (April 8, 1960), p. 1031. Yet, the camera with the narrower angle might have provided an unexpected and embarrassing amount of ground detail which could have become a political issue. The Wall Street Journal of September 26, 1960, refers to Tiros I as having "snapped clear photos of Russian terrain." Within a day, however, the timing device of the narrower angle camera malfunctioned so that the only pictures available were those taken near the receiving stations. (See Science, April 15, 1960, p. 1086.) The timing device corrected itself on May 10, 1960, and thereafter may have set a precedent by taking pictures over the Soviet Union and Communist China without official protest. See New York Times, May 26, 1960, p. 1. Although some pictures have been released and all will be deposited for scientific study, they will first have been scrutinized by officials. The Strategic Air Command has pointed out that even these first pictures could have been of use to it in the planning of some airborne refueling operations.

12. George B. Kistiakowsky, "Science and Foreign Affairs," Science, Vol. 131 (April 8, 1960), p. 1023. Research work on "science and public policy" bears most directly on this line of inquiry. This is the focus of a group led by Don K. Price, Dean of the Graduate School of Public Administration, Harvard University. This group does not, however, have any specific focus on international policy formation.

There is as yet no curriculum which pretends to train individuals adequately to understand the potential social aspects of space science and engineering aspects of contemporary international relations and to formulate policy concerning these aspects. It is unlikely that adequate patterns of coordination among the many interested and responsible groups can be designed until the presently recognized scarcity of personnel with sufficient interdisciplinary knowledge and interest has

been eliminated. For a general statement of this scarcity, see E. R. Piore and R. N. Kreidler, "Recent Developments in the Relationship of Government to Science," Annals of the American Academy of Political and Social Science, Vol. 327 (January 1960), page 18.

13. The possible development of significant programs abroad must not be underestimated because of high costs. Although the expense of launching scientifically instrumented earth satellites is great compared with many scientific enterprises, it is not great compared with the purchase of a military missile capability. It has been suggested that Great Britain should use the rockets remaining from its abandoned military missile program as boosters for scientific satellites. See "Europe Planning Joint Space Unit," New York Times, June 26, 1960.

Summaries of proposed space activities have been sent to COSPAR by a number of nations. Such descriptions do not, however, list resources which could be used if arrangements for sharing or collaboration were developed.

14. For example, Hugh L. Dryden, Deputy Administrator, of NASA, has said: "The task of space exploration is global in nature; it requires large resources; and its needs are better matched by the resources of the whole world than by those of one nation." ("Prospects for Space Travel", Proceedings of the American Philosophical Society, Vol. 104 (Oct. 17, 1960), p. 484.

15. The economic aspects of scientific enterprises have not been adequately studied. However, at least one group studying science and public policy, that at Harvard University under the leadership of Don K. Price, includes an economist, Dr. Carl Kaysen. For a general but nevertheless relevant and suggestive discussion, see Thomas C. Schelling, "International Cost-Sharing Arrangements," Essays in International Finance, No. 24 (September 1955), Princeton University, Department of Economics and Sociology, International Finance Section.

16. For a discussion of possible European rocket programs and the equipment they might use, see S. Fred Singer, "Europe's Ambitious Plans to Explore," Missiles and Rockets, Vol. 7 (Oct. 3, 1960),pp. 23-24.

17. See Note 16.

18. The economic aspects of the Air Force program of supporting unclassified research abroad provides an instance where science has been supported across national boundaries. Characteristically the IGY did not depend on international financing,although there were notable exceptions to this pattern. The proposed International Indian Ocean Expedition and other outgrowths of IGY do include more international economic sharing. As yet there are no definite plans for a comprehensive study of the planning, organization, financing, and execution of the IGY or its rocket and satellite program by means of economic, administrative, or other lines of social science inquiry. The Council for Atomic Age Studies at Columbia University has started a study of the IGY, although not specifically from an economic point of view.

19. See Rule 24 of the International Geophysical Committee (CIG) of the ICSU, ICSU Review, Vol. 2 (April 1960), page 67.

20. Research groups in a number of law schools including those of Chicago, Columbia, Harvard, and Michigan universities have made studies of one or more of the problems arising from the new scale and international character of expenditures, financial risks, or cooperation on technical matters which have been stimulated by scientific and technical advances. As yet, space programs have not received the same attention in this regard as have atomic energy or natural resources programs.

21. See Charles V. Kidd, American Universities and Federal Research, Belknap Press (1959).

22. For a description of the present difficulty of using American-controlled foreign currencies for science projects under Public Law 480, see "Use of Funds from Sales of Surplus Foods for Science and Education Is Not Up to Expectations," Science, Vol. 132 (Aug. 26, 1960), page 534.

23. For discussion of the possible impact of financing on the consultative activities of scientists, see, for example, the Report of the Third COSPAR Meeting, p. 11.

24. For a suggestive study of the IAEA which does not, however, consider possible implications for prospective international space programs, see John G. Stoessinger, "Atoms for Peace: the IAEA," in Organizing Peace in the Nuclear Age (a report of the Commission to study the Organization of Peace), New York University Press (1959).

25. See the New York Times, June 26, 1960.

26. The increasingly large budgets of many international science organizations and other considerations are prompting a considerable number of changes in the charters and bylaws of these organizations. Certain studies of these formal arrangements have been made at Columbia University by the Council for Atomic Age Studies, with the assistance of the Legislative Drafting Research Fund.

27. There are nine non-U.S.-based Smithsonian Optical Satellite Tracking Stations employing a total of about fifty operating personnel, of whom about half are foreign nationals. There are eight minitrack stations in operation or being negotiated, requiring over twenty technically trained persons. To the maximum extent feasible NASA attempts to employ local personnel for any and all of these positions.

28. Work at the optical tracking stations appears to involve considerable on-site calculation in connection with the taking of photographs and their immediate interpretation. Maintenance work on precision electronic and optical equipment must also be done. With four or more observers at each station there appears to be an opportunity for considerable on-the-job training. See Smithsonian Institution Astronautical Observatory, Tracking Satellites (mimeographed; April 1960).

The skills required at the minitrack stations have primarily to do with electrical and electronics engineering and communications services including teletype operations. The size of each station suggests there is the possibility of some on-the-job training.

29. The belief has been expressed by informed scientists that arrangements could and should be made to have foreign laboratories perform more or less routine data analysis. The report of the United Nations Ad Hoc Committee on the Peaceful Uses of Outer Space mentions the possible use of the new International Computation Center in Rome, established with the assistance of UNESCO, for the interpretation and utilization of data from meteorological satellites. See United Nations General Assembly, Report of the Ad Hoc Committee on the Peaceful Uses of Outer Space, A/4141 (July 14, 1959), Part II, paragraph 29, page 35.

30. See, for example, UNESCO inventories of science organizations and scientists in many different parts of the world. UNESCO has also sponsored studies of technical terminologies and their standardizations.

31. The Jodrell Bank radio telescope plays a unique role in the tracking of space probes as well as in radio astronomy. It might be of particular interest to consider the history of this unique instrument in order to better understand the circumstances under which it was built, and why similar developments did not take place in the countries which now have the largest space programs.

    One rather bizarre but nevertheless provocative illustration of the kind of problem which might well be anticipated is the case of the Greek electrical engineer Nicholas Christofilos. The principle of "strong focusing" was first expounded by Christofilos and communicated by him to an appropriate research center in the United States. His suggestion was ignored until the principle was subsequently discovered independently in the United States. This principle has made possible the high energy particle accelerators now operated by CERN and Brookhaven National Laboratories. See New York Times, March 19, 1959, p. 16.

32. The skills required in connection with the minitrack stations would, for instance, appear to be useful and transferable in many parts of the world.

33. The Stanford Research Institute has studied some of the uses of new technology to help underdeveloped areas meet their special needs.

34. Writing in the New York Times, Aug. 22, 1960, p. 2, Walter Sullivan described the disadvantage for the Soviet Union of having to put its man-in-space capsules in a polar orbit, whereas political geography makes it unnecessary for the United States to do so.

35. This need for global networks of tracking and receiving stations has been stressed by Livingston Merchant and others. See "Review of the Space Program," House Hearings Before Committee on Science and Astronautics, 86th Congress, Second Session (1960), Part I, p. 6. Data storage and arrangements for readout on command are helping the United States effort to become more self-sufficient in its space program. This technique may, however, introduce some new political problems while it eliminates others. The launching of many sounding rockets for synoptic surveys and the use of satellites for certain geophysical, navigational, or communications purposes necessarily involves the use of equipment which is geographically dispersed. Even outside the iron curtain, desirable locations for space project stations are sometimes unavailable, being placed in jeopardy by political conditions, or being the subject of objectives and restrictions. With increasing political change in Asia, Africa, and perhaps South America, the effects of such changes on our space program will have to be anticipated.

If maximum social benefit is to be derived from future space activities, studies on the relative political desirability of having ground stations, launching ranges, or re-entry ranges in different locations must proceed concurrently with technical studies on the need for and specification of such stations and ranges.

36. Plans for a satellite-mounted telescope as outlined in the New York Times, Oct. 9, 1960, p. 24, appear to call for a single receiving station with all data being relayed immediately to Princeton University. The need for elaborate ground installations and data analysis centers may make it economically desirable to have only one information receiving station, even for nonstrategic satellite equipment such as an astronomical

telescope. It should nevertheless be recognized that in many instances more scientific information might be obtainable with more receiving stations and that in their absence profound changes may take place in the professional organization and opportunities available to the international astronomical fraternity. Other scientific professions may be similarly affected as satellites are incorporated into the foremost tools of the experimental scientists.

37. The general problem of limited agreements designed to facilitate technical operations has been discussed by Philip C. Jessup and Howard J. Taubenfeld in Controls for Outer Space and the Antartic Analogy, Columbia University Press (1959).

38. There appears to be increasing general as well as professional awareness of the legal and political precedent-setting nature of various space activities. See, for example, "Spy Satellite to Test Sovereignty in Space," New York Times, Oct. 11, 1960, p. 1. The extent to which any one physical act does set a precedent affecting subsequent social behavior is, of course, a complex social problem which is made even more complex by "self-fulfilling prophecy" associated with the subtleties of the technologies involved, the auspices of those acting, and the affects of some published studies and reports.

39. Shortly after the launching of Sputnik I, some space scientists formed an international Committee on Contamination by Extraterrestrial Exploration, known as CETEX, whose work has now been taken over by COSPAR. CETEX prepared a report on the steps which should be taken to avoid biological contamination of the moon and planets. It was hoped that the governments with space probe capabilities would favor these procedures.

40. See "Billions of Tiny Wires in Orbit Planned for Radio Relay System," New York Times, Aug. 15, 1960, p. 1.

41. In the United States, at least, space scientists were instrumental in forestalling at least one threat to the advance of radio astronomy, but according to some well-informed observers there was and always will be a serious risk of lack of knowledge and coordination on the part of those who should be concerned, those who are concerned, and those who can do something about the situation. "Radio astronomy recently almost

came to an untimely end, simply through the negotiation of an international treaty on frequency allocations without adequate recognition of the needs of this young science for listening windows. Through the good offices of the National Academy of Sciences it was possible to bring scientists and the appropriate government officials together in time to establish a U.S. position for the Geneva International Telecommunications Union conference compatible with the needs of the radioastronomers." See George B. Kistiakowsky, "Science and Foreign Affairs," Science, Vol. 131 (April 8, 1960), p. 1022.

42. It is recognized, of course, that there are some basic engineering differences and mission differences between those space activities directed to scientific research and those directed to military ends. These differences are very well summarized in H. Guyford Stever, "Growing Problems in the Space Program," Aero/Space Engineering, Vol. 18 (April 1959) pp. 40ff.

43. Wallace R. Brode, "The Role of Science in Foreign Policy Planning," Department of State Bulletin, 62, No. 1078 (Feb. 22, 1960), p. 274.

44. A scholar visiting Japan in 1960 reported that the Japanese he met regarded the Soviet rocket shots into the Pacific at that time as intended demonstrations of Japan's particular military vulnerability.

45. It has been suggested, for instance, that the U.S. offer to exchange some of its Tiros II cloud pictures for foreign cloud data collected from below is partly intended to "allay fears that the weather-eye satellite is deliberately peeping at more than the weather over Red lands." See "U.S. Seeks More Help in Other Lands, Will Offer Data to Reds," Wall Street Journal, Sept. 26, 1960.

46. It is worth questioning whether events in our space history have confounded foreign attitudes toward our peaceful program. The U-2 example is the most obvious recent event. Further, our astronauts are all military personnel, and there is a military man-in-space program as well. The use of an Atlas missile as a vehicle for President Eisenhower's Christmas message transmission is believed, by some informants, to have confused further our distinction between the civilian and the military

space programs. See also Hal Gettings, "Usefulness of Transit Questioned," Missiles and Rockets, Vol. 7 (Sept. 26, 1960), p. 15, from which this excerpt is taken: "Speaking at last week's IRE (Institute of Radio Engineers) Symposium on Space Electronics and Telemetry, in Washington, D.C., Dr. Conrad C. Wan, of Hughes Aircraft, said that development of a system such as Transit for commercial applications 'appears needlessly redundant and unnecessary.'...Dr. Wan did not touch on the possible use of Transit in nuclear submarines to periodically check their inertial guidance systems. The navigational satellite is most often touted as a global aid for ships and aircraft -- seldom mentioned is this more vital Navy requirement."

Stephen B. Withey, Director of Public Affairs Studies, Survey Research Center, the University of Michigan, has noted that "it is clear from the SRC studies from 1946 to 1956 that it took the public a long time to separate military and peacetime uses for atomic energy. The development of medical uses was the major factor, with power production an ambiguous second because of military needs for power of a different kind, and also fear of radiation, etc., that has made problems sometimes in public acceptance of power plants near private housing." (From personal correspondence.)

47. One nuclear test detection system, Project Vela of the U.S. Department of Defense, includes one space component. A system of detection of nuclear weapons in space might use satellites extensively. See testimony by Dr. Herbert York, NASA Authorization for Fiscal Year 1961, Senate Report No. 1300: Report of the Senate Committee on Aeronautical and Space Sciences on H.R. 10809 (April 29, 1960), p. 80.

48. See Lincoln P. Bloomfield, The United Nations and the Strategy of Peace (mimeographed version), Massachusetts Institute of Technology (1960), p. 184.

49. See Report of the Section of International and Comparative Law of the American Bar Association (mimeographed; August 1959), p. 9.

50. The literature and bibliographies on "space law" are growing rapidly. The American Bar Foundation has prepared, under contract with NASA, a selective, qualitative compilation and analysis of proposals for a law of outer space. See also External Research Division, Department of State, Social Science Research on Outer Space: A Selective Listing, ER-27 (December 1959), entries 129-146; and Bibliography of the Space Law Collection (mimeographed), University of Oklahoma Law Library.

Much of the thought thus far developed is necessarily a priori. There remains a need to consider the legal context of specific space activities and, perhaps more important, the appropriate machinery for drafting, negotiating, and enforcing rules or otherwise settling and avoiding disputes related to space activities. Machinery for this purpose must take account of the technical nature of the likely disputes. Studies of developments for other purposes, such as the regulation of communications, the sharing of expensive equipment, or the use of unique resources, might provide helpful comparisons. See Philip C. Jessup and Howard J. Taubenfeld, Controls for Outer Space and the Antarctic Analogy, Columbia University Press (1959).

51. The question of the eventual relevance of routine satellite and rocket launchings and landings to an agency like the International Civil Aviation Organization does not seem to have been fully explored. In the event that rockets were used for the peaceful transport of man or materials from point to point or that satellites became the basis of worldwide air and sea navigation systems, it might be necessary to have the active participation of such an agency as well as such others as the Universal Postal Union and the World Health Organization.

52. The appropriateness of the emphasis given to atomic energy in many lesser-developed parts of the world has been questioned. (See, for example, Farrington Daniels, "Report on Asian Trip for the National Academy of Sciences and the Asia Foundation, February 6-April 23, 1960," Office of the Pacific Science Board, National Academy of Sciences.)

Some dissatisfaction concerning the emphasis given to some sciences was expressed to the International Conference on Science in the Advancement of New States held at the Weizmann Institute of Science in Israel.

See New York Times, Aug. 27, 1960, page 12. In respect to the space sciences, it should be noted that the USIA has apparently concluded that Voice of America should broadcast a program on "Science and Space" to Asia, Africa, Europe, and the Middle East. The program will include a description of the satellite telescope which the United States proposes to launch. See New York Times, Oct. 9, 1960, p. 24.

53. The need for private scholarly assessment of changes in world political "atmosphere" has been recognized, and plans for an independently operated "World Intelligence Center" have been outlined. See, for example, Quincy Wright, "Project for a World Intelligence Center," Conflict Resolution, Vol. 1 (March 1957), pp. 93-97. One part of this mapping of the "atmosphere" which is particularly pertinent to a space program is the quantitative measure of international cooperation in the natural sciences, including the space sciences, and the continuing assessment of the contribution which international science programs are making to international relations. Efforts can and should be made to discover ways to measure trends in the international organization and financing of space science, in the interest in, and quality of, space science as compared with other scientific and non-scientific activities around the world, and in the significant flow of scientific information and expertise across national boundaries through travel, publications, demonstrations and conferences.

54. Some of the incompatibilities between scientists trained in different environments have been referred to elsewhere in this chapter. It has been pointed out by experienced scientists that the short-run result of efforts at international or even interdisciplinary scientific or technical cooperation can dilute the impact and quality of technical accomplishments. It has sometimes been suggested that the work of UNESCO, for instance, is particularly vulnerable to this dilution. It remains, therefore, to delineate and weigh possible long-run benefits against the short-run liabilities of cooperation within the international community on scientific and technical subjects.

55. "Finance Minister Dr. S. E. Imoke of Eastern Nigeria, which will become an independent nation on October 1, expressed the hope that the countries from the Eastern bloc, especially the Soviet Union, would join in the attempt to harness scientific and technological knowledge for the less privileged on earth before proceeding with ambitious programs in outer space and trips to the moon....'We do not ask for the moon,' he said. 'All we seek is guidance, assistance, and cooperation in our efforts to extract from the resources of our countries a more abundant life.'" See "Better Life Here, Not on Moon, Urged," New York Times, Aug. 28, 1960, p. 58.

56. Along with announcements of plans for space activities or of accomplishments in space, it might be possible to include statements intended to inform and prepare appropriate publics for the social and psychological implications of the plan or event. In the words of Professor Alfred deGrazia, "space can be strong medicine and the least we should do is to make sure the label instructs the user on the proper application of the contents and of the possibility of side effects." More specifically, as suggested by Bert Hoslitz, Director, Research Center in Economic Development and Cultural Change, University of Chicago, the possibility of weather and communications satellites might be used as a stimulant in the developing nations for programs in data keeping, irrigation and dam construction, and literacy.

57. A most informative presentation of various sides of this argument is provided in House Hearings Before the Committee on Science and Astronautics, No. 3, Part I, Review of the Space Program, 86th Congress, Second Session (1960), pp. 1-34.

58. "For most people in the world the United States is not a very important object to be either for or against. People are concerned with their own problems and their own policies. If at a particular moment American action is favorable toward those, well and good; if not, our actions will be disapproved. For most people there are no independent identifications with foreign countries. We take this for granted for Americans. A few Americans may have favorite foreign countries, but these are usually favorites from a touristic point of view.... The attitude of most Americans toward the policies of most foreign countries is simply a reflection

of the current impact of those policies on the United States rather than the other way around. American effective attitudes toward Cuba, Puerto Rico, and Venezuela are hardly very different in the long run. Differences in policy are simply differences in current situations and we are friendly or hostile for the moment accordingly. We can see this in ourselves. It is much harder for us to recognize that attitudes toward the United States by others are similarly detached and of equally low saliency for policy." See Ithiel de Sola Pool, Research on Communication and Values in Relation to War and Peace (to be published by the Institute for International Order, New York City, early in 1961),pp. III-15,16, of prepublication draft. For the experiences of business executives in this matter, see Question 11 of the Harvard Business Review Questionnaire (in Appendix A at the end of this Footnote Volume).

In April-June 1960, Professor Jiri Nehnevajsa and Albert S. Francis of Columbia University surveyed samples of legislators and university students in Brazil and Finland. The respondents were asked to indicate which of a series of eighteen international political-economic-military circumstances they foresaw as changed by a series of events, including some in space. (In what follows the figures are given in the following order: (1) Brazilian legislators and (2) students; (3) Finnish legislators and (4) students.)

As to the effects of the USSR being first with manned space flight, an increase in the status quo was foreseen by 13, 15, 35, and 49 per cent. Other foreseen changes of increased chances for reconciliation and increased acceptance of Communism accounted for 10 per cent or less of the total responses in each of the four respondent categories. Most of the eighteen types of circumstances listed were seen as unaffected.

If the United States were first to succeed with manned space flight the status quo was foreseen as emphasized by 17, 19, 35, and 52 per cent. Evolution of democracy in Communist countries, reconciliation, and disarmament were foreseen as being more likely in this event by substantially less than 10 per cent of each category of respondent to each type of event. The remainder of the eighteen events were seen as essentially unaffected by this space activity. The study was done under Air

Research and Development Command, Air Force Office of Scientific Research, Contract AF 49 (638)-473 with Columbia University. The methods used are described in Technical Note TN-60-2 "Research on Comparative Impact of Actual Versus Anticipated Events," July 15, 1960.

For an interpretation of some responses of foreigners to early space activities, see Gabriel A. Almond, "Public Opinion and the Development of Space Technology," International Political Implications of Activities in Outer Space (Joseph M. Goldsen, Chairman), RAND Corporation Report R-362-RC (May 5, 1960).

59. "It is sometimes said that the prestige of the advocate of a new idea is a decisive factor in its acceptance or rejection by others. This is true, but only with important reservations. The proposition does not provide us with a sufficiently refined conceptual tool to probe the effective elements in the situation. On the one hand this statement is likely to be misleading and, on the other, it does not bring to the surface the advocate characteristics that are pertinent. Prestige is a blank term that covers a heterogeneous assortment of discrete attributes. Eminence is, in the last analysis, an accreditation of competence. It, therefore, attaches to many qualifications, the differential effects of which are masked by their all being referred to simply as prestige factors. All advocate characteristics which bear upon acceptance can be subsumed under the rubric of prestige, or the lack of it, if one wishes, but this gives no insight into the issues in the acceptance situation." Homer G. Barnett, Innovation: The Basis of Cultural Change, McGraw-Hill (1953), p. 313. For a detailed discussion of some aspects of this complex problem, see Ibid., Chap. 14, "Acceptors and Rejectors."

60. For example, according to American scientists who have recently visited Europe, the attitudes of European scientists, including some from the Communist bloc, regarding the quality of our space efforts indicate that they fully appreciate the quality of our scientific accomplishments. But in no sense is it clear what part these scientists play in decisions made by their governments regarding relationships with the

United States, as compared to relationships with other nations of the world. We do not know whether the governing elites attend closely to what the scientists say about our science, and we do not know whether, even if they do attend, this knowledge is used as a basis for making decisions about, for example, their commercial purchases, their military posture, their educational system, and their economic methods. Nor is it known, in general, what expertise is attended to under what circumstances.

61. A recent example of the untoward consequences of one such imbalance is discussed in R. Hart Phillips, "Rocket Fragments Fell on Cuba; 'Yankee Agression' is Charged." New York Times, Dec. 2, 1960, p. 1.

Footnotes

1. "...in any human situation, no matter how filled with quantitative data it may be, there are always present powerful human considerations that are incommensurable. These incommensurables -- a tangle of memories, prejudices, emotional needs, aspirations, common decencies -- exert a tremendous and probably always a determining influence upon the real, as opposed to the exposed, nature of a situation. Any wise decision in such a situation must take into account not only the data from which logical conclusions about present upgrading efficiencies can be drawn, but that other data which leads to the non-logical understanding of what human beings are, need, and want to be." See Elting Morison, "The Pertinence of the Past" (paper delivered at Executive Development Convocation, Spring 1959, School of Industrial Management, Massachusetts Institute of Technology).

2. "It is commonplace to speak of attitudes and values as if there was clear understanding and agreement on what was the referent of discourse. Close analysis of points of view seldom reveals a warranty for this assumption.

   "This is, however, not the place for a lengthy excursion into the latest points of view in psychology and sociology on these concepts. A word or two of elaboration may nevertheless clarify the intent of later passages and sections of this chapter.

   "Only in the crudest sense are attitudes and values preferred positions on a scale from strongly 'for' to strongly 'against' some stated position or state of affairs. Essentially, attitudes and values refer to a variously organized body of knowledge (facts and fancies) involving recollections, present experiences and future expectations, this knowledge itself including evaluative categories and judgments.

Thus, attitudes similar in the degree of endorsement or opposition to a position may be highly dissimilar in their content and structure.

"Part of the content of any attitude or value is one's own self and one's associations which both validate and interpret one's position and perspective. Thus, attitudes and values are peculiarly a product of where one stands in society, where one has been, and where one is going. Thus, a sharp shift in one's social or physical environment, one's knowledge, or one's expectations about the future, inevitably has an impact on one's attitudes and values.

"The content of knowledge about space is probably very sparse and unorganized (as is public knowledge about nuclear energy or foreign policy) and largely seen as irrelevant to one's self and one's associates. To the extent that developments or a lack of developments in space alter the body of knowledge, shift notions about relevance, and alter the viewpoints of one's associates, to that extent one can assume that there will be a shift in pertinent attitudes and values." (Correspondence with Stephen B. Withey, Director, Public Affairs Studies, Survey Research Center, University of Michigan.)

3. "What we think as individuals and as communities, and all the patterns of our behavior, make sense in a traditional context. They are relevant to the traditionally established circumstances in which we live. As these circumstances change, our thinking and behavior have to change too. The concepts, the attitudes, and the manners of old generations have to give way to new concepts, new attitudes, and new manners in the generations that succeed them. But tradition can change only slowly and painfully. Consequently, even in societies that are evolving at a leisurely pace there is likely to be some lag between the actual circumstances of the environment and the traditions that supposedly respond to them. What threatens when the pace is stepped up, however, is moral and intellectual chaos." See Louis J. Halle, "The Natural History of Man's Emergence into Space," International Political Implications of Activities in Outer Space, Joseph M. Goldsen, ed., RAND Corporation Report R-362-RC (1960), p. 205. Also see Margaret Mead, Donald N. Michael, Harold D. Lasswell, and Lawrence K. Frank, "Man in Space: A Tool and Program for the Study of Social Change," Annals of the New York Academy of Sciences, Vol. 72 (April 10, 1958), pp. 165-214.

4. "Despite many years of discussion and many pages of writing, the actual role of public opinion in the making of ... policy decisions, in the United States or elsewhere, is something of an enigma. To talk to some policy makers is to come away with the impression that public opinion is a highly volatile force, omnipresent, unpredictable, a combination of shifting searchlights within which the policy maker must function, and which constitutes a basic limitation on what he can do. On the other hand, there are both poll data and frequent observations which suggest that the policy maker is largely free to do what he wishes, and will do what he wishes, regardless of what those outside of government think or want....This is one of the more obscure areas of political analysis....Behind various statements about the role of public opinion work the implicit theories and intuitive calculations of public officials. So far as we know, these have not been described adequately or analyzed by scholars." Richard C. Snyder and James A. Robinson, National and International Decision Making (document prepared for the Institute for International Order, to be published early in 1961), pp. 102-103 of the draft copy.

5. See Clyde Kluckhohn, "Have There Been Discernible Shifts in American Values During the Past Generation?" in Elting Morison, ed., The American Style, Harper (1958), especially p. 181.

6. "But we are also going to have to deal with the dangers of mass insanity or mass imbecility, dangers that we may not recognize even in their realization. Anything we can do, therefore, to keep wisdom alive will be to the good. Perhaps we should set aside some schools and some universities for the development of 'generalists,' a few men with broad philosophical minds and a command of general knowledge who can survey the whole human scene in which the mindless operatives swarm, who can speak for direction and ultimate purpose, who can preserve the heritage of humanity through the period of transition. Perhaps we should build a few ivory towers against the day when we are able again to resume, whether on earth or in outer space, that progress which, rather than identifying us with the bees, distinguishes us from them." See Louis J. Halle, "The Natural History of Man's Emergence into Space," International Political Implications of Activities in Outer Space, p. 208. (For full citation see Note 3 above.) See also Charles Mackay, Extraordinary

Popular Delusions and the Madness of Crowds, George C. Harrap (1956).

7. The concerns expressed with regard to the role of space in society today and tomorrow generally have, as a background, an appreciation in one form or another of the complications, both political and social, which face us as a nation and as a world in the years ahead. While there is some difference of opinion as to the priority and intensity of these complications, there is apparently general agreement that they are of the sort described in such books as: Robert L. Heilbroner, The Future as History, Harper (1960); John Kenneth Galbraith, The Affluent Society, Houghton Mifflin (1958); and Walt Whitman Rostow, The United States in the World Arena, Harper (1960). Generally speaking, these complications arise from the growing demands in the years immediately ahead for enlargement of public services at home as well as in the world abroad. In addition, there is a feeling that the interests of the people at home as well as of those abroad will not be such as to find space central to their aspirations, preoccupations, or demands; all-out efforts in the space area may not be viewed sympathetically and therefore may not have the kind of support necessary for their realization.

Abroad as well as here, the proper allocation of efforts for space activities are matters of concern. A New York Times article, March 21, 1959, p. 2 ("Two Scientists Question Value of Space and Missile Program"), quoted Dr. A. R. J. Grosch, then manager of space programs for the International Business Machine Corporation, as saying: "There isn't any point in zooming off into outer space. We could spend the money better solving problems here at home -- taking care of our overcrowded, underfed millions. If we did that, we wouldn't need to find new worlds to colonize." Dr. Louis Ridenour, then Assistant General Manager of Research and Development in the Missile Systems Division of the Lockheed Aircraft Corporation, was quoted thus: "We turn in our cars before they are worn out and our nation would go broke if we didn't. Our missile program fits into the system very well, we send up missiles that never come back and so we have to make more missiles."

The London Economist, Vol. 195 (April 30, 1960), pp. 396-397, stated: "In one week, the 'important' industrial questions offered to

the public may be whether Britain should cast away money with satellites into space, develop a Channel Tunnel that nobody suggests would pay as a private commercial enterprise, or go in with France to find the public money to develop a supersonic airliner. It is usual to answer this by saying that Britain is a very rich society now; that its citizens have now enough income to make investment in space circuses as sensible a choice as the purchase of motor cars which are nice to polish but too dangerous actually to drive on the roads; and that vast incidental benefits to civil industry flow irresistibly from these ventures that must always be pushed just beyond the extremes of dry-as-dust profitability. Is it? Are they? It is unnecessary to adduce the usual arguments about benefits that could be gained by applying such resources to medical research, or in assistance to underdeveloped countries. More selfishly: the houses outside which the parked cars spawn are generally inconvenient, often smaller than one's grandfathers occupied, and aesthetically revolting."

According to a Reuters' dispatch (New York Times, June 11, 1960), Pravda published a letter (entitled "Isn't it too early to play with the moon?") from a citizen who wrote in part, "Damn the moon and serve up better food." See also Fred Hoyle, "The Case Against a British Space Programme," The New Scientist, Vol. 8 (August 11, 1960), pp. 394-395, and "For and Against a British Space Programme," The New Scientist, Vol. 8 (August 18, 1960), pp. 446-448.

8. See, for example, Wallace R. Brode, "Development of a Science Policy," Science, Vol. 131 (Jan. 1, 1960), pp. 9-15. Consider also the following statement by George B. Kistiakowsky, speaking as moderator of the Harvard Law School's Outer Space Symposium, held in early 1960: "I'd like to emphasize that I am not in outer space; I am firmly on the ground -- place down south; but even so I find myself completely unable to disassociate myself from being involved at least by implication in outer space. On two separate days I had two Nobel Prize winners come to my office. The first one of them said, 'George, you are selling basic science down the river in order to support outer space activities. It is shameful for a scientist to do so.' Three days later the other sat in the same chair and said, 'George, you are sabotaging our outer space program. You ought to be run out of Washington.'" See Harvard

Alumni Bulletin, Vol. 62 (May 7, 1960), p. 597.

"True strength and lasting prestige will come from the richness, variety, and depth of a nation's total program.... We should insist on a space program that is in balance with our other vital endeavors in science and technology and that does not rob them because they are currently less spectacular. In the long run we can weaken our science and technology and lower our international prestige by frantically indulging in unnecessary competition and prestige-motivated projects." See James R. Killian, Jr., "Making Science a Vital Force in Foreign Policy" (a paper delivered to the Dallas Council on World Affairs, Dallas, Texas, Sept. 23, 1960).

9. See Clyde and Florence R. Kluckhohn, "American Culture: Generalized Orientations and Class Patterns" (paper presented at the seventh meeting of the Conference on Science, Philosophy, and Religion in Their Relation to the Democratic Way of Life, held at the International House of the University of Chicago on September 9, 10, and 11, 1946); published in Lyman Bryson, Louis Finkelstein, and Robert Morrison MacIver, eds., Conflicts of Power in Modern Culture, Harper (1947).

10. "There may be occasional limiting conditions under which mass communications may produce a unanimous effect. There are also times in which the 'deviant cases' may be so few as not to be of practical importance. The more important the issue, however, the less likely is the effect to approach unanimity, because of the public's stronger interest in and knowledge of the problem. Therefore, the present status of communication research indicates that any study of the impact of the mass media must be one of the demography of effect -- the relative distribution of effects throughout the population. The major job of charting the appropriate population parameters remains to be done." See Raymond A. Bauer and Alice H. Bauer, "American Society and the Mass Media of Communication" (to be published in the Journal of Social Issues early in 1961), p. II-9 of dittoed copy. Data indicating differential public responses to space activities can be found in: Donald N. Michael, "Man in Space: What SR's Readers Think About It," Saturday Review, Vol. 42 (April 4, 1959), pp. 60-63, and Donald N. Michael, "Sputniks and Public Opinion: The Myth of 'Impact,'" Air Force Magazine/Space Digest, Vol. 43 (June 1960), pp. 72-75; and in Raymond A. Bauer, "Executives Probe

Space," Harvard Business Review, Vol. 38 (September-October 1960), pp. 6-15.

11. Detailed studies of congressional susceptibility to imposing values and attitudes on population groups are found in Lewis A. Dexter, "Congressmen and the People They Listen To" (dittoed), Communications Program D/56-18 Center for International Studies (1956), prepared for and available from 14N207, Massachusetts Institute of Technology, Cambridge, Massachusetts.

12. The following personal reactions to elements in the manipulation of the space program have been variously noted by the scientists and engineers involved, as seeming to them to contribute to the resentment and disillusion.

1. What they felt to be the disproportionate amount of publicity and spectacular promotion given to space activity efforts, "by self-seeking politicians or entrepreneurs who want to use space to advance their own interests." These interests are believed to have little to do with the professed interest in space exploration.

2. They felt that many of the statements made about the future of general space activities and specific space projects are based on ignorance -- sometimes willful -- of the facts, in particular, the ignorance of the tremendous difficulties involved in bringing even the simplest space activity to fruition.

3. They despaired -- given government funding methods -- of receiving the systematic long-range financial support necessary to bring to fruition within a reasonable time many of the projects which they feel can be accomplished, given such support.

4. They had sensed ambiguity in the relationship between NASA and the military services which seems to them to belie the "pious protests" of a civilian space program separate from the military program. The compromises and conflicts are seen as frustrating to both the military and the civilian effort.

5. The scientists in particular sensed pressure on them not to fail, whereas the traditional role of the scientist includes honorable failure in the quest for knowledge. Given the pressures of corporate profits, publicity, and national status, however, failure is not easily acceptable; moreover, exciting ideas are sometimes not explored because

of the risk of failure.

6. The disillusioned individuals usually admit that they are geared to respect a world which is based on their types of goals and their methods for reaching them, and that it is practically a professional tradition to dislike and distrust those whom they perceive as manipulating situations for the sake of expediency.

13. "The individual is having a harder and harder time finding a place for himself in science; and, though this is rationalized as an inevitable development that comes with the growth of science and its practice by groups, many recognize that this emphasis on smooth working relationships in happy laboratories may be changing the notion of knowledge at any price to knowledge as it is convenient and comfortable for the scientist." See Bernice T. Eiduson, "The Changing Self-Images of the Research Scientist" (paper presented at the American Psychological Association Meetings, September 1959, Cincinnati, Ohio).

14. "We do not yet understand the creativity of groups well enough to say that quantity (number of groups, amount of support, structured competition, i.e., all organizationally manipulated) cannot approximate the results of quality (individual talent plus professional motivation). Perhaps the space effort does lose something immediate if the 'best' people choose to pursue different interests, or even the same interests in a different way. While it is true that the disenchantment and cynicism of scientists may affect recruitment and creativity on an individual basis, this may not be true on an organizational level, and may have desirable consequences for the 'balance of power' relationships among elite groups in the society." (Correspondence with Dr. Herbert E. Krugman, Director of Market Research, Raymond Loewy Associates.)

15. For a related discussion see Chapter 6, section on the role of the science adviser. Also see Robert K. Merton, "Bureaucratic Structure and Personality," Social Theory and Social Structure, Free Press (1949), pp. 151-160; Harry C. Triandis, "Differential Perception of Certain Jobs and People by Managers, Clerks, and Workers in Industry," Journal of Applied Psychology, Vol. 43 (August 1959), pp. 221-225.

16. Richard L. Meier and others have pointed out that all successful "large machine" science projects very quickly use up available local talent

and require for their efficient operation national and, eventually, international participation both for research ideas and data analysis. In the past, this phenomenon has been observed in connection with atomic accelerators, computer facilities, radio telescopes, etc. It is speculated that the same situation will arise with space research, especially as the payload capacity increases into the thousands of pounds range.

17. Various factors that were suggested by members of the non-space science community as accounting for unfavorable or indifferent attitudes are listed below. The relative importance assigned to them varied.

(1) Some dislike the flamboyant public relations and propaganda associated with space activities. (E.g., Dr. Joseph Kaplan, as quoted by Dick Turpin in "Space Probes Need Publicity," Los Angeles Times, March 7, 1960, has said: "As a scientist, I am chagrined to have to face the realization that propaganda is as important as it is today in world politics." See also James S. Hanrahan, "Negative Reactions to the Age of Space"--especially pp. 4-7-- American Rocket Society publication 1191-60. And in the words of the present administrator of NASA: "There seems to be a contest going on in this country in which substantial numbers of people are attempting to outdo each other in predicting exotic accomplishments in space in the next few years. In my opinion, there is need for more common sense and good technical judgment to be injected into this picture." From an address by Dr. T. Keith Glennan to the 4th USAF BMD Symposium on Missiles and Space Technology, Los Angeles, Aug. 24, 1959.)

(2) Some dislike affiliation with the military -- and regardless of what may be said by NASA and the White House, they feel space is chiefly a military activity.

(3) Many are committed to research funded through sources which would not permit a shift in their programs to relate them to space activities. Moreover, those with good and continuing support and those hoping to get such support from their present sponsors have no motivation to abandon their commitments.

(4) Many for whose work space probes might be useful in one way or another prefer to depend instead on techniques more familiar to them.

(5) Some have not lost the feeling that space activity is science fiction and therefore not a proper area of attention for a serious scientist with a serious research program.

(6) Planning and launching a research package for a space probe usually takes a long time, perhaps years, and because of the small supply of rockets and the demand for them there is no assurance of when, if ever, it will get off the ground. Some scientists are not prepared to risk their careers in an activity with coordinating elements so far out of their control.

(7) Some resent the amount of money expended on space activities, a fraction of which, they feel, would accomplish much more if it were put into their own earth-based activities.

(8) Some feel that space activities should be planned in close coordination with pertinent earth-bound activities; until this is done they doubt that the first interest of space is truly science.

(9) Some are repelled by the big business-big money approach. While generally they know that some scientific activities do require large amounts of money, the promotional efforts that seem to be considered necessary to insure the money are incompatible with their image of science and the way research should be conducted.

(10) Some resent what they believe to be willful confusion of science with engineering. They insist that rocket design and rocket launchings are engineering and that calling them science degrades science.

18. See Donald N. Michael, "Man-into-Space: A Tool and Program for Research in the Social Sciences," American Psychologist, Vol. 12 (June 1957), pp. 324-328.

19. Raymond A. Bauer, "Executives Probe Space," Harvard Business Review, Vol. 38 (September-October 1960), pp. 6-15.

20. "When the last big discussion of postwar aid to Britain was being argued in Congress, most of the organizational mail was for it, and most of the individual letters were against it. It is possible to organize every kind of voluntary group back of something as a group -- and still have a large number of individual dissidents who generate important undercurrents. We need studies comparing what people say -- when approached as individuals -- and what they say as members of

organized groups." (Correspondence with Margaret Mead, American Museum of Natural History.)

21. "For an adult to know that other adults are all talking about and reading about space is not the same as for the child to know this. He sees adults taking it seriously (regardless of what they say about it). When we listened to Buck Rogers we believed it was the 25th Century and it had no expectancy value. Today it's real, but what is real for the adults who say so may be quite different for the child who perceives it that way truly." (Correspondence with Dr. Herbert Krugman.)

22. For interview techniques with children, see Eugene L. Hartley and Dorothy C. Krugman, "Note on Children's Social Role Perception," Journal of Psychology, Vol. 26 (October 1948), pp. 399-405. For learning theory applied to development of values, see Herbert E. Krugman and Eugene L. Hartley, "Studies in the Development of Consumer Tastes" (scheduled for publication in Public Opinion Quarterly in the spring of 1961).

23. "Here in a ten year project, or less, we will see the most cogent indicators of value (political, social, etc.) consequences of space activities -- and we will see them in process. We need only a handful of schools for collection of longitudinal data, and the Purdue Young People's Opinion Poll (high school and college opinions) for our national cross-checks." (Correspondence with Dr. Herbert Krugman.)

24. The following discussions illustrate these points; Donald N. Michael, "Sputniks and Public Opinion: The Myth of 'Impact,'" Air Force Magazine/Space Digest, Vol. 43 (June 1960), pp. 72-75; Stephen B. Withey, "Sputnik...Some Consequences, Expectations, and Attitudes," Survey Research Center, University of Michigan (mimeographed; January 1958); Stephen B. Withey, J. M. McLeod, and J. Swinehart, "Satellites, Science and the Public: A Report of a National Survey on the Public Impact of Early Satellite Launchings," Survey Research Center, University of Michigan (February 1959); Stephen B. Withey, "Public Opinion about Science and Scientists," Public Opinion Quarterly, Vol. 23 (Autumn 1959), pp. 382-388; and R. C. Davis and Stephen B. Withey, The Public Impact of Science in the Mass Media, Survey Research Center, University of Michigan (1958).

25. A parallel and revealing situation may be found in the disorganized nature of early information and attitudes about nuclear energy. See

E. Douvan, A. Walker, B. Darsky, and Stephen B. Withey, The Impact of Atomic Energy on Society, Survey Research Center, University of Michigan (1953), and B. Fisher, C. Metzner, and B. Darsky, Public Response to Peacetime Uses of Atomic Energy, Vols. 1 and 2, Survey Research Center, University of Michigan (1951). For a discussion of the difficulty of separating military and peaceful uses, see E. Douvan and Stephen B. Withey, "Some Attitudinal Consequences of Atomic Energy," Annals of the American Academy of Political and Social Science, Vol. 290 (November 1953), p. 108.

26. "... despite many years of discussion and many pages of writing, the various roles of the press are not clear. There seem to be at least two major influences which characterize the activity of the press. First, the press perhaps more than any other agency, helps to create as well as reflect the environment in which daily interaction...occurs. Second, while the situation is obvious with respect to totalitarian countries, in which the press is government controlled, it seems highly likely that in other societies the press has also emerged as an actual adjunct to official policy making structures and processes." Richard C. Snyder and James A. Robinson, National and International Decision Making (to be published by the Institute for International Order, New York City, early in 1961), p. 110 of prepublication draft. See also Ithiel de Sola Pool and Irwin Shulman, "Newsmen's Fantasies, Audiences, and Newswriting," Public Opinion Quarterly, Vol. 23 (Summer 1959), pp. 145-158; and Wilbur L. Schramm, ed., One Day in The World's Press: Fourteen Great Newspapers on a Day of Crisis, November 2, 1956, Stanford University Press (1959).

27. "The number of specific findings are so great that the reader is likely to assume that they are of great help in assessing the impact of the mass media on American society. Actually their value is, at present, quite limited for this purpose....Communications research has done much to help us identify the relevant parameters of the problem, but the crucial job of giving values to these parameters is yet to be done." See Raymond A. Bauer and Alice H. Bauer, "American Society and the Mass Media of Communication," (to be published in the Journal of Social Issues in early 1961), p. II-5 of dittoed copy.

28. Some anticipated space projects will in effect involve building a large ship on end at the launching site. The contemplated Nova rocket, for example, would stand about as tall as the Washington monument and probably cost upwards of a billion dollars. Our economy has had no peacetime experience with this kind of "one-shot" activity. Normally in peacetime we finance either many relatively cheap, and therefore disposable, items or an expensive item -- such as an ocean liner -- which can be used over and over again. A really big rocket represents a new type of investment, since in the nature of rocket technology the first shot may fail. Thus there is the not unlikely specter of several years of publicized effort and several billion dollars blowing up when only 100 yards off the pad. Can a society used to traditional modes of investment revise its values so that such a spectacular and expensive "test" would not produce strong pressures to forego further investments of the sort?

29. Daniel Lerner, Professor of Communications Research at MIT, and his associates found some interesting differences recently in sophisticated European publics regarding expectations about the future importance of space activities. In a general way, those people who foresaw intensive and, perhaps, disastrous competition between East and West, also foresaw space as an important activity in the future. Those people who foresaw a lessening of tensions and the need for greater cooperation, also foresaw a lessening role for space. See also R. C. Davis and Stephen B. Withey, The Public Impact of Science in the Mass Media, Survey Research Center, University of Michigan (1958); and A. W. Bendig, "Factor Analytic Dimensions of Attitudes Toward Man-into-Space," Psychological Newsletter (New York University), Vol. 10 (January-February 1959), pp. 123-130.

30. For example, an excellent summary of opposition to changes in transportation is found in Wilfred Owen, The Community Objects (a report prepared for the Air Force Association, 1954).

31. It is significant, perhaps, that among those people today who would be spoken of as having broad horizons, there is questioning regarding the appropriate allocation of resources to meet these many challenges on the horizon. For example, "...certainly there are scientific problems of overwhelming importance that can be solved for a small fraction of

a single Atlas or Titan fizzle. Is it possible that, in the long run, we'll be better off relative to the Russians to channel expenditures into other fields?... and what about cancer research, studies in geriatrics, urban redevelopment -- even aid to India?" (From a speech by Robert J. Low, Executive Officer, High Altitude Observatory of the University of Colorado, entitled "International and Economic Aspects of the Space Age," delivered to the National Conference on Aviation Education at the Air Force Academy, Denver, March 25, 1960.)

And Dr. George B. Kistiakowsky, in a speech entitled "A Decade of Progress," delivered to the National Science Foundation, May 12th, 1960, said: "Nor need we look beyond our own shores to view unreached horizons of science. Our hospitals are overcrowded with men, women, and children emotionally unfit to move among their fellow men. Killers and cripplers of men such as cancer, arthritis, heart disease, muscular dystrophy, all await the day when science will marshal still greater forces against them. Rich deposits of minerals and food await extraction from the sea, while the sea awaits desalination in quantities large enough to open new lands to mankind. The atom awaits fusion, photosynthesis to be harnessed, new galaxies to be discovered. Science itself awaits the day when it will be reunited with music, art, and literature into harmonious culture to move together, toward the achievement of excellence in our lives."

See also a review by John Rader Platt (Department of Physics, University of Chicago) of Basic Research in the Navy (a report to the Secretary of the Navy by the Naval Research Advisory Committee), Bulletin of the Atomic Scientists, Vol. 16 (June 1960), p. 221, which reads in part: "What we need... is a 100-fold redirection of money and competent research scientists into other long-neglected areas of basic research and invention. Areas where 100-fold may mean 100 scientists, to balance a little bit the hordes already working on space and fusion. Areas related to transportation, housing, textiles, contraceptives, Operations Analyses of local government mechanisms, and so on; where high technology sees no dividend and has not even a toehold. Survival is also, like technology, a many-factor problem; and for optimum success, it also needs a distribution of research effort among all the factors, not just the well-advertised military and industrial factors."

32. See Robert K. Merton, "The Self-Fulfilling Prophecy," in Social Theory and Social Structure, Free Press (1949), pp. 179-195.

33. See, for example, the many speculations on project Ozma. One such: "Project Ozma Begins Operation at National Radio Astronomy Observatory," National Science Foundation Press Release NSF-60-120, April 12, 1960.

34. The positions of the major American religious denominations, the Christian sects, and the Eastern religions on the matter of extraterrestrial life need elucidation. Consider the following:

"The Fundamentalist (and anti-science) sects are growing apace around the world and, as missionary enterprises, may have schools and a good deal of literature attached to them. One of the important things is that, where they are active, they appeal to the illiterate and semi-literate (including, as missions, the preachers as well as the congregation) and can pile up a very influential following in terms of numbers. For them, the discovery of other life -- rather than any other space product -- would be electrifying. Since the main ones among these sects are broadly international in their scope and are, in some places, a news source, the principal distributors of mass media materials, an important source of value interpretation, a central social institution, an educational institution, and so on, some scattered studies need to be made both in their home centers and churches and their missions, in relation to attitudes about space activities and extraterrestrial life. Additionally, because of the international effects of space activities and, in the event of its happening, of the discovery of extraterrestrial life, even though space activities are not internationalized, it is very important to take account of other major religions. So, for example, Buddhist priests are heavily politically engaged in Ceylon. So, too, in Burma, many politically active men (including U Nu) are professedly active Buddhists. The Burmese convoked the Sixth Great Buddhist Council which brought together a huge international group of Buddhist lay and ecclesiatical leaders and it seems likely that -- at least in the case of Theravada Buddhism -- with the wide participation of modern-educated, politically active men, Buddhist beliefs and principles are being re-interpreted. We need, and we do not have, good observations or interpretive statements about the possible repercussions of space activities, etc., for these Buddhists." (Correspondence with Dr. Rhoda Metraux.

The observations are based on field work with the Montserrat Anthropological Expedition, 1953-54, field work in Haiti, and examination of sectarian literature.)

If plant life or some subhuman intelligence were found on Mars or Venus, for example, there is on the face of it no good reason to suppose these discoveries, after the original novelty had been exploited to the fullest and worn off, would result in substantial changes in perspectives or philosophy in large parts of the American public, at least any more than, let us say, did the discovery of the coelacanth or the panda. It might well be that this sort of discovery would simply not be sufficiently salient for most people most of the time to cause any noticeable shift in philosophy or perspective. If super intelligence is discovered, the results become quite unpredictable. It is possible that if the intelligence of these creatures were sufficiently superior to ours, they would choose to have little if any contact with us. On the face of it, there is no reason to believe that we might learn a great deal from them, especially if their physiology and psychology were substantially different from ours.

It has been speculated that, of all groups, scientists and engineers might be the most devastated by the discovery of relatively superior creatures, since these professions are most clearly associated with the mastery of nature, rather than with the understanding and expression of man. Advanced understanding of nature might vitiate all our theories at the very least, if not also require a culture and perhaps a brain inaccessible to earth scientists. Nature belongs to all creatures, but man's aspirations, motives, history, attitudes, etc., are presumably the proper study of man. It would also depend, of course, on how their intelligence were expressed; it does not necessarily follow that they would excel technologically.

It is perhaps interesting to note that when asked what the consequences of the discovery of superior life would be, an audience of Saturday Review readership chose, for the most part, not to answer the question at all, in spite of their detailed answers to many other speculative questions. Perhaps the idea is so foreign that even this readership was bemused by it. But one can speculate, too, that the idea of intellectually superior creatures may be anxiety-provoking. Nor is it

clear what would be the reactions to creatures of approximately equal and communicable intelligence to ours.

What may perhaps present a particularly knotty philosophical problem, and one which would seem most clearly to have the potentials of profound repercussions for our values and attitudes and philosophies, could arise if we discovered a creature whose intelligence and behavior, by our standards, was indeterminate to the point that we were unable to decide whether or not it should be treated morally and ethically as if it were "a human being." Certainly, this could provide a continuing subject of controversy across and within various earth cultures; some people who had not otherwise speculated on these matters might gain a sense of the complexity of the universe. For a convincing presentation of this idea, see Vercours, You Shall Know Them, Pocket Books (1955).

On this general problem see Daniel C. Raible, "Rational Life in Outer Space?" America, Vol. 103 (Aug. 13, 1960), pp. 532-535; Wolfgang D. Miller, "Religion in Space," Man Among the Stars, Criterion Books (1957), pp. 221-240; and "Oxnam Sees Space Conquest in 175 Years," Washington Star, Jan. 4, 1960.

35. Professor Jiri Nehnevajsa and Albert S. Francis of Columbia University, in April-June 1960, surveyed samples of about 100 legislators and 100 university students in both Brazil and Finland. The respondents were asked to indicate which of a series of circumstances they foresaw as changed by a series of developments, including some in space. (In what follows the figures are given in the following order: (1) Brazilian legislators and (2) students; (3) Finnish legislators and (4) students.) The discovery of civilized alien life was foreseen as increasing the chances for East-West reconciliation by 15, 11, 5, and 6 per cent of the respondents, and as increasing the chances of a third political force by 6, 6, 11, and 20 per cent of the respondents. Increased status quo and increased likelihood of disarmament accounted for most of the remaining scattered responses, being, respectively, 2, 5, 21, and 21 per cent, and 5, 7, 6, and 5 per cent. The remaining types of situations facing the world were seen as essentially unaffected by this event. (See Chapter 8, Note 58, for other details of this survey and for complete citation.)

36. A possible but not completely satisfactory means for making the possibility "real" for many people would be to confront them with present speculations about the I.Q. of the porpoise and to encourage them to expand on the implications of this situation. Unfortunately the semantics of "animal," at least for Americans, is such that even a human level I.Q. would not be as threatening as a "being" which wasn't an earth animal.

37. Such studies would include historical reactions to hoaxes, psychic manifestations, unidentified flying objects, etc. Hadley Cantril's study, Invasion from Mars (Princeton University Press, 1940), would provide a useful if limited guide in this area. Fruitful understanding might be gained from a comparative study of factors affecting the responses of primitive societies to exposure to technologically advanced societies. Some thrived, some endured, and some died.

38. A series of articles on the astronauts began in the Sept. 14, 1959, issue of Life magazine.

39. See, for example, "Astronaut Plan Termed a 'Stunt.' Bush Says Project Has Little Value -- Sees 'Confusion' in the Missile Program," New York Times, April 7, 1960; and "DuBridge Blasts 'Space Idiots'; Calls for Down-to-Earth Stories About Problems," Los Angeles Times, May 1, 1960, in which Lee DuBridge was quoted as saying also, "I believe even the Mercury Program, in spite of all the nauseating journalistic publicity about the astronauts, has now been converted into a needed research program." See also the editorial, "Don't Rush the Astronauts," Washington Post and Times Herald, Nov. 24, 1960.

40. "Women want men to stay at home now probably more than they have at any period in history. They need them more. They need them to look after the children and help build the house and do all sorts of things that they didn't use to need husbands for. They used to have other female relatives and neighbors to help, or not so many children. But now, they need husbands at home, and there is a tremendous objection to men going anywhere. Part of the feeling about space, which spreads right through the country, is women's objection to men's going there." See Margaret Mead, "The Newest Battle of the Sexes," Air Force Magazine/Space Digest, Vol. 43 (July 1960), p. 78.

41. Eric Larabee interprets the popularity of the "Western" and the "Private Eye" on TV as due to unconscious effort on the part of the viewer to bring the jungle back to the city; that is, to present man with the unexpected that he must confront and use his wits and his body to overcome. To the extent that space may provide a surrogate or vicarious frontier for people, it may be attractive in this sense too.

42. See Donald N. Michael, "Social Studies Must Go On to Find Out How To Keep Space Crews Content," Missiles and Rockets, Vol. 3 (April 1958), pp. 110-114; and Jiri Nehnevajsa, "Man in Space Means Men in Space: Some Consequences," American Rocket Society Reprint 969-959 (Nov. 17, 1959).

43. For a recent popular summary of this situation see Walter Sullivan, "Satellite Shows Wide Ray Threat," New York Times, Nov. 27, 1960, p.1. At the present stage of knowledge, the effects of any one of most of the factors believed to be of major significance to man's biological and psychological survival in space can be estimated for an exposure period of not more than thirty days. There is no adequate knowledge of the combined effects of these factors for any period of exposure. See "Life Sciences for Space Use," Aviation Week, Vol. 73 (Nov. 7, 1960), p. 67.

APPENDIX A

Introduction

In Chapter 6 -- "Attitudes and Values" -- a brief summary was presented of the report by Raymond A. Bauer, of the Harvard Graduate School of Business Administration, on a study designed and conducted by him for the Harvard Business Review. Based on a questionnaire survey, the study explored the attitudes and opinions of business executives about space activities.

Appendix A presents the full text of the report. There were three reasons for our decision to include it here. In the first place, the data are of much intrinsic interest. Secondly, the illuminating analysis by Professor Bauer, with the assistance of Edward E. Furash, is an excellent example of the kind of insight that can result when a survey study has been specifically designed to show the relationships between the data it elicits. And third, the new questions posed by the analyses and the various response ambiguities exposed by the findings demonstrate that survey studies, like any other research, cannot be expected to close a matter once and for all but must be thought of in a context of continuing revisions and extensions appropriate to changes in the situation about which the questions were asked.

THE OPINIONS HELD BY BUSINESS EXECUTIVES ABOUT SPACE ACTIVITIES -- WITH RECOMMENDATIONS FOR FUTURE STUDIES

A special report to the Brookings Institution based on information gathered for the Harvard Business Review through a study of business executive subscribers.

By

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With the assistance of

Edward E. Furash, Assistant Editor, Harvard Business Review, Harvard Graduate School of Business Administration

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economic payoff and research results for everyday life on earth; 4. Meeting the challenge and adventure of new horizons; 5. Winning the prestige race with the Soviet Union. The possible meaning and relationships of these objectives are discussed in this section.....

D. Civilian vs. Military: Respondents appear to draw a clear distinction between civilian and military objectives (and indicate which program they think will best fulfill each goal), but they do not necessarily distinguish between existing programs.....

E. Level of Information: It would be a mistake to assume that the distinctions made reflect detailed knowledge of the actual differences between the two programs, for even many of the most enthusiastic executives are not completely informed, and they frankly admit that they wish they knew more.....

F. How Are We Doing? To the small extent that executives do complain about the space program, it is predominantly about the execution of the program rather than the idea of space research. Few think that the program does not need to be stepped up. In general, there is a tendency to feel that more can be done with the resources already committed.....

G. How Much? There is considerable willingness to grant the civilian part of the space program even more funds than executives think it is already getting. A preponderant majority of executives feel so strongly in favor of space research that they give it priority over a cut in taxes.....

H. The Role of Private Industry: Respondents hope for a role for private industry in the space program, but many of their comments have a wistful tone unaccompanied by firm confidence. Their plea is that the government will make use of private industry through research contracts, for they recognize that, for the moment, financing is in the hands of the government.....

I. Age and Education: Though few differences in opinion appear among executives responding to this survey according to their position, industry, business function; on a certain few questions, those who are older, and those who have less education show a trend toward conservatism about the space program.....

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Part I: INTRODUCTION

A. Background

One of the continuing departments in the Harvard Business Review is a feature entitled "Problems in Review." This feature provides a forum for investigating various "problem issues" in both business and national affairs, and reports the opinions of HBR subscribers on these issues. Here are a few representative topics explored in this feature: "Business and Politics" (May-June, 1959); "Planned Obsolescence" (September-October, 1959); "Cold-War Thaw" (January-February, 1960); and "Expense Accounts" (March-April, 1960).

The Editors of HBR conceive of this feature as a vehicle for bringing such topics into open discussion with a view toward injecting clarity and "settling the dust." The feature provides an opportunity to explore the norms of business behavior and the opinions of executives on various ideas or practices that have become either controversial or widely accepted, while at the same time providing a questioning, exploratory analysis and evaluation. Thus the research conducted is designed to explore the topic, to provide material for editorial commentary, to suggest potential solutions, and to stimulate further research and careful rethinking of these issues.

The research methodology used for the feature consists of a survey of HBR subscribers by mail questionnaire, coupled with personal interviews both during the questionnaire design and as part of the survey itself. There are six surveys per year (one for each issue of HBR), and the sampling is designed so that each subscriber is surveyed about once per year, resulting in a continuous sampling of HBR readers. Further discussion of the sample, and so forth will be found in a later section.

B. The Purpose of the Study

With these elements in mind, I suggested to the Editors of the Harvard Business Review the topic of "space research," and they in turn asked me to design a study exploring the views of the business community on various aspects of the national space programs, using a sample of HBR readers. (See: Raymond A. Bauer, "Executives Probe Space," Harvard Business Review, Vol. 38, September-October, 1960, pp. 6-15.)

The HBR subscriber universe was quite suitable for such a study, first of all because a sample was readily available; secondly, because a great deal of opinion and demographic data had been collected about this universe through the continuous sampling process; and thirdly, because the executives had proven highly articulate in the past on many diverse topics, as well as having shown themselves as increasingly willing to cooperate in HBR studies. Comparing the demographic characteristics of HBR readers with those available for the business community as a whole suggested that the sample might provide an invaluable opportunity for gathering the opinions of executives whose education, businesses, company size, age, income, and so forth indicated that they should represent an important and influential segment of the business community, even if not a completely representative one.

In sum, this seemed to be an opportunity for at least an exploratory study of the attitudes of one significant segment of the public on space research. A number of results were hoped for:

1. To gain some insight into the dynamics of space research opinions held by "influential" executives.

2. To gauge the strengths of these opinions, and their direction, thereby getting some information that might serve as a guide for formulating /questions about/ governmental or industrial policy.

3. To generate ideas for further research in the area of business opinions on space research and the space programs; to gain some insight as to what additional research might be needed.

C. The Sample

As noted earlier, the samples used by HBR are designed so that each subscriber is surveyed about once per year, usually just before his yearly renewal, or when his subscription has two years to run in the case of executives who subscribe for more than one year. The sample provided by HBR for this study consisted of 6,200 readers selected to report in the

"Problems in Review" that would appear in the September-October issue.[1] Of the executives surveyed, 1,950 returned questionnaires, for a return of 31.5%.

This rate of return compares favorably with previous HBR surveys. Since the inception of the surveys, the rate of return has risen steadily, with the most recent surveys returning above 30%. These rates of return vary, of course, with the topic and the time of year in which the survey is conducted. This study was conducted in June of 1960. At the same time, one can consider this rate of return extraordinarily good, in that the questionnaire sent out was six pages long. The usual HBR survey for "Problems in Review" consist of only four pages. In effect, an extra-long, more than ordinarily difficult questionnaire returned nearly as well as most shorter, less complicated surveys that had been conducted in the near past, and much better than many conducted a longer time ago. These factors might be considered good indicators of the serious interest in this topic on the part of businessmen.

However, though the rate of return in HBR surveys may have varied somewhat over time, the demographic characteristics of the samples have remained quite consistent, or have reflected changes in subscriber characteristics that could be identified by other means. Follow-up surveys to nonrespondents in many past surveys have borne out the demographic representativeness of the samples, their representativeness of subscriber opinions for the particular topics under discussion, and for being representative as to degree of interest in the topic. The demographic characteristics of the sample returning in this survey outlined in Exhibit I match quite closely the demographic characteristics of previous samples, of this sample when used in the past, and of demographic characteristics obtained from other sources, (e.g., a mail study of reader characteristics with a return of 67%).

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[1]The circulation of HBR at the time of the survey was about 64,000.

EXHIBIT I

Profile of the Executives Responding

Management position

Top management	=	chairman of the board; board member; owner; partner; president; division or executive vice president; vice president; treasurer, secretary-treasurer; controller; secretary (to the corporation); general manager, general superintendent; editor; administrative director; dean and assistants thereto	45%
Upper middle management	=	functional department head (e.g., advertising sales, promotion, production, purchasing, personnel, engineering, public relations, brand manager, and the like)	23
Lower middle management	=	assistant to functional department head; district manager; branch manager; section manager; and the like)	13
Nonmanagement personnel	=	all others employed in business	10
Professional	=	doctor; practicing lawyer; practicing CPA; professor; consultant; military officer; government official; union official; clergyman; and the like	9
			100%

Formal education

High school	8%
College	51
Graduate school	41
	100%

Income group

Under $10,000	16%
$10,000-19,999	48
$20,000-29,999	20
$30,000-39,999	7
$40,000-49,999	3
$50,000-74,999	3
$75,000-99,999	2
$100,000 and over	1
	100%

Age

Under 30 years	9%
30-34	15
35-39	19
40-44	19
45-49	15
50-54	10
55-59	7
60-65	4
Over 65	2
	100%

Company size by number of employees

1-49	15%
50-99	7
100-249	10
250-499	9
500-999	8
1,000-4,999	19
5,000-9,999	7
10,000-20,000	6
Over 20,000	19
	100%

EXHIBIT I continued

Industry

Manufacturing consumer goods	16%	Construction	2%
Manufacturing industrial goods	25	Mining or extraction; oil	3
Engineering, research and development	10	Retail or wholesale trade	10
Management consulting and business services	6	Transportation or public utilities	5
Banking, investment, insurance	8	Communications and advertising	5
		Consumer services	3

Other 7%

Note: Of the 1,950 total returns, 1,717 were received in time for machine tabulation, and the balance inspected and found to have no significant demographic or opinion differences.

D. Questionnaire Design

Keeping in mind that this was to be an exploratory study, the mail survey questionnaire was designed to obtain opinions and knowledge about a number of different aspects of the space program. The following topics, not in order of importance or emphasis, were covered:

1. Business implications of space research:
   a. What role should private industry play in the carrying out of space research?
   b. What is the respondent's own role, if any, in space research?
      1. Amount of company business due to space research programs?
      2. How much of his own business time is spent in business activities related to the space program?
   c. What possible applications of space research results might there be to the normal activities of the company?
      1. When might such results be applied?
      2. What types of applications are foreseen?
   d. If at all, what loss of prestige overseas have executives experienced since the USSR launched Sputnik I? Can they be attributed to the Soviet "successes"?
2. Knowledge and perceptions about space program activities:
   a. To what degree do executives perceive the space research sponsored by the Federal Government as being a unified program?
      1. Do they perceive differences between NASA and Armed Forces space programs?
      2. Can they identify the group in charge of specific projects?
      3. Can they identify the project names now being used? Are project names useful when communicating with the public?
      4. Under what aegis is space research best achieved?
   b. What funds are allocated to space research? Any differences perceived between military and civilian allocations?
      1. How much is now being spent?
      2. How much should be spent?
      3. How much do they think will be spent?
   c. What do they think of the capabilities of the various groups in charge of space research insofar as their ability to achieve given objectives?
3. Opinions about space research and the space programs:
   a. How do they evaluate various possible objectives of space research?
      1. How do they rank these objectives relative to each other?
      2. Under what aegis will such objectives be best achieved?

b. What kinds of results will be obtained from space research?
   1. What differences are perceived between direct results and so-called R & D peeloff?
   2. With what certainty will these various results be achieved?

c. What value do executives place on "pure" research? What attitudes do they have about the fruitfulness of purely scientific enquiry?

4. National implications of space research:

a. Do executives feel that the U.S. has adequate resources to meet both our space program plans and the other needs of our country and people?

b. What do executives think of the way that the government has handled space research?
   1. Do they consider the space program a political football?
   2. Do they think the public is told enough or perhaps too much about the space program?
   3. Should the U.S. attempt propaganda victories in the area of space research?
   4. How well do executives think we are doing in space research vis-a-vis the USSR?
   5. How do executives think we can best step up the space program, if at all?

c. Do executives think that control of outer space is the most important military objective that the United States should have?

d. Do executives see a need for a unified space program with <u>one</u> director?

e. How highly do executives rate purely scientific space research against alternative uses of our national income? e.g., versus new hospitals, education, or cutting taxes?

5. Demographic and business information about the respondents:

a. What general function does he perform in his company?

b. What type of business is he in?

c. What is his importance in the management of his company?

d. What is his age?

e. What is his income?

f. Where does he live?

g. How large is the company he works for?

h. What is his education?

A sample of the actual questionnaire used in the study can be found on the next several pages.

WE NEED YOUR HELP
Please return this by JUNE 23, so results can be compiled for the SEPTEMBER–OCTOBER ISSUE OF HBR

HARVARD BUSINESS REVIEW
SURVEY ON THE SPACE PROGRAM

Of late, astronauts, Explorers, Pioneers, Vanguards, weather satellites, communications satellites, trips to the moon, space race, missile lag — and a dozen more terms — are cropping up with increasing frequency in the daily press and our own casual conversations. At present, the federal government is sponsoring space research through two types of programs: civilian (NASA) and military (Armed Forces). Where are these programs going? What are they worth? What kind of payoffs will result? How fast or slow should we go? What are or will be the effects on the business community?

As part of putting this problem in review, the Editors of HBR feel that readers would welcome an opportunity to compare their opinions and the activities of their companies with those of other business executives. We are interested in your company activities, your frank opinions, and your views of the situation. We know that you will respond to the best of your knowledge. Naturally, you are not asked to sign our survey, or to identify yourself beyond some general information to be used for statistical purposes only.

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1. The following statements have been made from time to time about various aspects of the space programs. How do you feel about these statements? Please circle the number which best corresponds to your feeling about each statement. (Please do not circle more than one number per statement.)

	Agree	Partially Agree	Neutral	Partially Disagree	Disagree	
a. "I'd hate to put any limit on what will result from the space programs. After all, anything could happen. Look what has happened in the past."	64%	25%	4%	4%	4%	(1)
b. "The politicians in Washington are not really interested in scientific advancement from research into outer space, but only in using the issue for political profit."	5	30	7	27	32	(2)
c. "Why bother putting men in space? We can do all we want up there with robot machines."	3	6	5	12	74	(3)
d. "Outer space is the new frontier. Research and exploration will have profound and revolutionary effects on our economic growth."	62	23	6	6	3	(4)
e. "What we need is one space program, with one director."	39	18	9	12	22	(5)
f. "The country that controls outer space controls the destiny of the earth."	31	36	10	11	12	(6)
g. "Mankind wants to go into outer space because it is there . . . we are drawn by our desire to know and conquer anew."	62	27	5	4	2	(7)
h. "The horizons that will be opened to man by the exploration of outer space are not recognized by most people today."	72	20	4	3	2	(8)
i. "This whole idea of competing with Russia in a race for space is nonsense."	6	13	3	20	58	(9)

N = 1,717

2. A number of objectives have been suggested for the space program. Which objective do you consider most important? Which least important? Please rank the objectives listed below in order of your preference. If the objective is most important, write a "1" in the space after it; if next most important, write in a "2"; etc. Then check the appropriate box to indicate which program — NASA or Military — will best achieve each objective.

		Per cent in each rank (Ranking 1 to 5)					Ave. Rank	(15) NASA Will Best Achieve	(16) Military Will Best Achieve	
		1	2	3	4	5				
1. a.	Pure science research and gaining of knowledge	47	26	16	9	2	1.9	96% ☐	4% ☐	1
5. b.	Winning prestige race with Soviet Union	3	11	24	25	37	3.9	40% ☐	60% ☐	2
4. c.	Meeting the challenge and adventure of new horizons	8	17	15	25	25	3.6	90% ☐	10% ☐	3
3. d.	Tangible economic payoff and research results for everyday life on earth	14	23	27	20	16	3.0	94% ☐	6% ☐	4
2. e.	Control of outer space for military and political reasons	31	24	18	20	9	2.6	16% ☐	84% ☐	5

3. Listed below are a number of different projects now being sponsored by the federal government. Which program — NASA or Military — is in charge of each project? (If you don't know, make your best guess. Please check only one program for each project.)

		(17) NASA In Charge (Civilian)	(18) Military In Charge	
a.	Mercury	54% ☐	46% ☐	1
b.	Nike	3% ☐	97% ☐	2
c.	Weather satellites	86% ☐	14% ☐	3
d.	Pioneer	51% ☐	49% ☐	4
e.	Icarus (nonexistent)	65% ☐	35% ☐	5
f.	Explorer	47% ☐	53% ☐	6
g.	Tiros	55% ☐	45% ☐	7
h.	Discoverer	43% ☐	57% ☐	8
i.	Vanguard	22% ☐	78% ☐	9

4. There has been a great deal of speculation about the scientific and economic achievements which might result from the space programs. Some would be direct results of the space programs; others would be by-products of space research and development. Which of these promises do you think will eventually pay off? Please circle below the number which best represents your estimate of the probability that each item has of happening. (Please circle only one number per item.)

		Almost Certain to Happen	Very Likely	Possible	Very Unlikely	Never Will Happen	Belief Index*
a.	Accurate long-range weather forecasting	53%	34%	11%	1%	1%	4.37 (19)
b.	Mining on other planets	4	10	44	36	6	2.34 (20)
c.	Revolutionary improvements in communications (T.V., Radio, Telephone, etc.)	69	25	5	1	0	4.62 (21)
d.	Colonizing other planets	3	5	37	44	11	2.45 (22)
e.	Antigravity devices	11	21	42	21	6	3.13 (23)
f.	Compact nuclear power plants	47	32	18	3	1	4.24 (24)
g.	Robot devices	54	28	15	2	1	4.32 (25)
h.	New mathematics and physics	52	29	16	3	1	4.31 (26)
i.	New medical and biological knowledge	56	30	12	1	1	4.39 (27)
j.	New fabricating materials	46	25	24	9	0	4.20 (28)

* See Part II, Exhibit III, for explanation.

5. Is any of your company's business related to the space programs? (Please check as many as are applicable.)

We have a Military space program contract or subcontract	22% ☐	(29-1)
We have a NASA contract or subcontract	15% ☐	(29-2)
We have some sales to NASA or Military space program contractors	29% ☐	(29-3)
We are planning a program which we believe will get us into the space business	8% ☐	(29-4)
We do no business directly related to the space program	63% ☐	(29-5)

6. How much of your own time in the past month, if any, was involved with business activities related to the space program? (Please check one only.)

None	83% ☐	(30-1)
1% - 24%	13% ☐	(30-2)
25% - 49%	2% ☐	(30-3)
50% - 74%	1% ☐	(30-4)
75% - 100%	2% ☐	(30-5)

7. How soon do you think it will be before knowledge gained from the space program could be applied to the industrial or consumer products of your company? (Please check one only.)

Already being applied	20% ☐	(31-1)
Within next 6 months	1% ☐	(31-2)
6 months to 1 year	2% ☐	(31-3)
1- 2 years away	8% ☐	(31-4)
3- 5 years away	15% ☐	(31-5)
6-10 years away	10% ☐	(31-6)
More than 10 years away	15% ☐	(31-7)
Very unlikely ever	30% ☐	(31-8)

If you foresee some or any applications, will they be direct results of the space program, or a by-product of space research and development?

Direct result	30% ☐	(32-1)
By-product	78% ☐	(32-2)

Can you give examples of such applications? .....

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8. Though we can't expect you to know exactly, how much money per year do you think the federal government is now spending on NASA or Military space program projects? Please try to make the best guess you can. In addition, how much do you think should be spent? How much do you think will be spent in 1965? Please be certain to answer for both NASA and Military programs. (Please check each section only once for each program, however.)

	Now Spending		Should Spend		Will Spend in 1965		
	(33) NASA	(34) Military	(35) NASA	(36) Military	(37) NASA	(38) Military	
Under $100 million per year	5% ☐	1% ☐	2% ☐	4% ☐	1% ☐	1% ☐	1
About $100 million per year	8 ☐	3 ☐	2 ☐	8 ☐	2 ☐	2 ☐	2
About $500 million per year	26 ☐	12 ☐	12 ☐	11 ☐	6 ☐	5 ☐	3
About $ 1 billion per year	33 ☐	25 ☐	29 ☐	24 ☐	21 ☐	16 ☐	4
About $ 5 billion per year	20 ☐	35 ☐	29 ☐	31 ☐	32 ☐	30 ☐	5
About $ 10 billion per year	6 ☐	12 ☐	14 ☐	14 ☐	17 ☐	20 ☐	6
About $ 15 billion per year	2 ☐	6 ☐	6 ☐	5 ☐	8 ☐	10 ☐	7
About $ 20 billion per year	1 ☐	3 ☐	3 ☐	4 ☐	6 ☐	7 ☐	8
About $ 25 billion per year	1 ☐	2 ☐	2 ☐	2 ☐	2 ☐	3 ☐	9
Over $ 25 billion per year	1 ☐	2 ☐	3 ☐	2 ☐	5 ☐	7 ☐	X

9. Do you think that control of outer space is the most important military objective that our country should have?

Yes	36% ☐	(39-1)
No	64% ☐	(39-2)

Why? .....

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10. Which program — NASA or Military — do you think will be first to achieve results in each of the areas listed below? (Please check only one program for each area.)

	1 NASA Will Achieve First	2 Military Will Achieve First	
a. Long-range weather predicting system	☐ 85%	☐ 15%	(40)
b. Manned space stations	☐ 32%	☐ 68%	(41)
c. Compact nuclear power plant	☐ 66%	☐ 34%	(42)
d. Man landing on the moon	☐ 39%	☐ 61%	(43)
e. Travel to other stars	☐ 60%	☐ 40%	(44)

11. Do you think that American business has lost prestige overseas since the Russians put sputnik up? (Please check as many as are applicable.)

a.	I know of instances in which my own company has lost sales or opportunities abroad as a result	1% ☐	(45-1)
b.	Business associates have reported to me instances in which they have lost sales or opportunities abroad	2% ☐	(45-2)
c.	I have read or heard a good deal about our loss of prestige abroad	52% ☐	(45-3)
d.	I have felt the loss of this prestige when conversing with foreigners or in my travels abroad	9% ☐	(45-4)
e.	Other nations and foreign customers are now putting much more faith in Russian products and technology than before sputnik	31% ☐	(45-5)
f.	I think that we have lost relatively little prestige	58% ☐	(45-6)
g.	On the contrary, it has made us more human and likeable	12% ☐	(45-7)

12. How well do you think we are doing in space research? (Please check as many as are applicable.)

a.	Our methods are inefficient	23% ☐	(46-1)
b.	We are behind the Russians	32% ☐	(46-2)
c.	We are ahead of the Russians	20% ☐	(46-3)
d.	We are about up with the Russians	39% ☐	(46-4)
e.	We don't get as much per dollar out of our research as private industry does	53% ☐	(46-5)
f.	We don't get as much propaganda out of research as the Russians do	77% ☐	(46-6)
g.	We don't get as much research per dollar spent as the Russians do	39% ☐	(46-7)

13. How do you think we can best step up the space program? (Please check one only.)

Make better use of present funds	70% ☐	(47-1)
Allocate more money for programs	31% ☐	(47-2)
We don't need to step up the space program	5% ☐	(47-3)
We are already doing our best	4% ☐	(47-4)

14. Do we have adequate resources to meet both our space program plans and the other needs of our country and people? (Please check as many as are applicable.)

a.	Yes, easily	33% ☐	(48-1)
b.	Yes, with special effort	59% ☐	(48-2)
c.	No, not enough money	3% ☐	(48-3)
d.	No, not enough manpower	4% ☐	(48-4)
e.	No, excessive burden on the economy	4% ☐	(48-5)
f.	We would need a stronger sense of purpose and national effort to be able to do it	59% ☐	(48-6)
g.	We would need strong political leadership to show us the way	45% ☐	(48-7)

15. Do you think we are told enough about the space program? (Please check as many as are applicable.)

a.	We are told too much already	10% ☐	(49-1)
b.	We should be informed of more details and plans	32% ☐	(49-2)
c.	Secrecy is most important; the less we know the better	1% ☐	(49-3)
d.	More information would only confuse most people	17% ☐	(49-4)
e.	People are already pretty confused as to what is going on now	33% ☐	(49-5)
f.	We're not really behind; the government is just keeping quiet	12% ☐	(49-6)
g.	We are told just about enough right now	35% ☐	(49-7)
h.	We need more publicity for propaganda purposes	31% ☐	(49-8)

16. If the United States could spend several million dollars in the next month or two to achieve a spectacular propaganda victory in space research, but in reality accomplish little concrete progress, would you be in favor of such a move?

Yes	34% ☐	(50-1)
No	66% ☐	(50-2)

Why? .....

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17. It has been suggested that military superiority does not necessarily require that we explore outer space. Suppose, for the moment, that we could guarantee ourselves military advantage or status quo with missiles without going to pure space research. Under these circumstances, how would you feel about purely scientific space research? To tell us, please indicate which item in each of the following pairs you consider more important:

		1			2	
a.	Space research	42% ☐	OR	New hospitals	58% ☐	(51)
b.	Space research	16% ☐	OR	Better education for our citizens	84% ☐	(52)
c.	Space research	59% ☐	OR	Foreign economic aid	41% ☐	(53)
d.	Space research	61% ☐	OR	Power plants and dams	39% ☐	(54)
e.	Space research	14% ☐	OR	Medical research	86% ☐	(55)
f.	Space research	97% ☐	OR	Shorter working hours	3% ☐	(56)
g.	Space research	96% ☐	OR	More leisure and consumer goods	4% ☐	(57)
h.	Space research	73% ☐	OR	Cutting taxes	27% ☐	(58)

18. Some suggest that unless private enterprise is on its toes, the government will pre-empt business in the development of outer space. As a consequence, they suggest that private business begin to take a leading role in space development. The question, then, is whether all these enormous undertakings are to be for now and all time a government preserve.

What do you think? .....

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E. Sample Bias Analysis

Because our initial analysis of the data indicated that the opinions expressed were very favorable to the space program, we immediately took special steps to investigate the possibility of some serious sample bias. For example, are executives who read HBR more in favor of the space program?

To find out, we surveyed a sample of executives drawn at random from the Poor's Register of Directors and Executives. All HBR subscribers were screened out. Of 200 non-subscribers, 18.5% returned questionnaires. One can consider this a good rate of return from a group having no immediate connection with the survey (e.g., not being subscribers to the magazine conducting the survey), and some indication of the interest that the topic in general has for executives.

Generally, their replies support the findings obtained from the main sample.[2] The broad dimensions of their opinions seem to coincide for a large majority of the questions in the survey. In addition, the direction of these opinions appears to be remarkably similar.

However, there is another, very possible bias. Are executives who favor the space program the only ones who returned questionnaires? This is by no means a self-evident notion, since those who are "agin things" are often the ones who feel the urge to express their feelings. To check this, we made a telephone survey of 100 HBR subscribers randomly selected in the Chicago and Boston areas, and pushed the calls through until we had answers. These executives showed themselves to be no less favorable

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[2] We come to this conclusion by comparing the replies of the Poor's sample with both the replies of the HBR sample as a whole and with comparable sub-groups in the HBR sample. In effect, this was a double-check, for the HBR sample, as will be discussed later, shows a good deal of homogeneity of opinion across the demographic and business characteristics of the sample. This homogeneity is true of the Poor's sample as well, though the smallness of the sample makes such a conclusion somewhat tenuous. The opinions of the Poor's sample do, however, correspond quite well with the general trend and dimension of opinions for those executives for example in the HBR sample holding similar management positions, or in companies of comparable size, as well as to the sample as a whole. In addition, the executives in the Poor's sample are no more involved in the space program than those in the HBR sample.

to or involved in the space program than were the original mail questionnaire respondents.[3] From this point on, the data were taken at face value.

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[3] A discussion of the telephone interviews will be found in Appendix B, along with a copy of the interview schedule itself. The necessity of phrasing some questions differently for the purposes of the telephone interview apparently produced some differences in the responses obtained. However, the direction of these differences was neither consistently for nor against support of the space program.

Part II: FINDINGS

A. Optimism Relatively Unlimited: "Anything could happen!"

Space is a complicated business. It is a matter not only of science and technology but also of economics -- and of politics, both domestic and international. Even men associated with the space program itself vary in their commitment to the program, and in their judgment as to what should be done and in what order.

For example, in some Washington offices it is muttered that certain politicians have no interest in the space program per se but are exploiting it as a "hot" political issue. While to the public the desirability of putting a man in space seems self-evident, some scientists would give this objective a lesser priority than it now has. Prof. Van Allen, discoverer of the Van Allen belt, has been quoted as saying that in the immediate future we would do better to concentrate our resources on instrumented satellites rather than attempt to put a man in space.[4] Others worry that we are too much concerned with competition with the Soviet Union and not enough with building a fundamentally sound research program. Those who raise such questions are often vitally concerned with the success of the space program, but tend (on occasion) to express the cynical feeling that it is being converted into a circus.[5]

On the other hand, there is a set of very optimistic beliefs, frequently held by the very same men: the space program will have a healthy,

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[4] Time, June 6, 1960, p. 63.

[5] For further discussion and presentation of such material, see House Report No. 2091, The Practical Values of Space Exploration (Washington, Government Printing Office, 1960).

marked effect on our economy; it will bring about a vast increase in scientific knowledge; it is the new arena of adventure for man, and so on.

But, as has been demonstrated time after time, Washington is not the United States, and particularly not the United States business and professional community. With this in mind, we asked executives to comment on a representative group of optimistic and cynical statements about space research. Their replies are summarized in Exhibit II.

The general attitude of executives toward space research is that "anything is possible." The impact of technological advances in the past several decades has led them to be extremely reluctant to say that anything is impossible.

The following replies in personal interviews succinctly characterize the attitudes of our respondents:

> "I suppose something like this sounds farfetched, but who is to say 'no'? Put yourself back 25 years, and think of how many of the developments we could not have anticipated. I would hate to say that anything is impossible."
>
> -- President, small company involved in the construction of radar facilities.

> "I would not totally deny that an anti-gravity device is even possible. Why not? Physicists now talk about anti-matter particles. It is difficult even to comprehend what anti-matter might mean. Unfortunately, or fortunately, as the case may be, common sense is no longer a guide. I was very impressed by a remark of the famous physicist Edward Teller to the effect that common sense would tell us some of the implications of Einstein's Theory of Relativity are sheer nonsense. Nevertheless, Einstein is right; common sense is wrong."
>
> -- Vice President and Treasurer, large firm manufacturing industrial chemical products.

The following optimistic statements are agreed to in whole or in part by more than 75% of our respondents:

> "The horizons that will be opened to men by the exploration of outer space are not recognized by most people today." (72% agree, 20% partially agree)

> "I'd hate to put any limit on what will result from the space programs. After all, anything could happen. Look what has happened in the past." (64% agree, 25% partially agree)

> "Mankind wants to go into outer space because it is there . . . we are drawn by our desire to know and conquer anew." (62% agree, 27% partially agree)

> "Outer space is the new frontier. Research and exploration will have profound and revolutionary effects on our economic growth." (62% agree, 23% partially agree)

EXHIBIT II

Executives Are Optimistic About the Space Programs

The following statements have been made from time to time about various aspects of the space program. How do you feel about these statements? Please circle the number which best corresponds to your feeling about each statement. (Please do not circle more than one number per statement.)

Possible Statements About the Space Program	Per Cent of All Respondents Giving This Opinion for Each Statement				
	Agree	Partially Agree	Neutral	Partially Disagree	Disagree
"I'd hate to put any limit on what will result from the space programs. After all, anything could happen. Look what has happened in the past."	64%	25%	4%	4%	4%
"The politicians in Washington are not really interested in scientific advancement from research into outer space, but only in using the issue for political profit."	5	30	7	27	32
"Why bother putting men in space? We can do all we want up there with robot machines."	3	6	5	12	74
"Outer space is the new frontier. Research and exploration will have profound and revolutionary effects on our economic growth."	62	23	6	6	3
"What we need is one space program, with one director."	39	18	9	12	22
"The country that controls outer space controls the destiny of the earth."	31	36	10	11	12
"Mankind wants to go into outer space because it is there . . . we are drawn by our desire to know and conquer anew."	62	27	5	4	2
"The horizons that will be opened to man by the exploration of outer space are not recognized by most people today."	72	20	4	3	2
"This whole idea of competing with Russia in a race for space is nonsense."	6	13	3	20	58

The following critical statements are rejected by a minimum of 50% of our respondents:

> "Why bother putting men in space? We can do all we want up there with robot machines." (74% disagree, 12% partially disagree)
>
> "This whole idea of competing with Russia in a race for space is nonsense." (58% disagree, 20% partially disagree)
>
> "The politicians in Washington are not really interested in scientific advancement from research in outer space, but only in using the issue for political profit." (32% disagree, 27% partially disagree)

Since "politicians" are usually a favorite target of criticism by businessmen, it is a little surprising that the last of these statements has been rejected by a majority of the sample: only 5% agree in toto, 30% in part,and 7% are neutral.

The statement, "What we need is one space program, with one director," was included in order to obtain executives' opinions on this long-standing element in the space program debate; 52% of the respondents agree with the statement in whole or in part.

Unfortunately, no comparable opinion information is available from other influential groups. Surveys of the general public reveal a woefully low level of involvement, and any comparison to HBR subscribers would be irrelevant. It is our impression, however, that skeptical attitudes are more widely distributed among Washington officialdom and the engineering or scientific community directly concerned with the space program than among executives responding in this survey.[6] Perhaps this is due to the fact that the latter groups are better informed as to what is going on, or perhaps due to the fact that they have seen some of their own programs suffer at the expense of ones which they regard less favorably.

Certainly, however, supporters of the space program can take heart from the seemingly extremely positive opinions executives reveal in this study. At the very least, their opinions would suggest that there is no large or hard core of resistance to space research on the part of the business

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[6]This impression, however, may be erroneous. Several subgroups in our sample were isolated for analysis on the basis of their involvement in the space program. Three criteria were invoked: company involvement in "space"' personal time devoted to space business; and correct identification of space projects. No one of these three subgroups gave answers conspicuously deviant from the sample as a whole.

community. On the other hand, it would be a mistake at this point to overestimate the "hardness" of their support for the programs. The tenacity of their support is certainly a good subject for future research. We will explore this problem later in our report.

B. Expected Payoffs

What do executives think the space program will produce? To find out, we presented executives with a list of tangible payoffs which have been anticipated from the space program, and asked them to estimate the likelihood that each payoff has of actually coming about. Their responses can be found in Exhibit III.

These payoffs may be divided into three categories: research and development payoffs which will have benefits on this planet; payoffs from the earth-circling satellites; and payoffs which would be dependent on man traveling to outer space. As for anti-gravity devices, they have been suggested in the most speculative of discussions of research and development payoff from the space program. We included them in the list to see how far along the speculative road executives would run. Less than half (actually 32%) think such devices are very likely or almost certain, and 42% think them "possible." While this is a very different picture from the overwhelming probability attached to the other R & D payoffs, it still constitutes considerable support for a very uncertain development. It is perhaps equally striking, however, that only 6% of the sample are willing to say flatly that this will never happen.

American businessmen have become accustomed to the fact that military research invariably produces a great deal of technical and scientific "peeloff." It is no surprise, then, that they anticipate technical and scientific payoffs from the space program -- whether it be a military space program or a peaceful civilian effort. The following R & D payoffs which will have benefits on this planet are considered by executives to be "very likely" or "almost certain" (combined): new medical and biological knowledge (86%); robot devices (82%); new mathematics and physics (81%); compact nuclear power plants (79%); and new fabricating materials (71%).

Anti-gravity devices aside, many of these possible payoffs are pretty much within the capabilities of our present technology and science. Executives seem to recognize this, and express great confidence in the future

EXHIBIT III

Executives Believe the Space Program Will Pay Off

There has been a great deal of speculation about the scientific and economic achievements which might result from the space programs. Some would be direct results of the space programs; others would be by-products of space research and development. Which of these promises do you think will eventually pay off? Please circle below the number which best represents your estimate of the probability that each item has of happening. (Please circle only one number per item.)

	Per Cent of All Executives Giving This Opinion for Each Payoff					
Possible Payoffs	Almost Certain to Happen	Very Likely	Possible	Very Unlikely	Never Will Happen	Belief Index*
Revolutionary improvements in communications (TV, Radio, Telephone, etc.)	69%	25%	5%	1%	0%	4.62
New medical and biological knowledge	56	30	12	1	1	4.39
Accurate long-range weather forecasting	53	34	11	1	1	4.37
Robot devices	54	28	15	2	1	4.32
New mathematics and physics	52	29	16	3	1	4.31
Compact nuclear power plants	47	32	18	3	1	4.24
New fabricating materials	46	25	24	9	0	4.20
Antigravity devices	11	21	42	21	6	3.13
Colonizing other planets	3	5	37	44	11	2.45
Mining on other planets	4	10	44	36	6	2.34

*Weighted by degree of probable payoff, with "Almost Certain to Happen" = 5, "Never Will Happen" = 1.

products of space research. As General James M. Gavin, President of Arthur D. Little, Inc., put it when interviewed:

"I think that our missile and space technology is one of the most significant economic entities of our time. There are numerous examples that can be cited of the application of this technology to industrial uses. The obvious ones, for example, have to do with the development of materials for use under extreme temperature ranges . . . . The solutions to the problems of data handling have necessitated the invention of many new types of measuring and telemetering devices.

"One of the most interesting direct applications of missile technology is that apparently being experimented with by the Soviets for use in drilling. To our surprise, not very long ago we learned that the Soviets were making extensive use of a turbo-drill to obtain much greater depth in oil well drilling than we had considered practicable. Soviet publications, however, tell us that they now have gone beyond the turbo-drill to a flame drill. . . . This is a direct application of a jet flame to commercial usage. I should add that American industry also has been experimenting with a flame drill for several years."

The impact of the space programs on our economy has been effectively outlined by Ralph J. Cordiner, Chairman of the Board of General Electric Co.:

"The effort to explore space, and to keep from falling behind other nations in this area, will accelerate the progress of many present-day industrial technologies. The discoveries made in the race for space will have many applications outside the space program. At the same time we must remember that the space technologies are not being made out of whole cloth; they are for the most part extensions of industrial technologies developed for commercial and military purposes.

"Electronics, for example, is a technology that has been under constant development and use for four or five decades; but the needs of the space program have put extra pressure on the drive for miniaturization. This will be valuable in such important commercial fields as communications, data processing, automation, and even home appliances."

Mr. Cordiner goes beyond direct technical payoff, however, and asserts that the space program has stimulated the growth of small business:

> "I only ask that you leaf through the advertisements in the technical magazines to see how many thousands of new businesses have sprung up to handle the requirements of modern technology."

Executives in our survey were asked what sorts of payoffs they expect in their own industries. As expected, the majority feel these payoffs will be by-products of the space program rather than direct results. (The proportions were 78% to 30% -- some executives cite both payoffs.) Most often cited are new fabricating materials, ceramics, and electronic units or components. At the same time, a good number say that they cannot say exactly what the application will be, but expect that "something will happen" -- even if it's just more sales of current products.

In giving a high probability to practical R & D payoffs from the space programs, our respondents parallel the best judgment of the experts. Whether they do this from specific knowledge, or from generalized faith in the space program and the capacity of <u>any</u> large technical effort to generate payoffs, we have no way of knowing. The basis for their predictions would make a worthwhile topic for future research.

As for payoffs from earth satellites, two practical programs for earth satellite systems have been widely publicized. Though some informed persons see considerable difficulties, the probability of practical results is high. Our respondents agree. Accurate long-range weather forecasting is seen as almost certain by 53% and as very likely by an additional 34%. Only 1% say it will never happen. Similarly, revolutionary improvements in communications are anticipated by 69% as almost certain, and by 25% as very likely. <u>No one</u> said this would never happen.

Greatest reservations are expressed with respect to the practical results of man's travels to other planets. Only 5% think it is almost certain or very likely that we would mine other planets, and a mere 8% foresee the colonization of other planets. However, it is again remarkable that very, very few are willing to take the firm position that these things will <u>never</u> happen -- only 6% in the case of mining, and 11% in the case of colonization. Such possibilities have been discussed by serious and informed men, though as highly speculative. Such discussions, however, have not received wide-spread publicity. Our respondents seem to share these

attitudes. The opinion of executives, therefore, seems to be a combination of skepticism about such activities and a general reluctance to say that anything is "impossible."

The greater skepticism of executives for such payoffs as colonization and mining of other planets should occasion less surprise than an outright refusal to reject such "far out" projects as impossible. The plausible earth satellite programs for weather prediction and improved communications are seen as very likely by a strong majority. However, greatest credence is placed where past experience has shown that some form of benefit is almost inevitable: R & D by-products. Finally, 70% of the respondents say that they expect some eventual application of space-generated knowledge in their own companies.[7] But 78% think such applications will be by-products of space efforts, and only 30% expect them to be direct results such as improved weather forecasting.

This attitude of executives toward R & D by-products deserves more than passing comments. Their opinions on the question of investment in the space program and other government-financed technological programs cause one to suspect that the business community has smuggled some very liberal economic doctrine in through the back door. A large government expenditure on basic research would probably be frowned on as "improper" and "wasteful." Yet some of the very men who might take that position, speak of research by-products of the space program in much the same way in which basic research is often defended: "You never know what you will find."

It would be a worthwhile though difficult research job to discover to what extent, exactly, businessmen favor programs such as space research because they permit the government to play a role in technological innovation in the American economy that might be considered ideologically improper

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[7] This 70% consists of the following spread of the time that will elapse before some knowledge gained from the space program could be applied to the industrial or consumer products of their company:

20% say "Already being applied."
1% say "Within the next six months."
2% say "6 months to 1 year."
8% say "1-2 years away."
15% say "3-5 years away."
10% say "6-10 years away."
15% say "More than 10 years away."

under other circumstances. Though General Gavin has been very articulate in outlining the R & D benefits of space research to the civilian economy, he also recognizes that "Some people carry this too far. The benefits they cite are often not proportionate to the effort. It's like using a howitzer to swat a fly. We must maintain some sense of proportion."

C. Why Support a Space Program?

We isolated five general reasons for supporting the space program: military and political considerations; prospect of economic payoff; a general sense of adventure; desire for increased knowledge; and the wish to win the race for prestige with the Soviet Union. Granted, none of these reasons is cleanly separable from any of the others. That is, winning the prestige race with the Soviet Union is in part a military and political objective. In addition, the reasons themselves are not entirely separable from the definition which the individual gives to the term "space program." For some people, the program obviously includes all missilery and rocketry, and such persons are more likely to think of military considerations.

Granting the complexity of these five "objectives" of the space program, we nevertheless presented them to our respondents and asked that they rank them from 1 to 5 in order of priority. The frequency with which the various objectives are assigned each rank is presented in Exhibit IV, along with the average rank accorded each objective. Executives rank the objectives in the following order of priority: 1. pure science; 2. control of outer space for military and political reasons; 3. tangible economic payoffs on earth; 4. adventure; and 5. prestige vis-a-vis the Soviet Union.

"Pure science" easily takes first place in the listing, receiving an average rank of 1.9. "Control of outer space" is second with an average rank of 2.6. It might be argued that the "prestige race with the Soviet Union" is part of the military and political picture. However, even if we were to combine both the first and second place votes for the "prestige race" with those for "control of outer space," the combined vote for these two objectives would not equal the combined first and second place votes for "pure science."

There are certain negative conclusions which can be drawn from these ratings. Certainly, only a few of our respondents think the major objective of the space program should be pursuit of adventure, and even fewer give priority to the prestige race with the Soviet Union. Also, since "pure

science" is rated above military and political objectives, one can at least infer that the space program is not seen as an exclusively military enterprise.

Attitudes toward the prestige race with the USSR are particularly interesting. As noted earlier, 78% of all respondents reject the statement that "competing with Russia in a race for space is nonsense." But there are several aspects of the "race with Russia." The question here is prestige, and of salience relative to other objectives.

Most respondents (77%) think that we do not get the propaganda advantage out of research that the Russians do. However, they do not think the space program should be reoriented for propaganda purposes. Two thirds of the respondents reject the notion of spending several million dollars for a rapid spectacular propaganda victory. It would seem that most respondents would support the notion that we should get more propaganda mileage out of our space program, but that this propaganda must be based on a fundamentally sound program. Certain respondents express the fear that a predominantly propagandist effort would be seen through and would backfire. Here are some typical comments:

> "We are not using our present space accomplishments for as good propaganda purposes as we might. Rather than spend more on space research for a propaganda victory, we should propagandize to a greater extent some of our present space work." -- Research Supervisor, industrial goods manufacturing.
>
> "Concrete progress, properly advertised in the right places will do more than all the wasted costly propaganda we put out. More truth is needed, and less baloney." -- General Manager, small retailing firm.
>
> "Let's just get the job done -- they will know about it. The resources we have should be devoted to making progress; propaganda victories are short-lived and do not fool anyone. Who do we think we'd be kidding?" -- President, large consumer goods firm.
>
> "The political advantage gained at this period of low prestige would be worth the money. The small price of several million is like an over-all public relations program for a large business. It is intangible, yet beneficial." -- Assistant to the President, defense industry company.

EXHIBIT IV

Executives Rate Pure Science as Prime Objective of Space Research

A number of objectives have been suggested for the space program. Which objective do you consider most important? Which least important? Please rank the objectives listed below in order of your preferance. If the objective is most important, write a "1" in the space after it; if next most important, write in a "2," etc.

	Per Cent of All Respondents Giving This Rank for Each Objective					
	Ranking (1 to 5)					Average
Possible Objectives	1	2	3	4	5	Rank
1. Pure science research and gaining of knowledge	47%	26%	16%	9%	2%	1.9
2. Control of outer space for military and political reasons	31	24	18	20	9	2.6
3. Tangible economic payoff and research results for everyday life on earth	14	23	27	20	16	3.0
4. Meeting the challenge and adventure of new horizons	8	17	15	25	35	3.6
5. Winning prestige race with Soviet Union	3	11	24	25	37	3.9

A few years ago the picture might have been different. Our respondents might have been clamoring for a "prestige stunt" in the first few months after Sputnik I. But, by mid-1960 their main concern seems to be that we get credit for what we have done, that we reap an appropriate propaganda advantage from an essentially sound program. To repeat - executives are overwhelmingly convinced that the Soviets are better propagandists.

It is harder, however, to understand the meaning of the objectives to which our respondents attach high priority -- pure science and control of space for military and political reasons. A total of 78% of the respondents cast their vote for one or the other of these two objectives. It might therefore look, at first glance, as though our respondents are composed largely of men who disagree over "scientific" versus "military" uses of space. However, rather than representing conflicting orientations, these two answers actually were a popular 1-2 combination. That is to say, the respondent who put "science" in first place was very likely to vote for "military and political reasons" in second place, and vice versa.

We made a special effort to get at the meaning of these two dominant "objectives." It was reasoned that if they mean what they are purported to mean, then the sponsors of each objective should exhibit contrasting attitudes on various other items. In order to get as pure a "scientific" group as we could, we took all those respondents rating pure science in first place, and then excluded from the group those respondents giving second place to military and political considerations. Similarly, to get a purely "military and political" group, we excluded from that group all respondents rating pure science second. We then looked at the attitudes of these two "groups" on some key questions. These questions, which will be dealt with briefly here, are treated more fully in following sections.

For example, we asked respondents to estimate present expenditures for both the civilian and military space programs, and then to estimate what sums that they thought should be spent on each of these programs. It would be reasonable to expect that a man who favors military objectives would also be more likely to favor increase of funds to the military space program, whereas the proponent of "pure science" would be inclined toward the civilian space program.[8]

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[8]This reasoning is reinforced by the fact that 96% of all respondents think that NASA would be better in achieving scientific objectives, and 84% think the military would be better at achieving control of outer space for military and political reasons.

Actually, the two groups are virtually identical in their estimation of the present expenditure of funds for both programs, and in what they think should be spent on both the civilian and the military programs. Both groups are somewhat inclined to raise the civilian budget, and to hold the military budget constant. In sum, there are no systematic differences between the groups that we are able to discover.

As for another example, respondents were asked about a number of objectives which might reasonably involve either or both the civilian and military space programs. They were asked which program was more likely to achieve a given objective. Presumably, if there were any sentimental leaning toward one program or the other, there would be a disposition to say that one's preferred program would be first to accomplish such an objective as, for example, placing a man on the moon. But there are no differences in opinion between our two groups. Both agree in virtually identical proportions that the civilian program would be first with weather forecasting, a compact nuclear power plant, and travel to the stars; and that the military would be first with manned space stations, and in landing a man on the moon.

At one point we tried to get our respondents to think of the space program divorced from military considerations. We asked them to accept the assumption that military superiority could be achieved without exploration of outer space. Under such circumstances we requested that they rate their relative preference for continued space research over a series of other social objectives. Now, since some of our respondents indicate that the major objective of the space program should be control of outer space for military and political purposes, they should show diminished enthusiasm for the space program if this consideration were ruled out. (With these respondents in particular, it is quite reasonable to expect them to respond to such a hypothetical situation.) On the contrary, both groups gave nearly identical patterns of response.

In brief, it is difficult to know just what executives responding to this survey mean by their choice of preferred objectives. Because we had various supporting data, it was reasonably possible to assess the meaning of the low priority given to the prestige race with the USSR. For the two objectives with the highest ranks -- "pure science" and "control of outer space" -- the supporting data fail to show any clear differentiation of meaning. In a sense, there is always a reason why a man selects any answer

from the range of possible answers. However, in the absence of further information, we have to assume that these answers have become conventional "buzz words." Some further research is needed here.

D. Civilian vs. Military

Our national space research splits into two programs: a military program; and a civilian program devoted to peaceful use of space. The civilian National Aeronautics and Space Program (NASA), would gain a good deal of advantage if the two programs were kept distinct in the public mind. Many NASA projects depend on international cooperation which would not be forthcoming if they were believed to involve military objectives. Furthermore, it is hoped that the NASA program will contribute to our international image as a peaceful nation, and become an instrument for furthering international cooperation.

Yet it is not always easy to distinguish the two programs. The U-2 incident, with NASA being used as a cover for spy flights, scarcely contributed to the notion that the NASA program is peaceful and civilian. It is a matter of some frustration to NASA supporters that the six astronauts who are training for the first manned flights into space are military men, and that this may lead the public to believe that Project Mercury is a military undertaking. Further confusion is added by the fact that the boosters used in launching civilian vehicles were developed by the military, and, to top things off, the Navy launched a navigational satellite later described as excellent for both guiding missile-carrying submarines and civilian uses. If Mr. Average Citizen is confused, he has reason to be.

We were anxious to find out if and how executives distinguish between the civilian and military programs. For this purpose we asked three questions: (1) which of the programs would best achieve the broad objectives discussed previously; (2) which would be first to achieve certain specific objectives; and (3) which program is in charge of a number of specific projects. The answers to these questions are given in Exhibits V, VI, and VII. As a matter of fact, these data tell us which objectives are seen as civilian and which as military. For example, it is not self-evident that landing on the moon and manned space stations would be seen as military objectives.

EXHIBIT V

NASA Considered Better for Pure Science Research

Which program, NASA or Military, will best achieve space research objectives? Check the appropriate box to indicate which program - NASA or Military - will best achieve each objective.

	Per Cent of All Respondents Indicating This Program Will Best Achieve Each Objective	
Possible Objectives	NASA Will Best Achieve	Military Will Best Achieve
Pure science research and gaining of knowledge	96%	4%
Control of outer space for military and political reasons	16	84
Tangible economic payoff and research results for everyday life on earth	94	6
Meeting the challenge and adventure of new horizons	90	10
Winning prestige race with Soviet Union	40	60

EXHIBIT VI

Military Will Be First With Man in Space

Which program - NASA or Military - do you think will be first to achieve results in each of the areas listed below? (Please check only one program for each area.)

Potential Result	Per Cent of All Respondents Indicating This Program Will Achieve Each Result First: NASA Will Achieve First	Military Will Achieve First
Long-range weather predicting system	85%	15%
Manned space stations	32	68
Compact nuclear power plant	66	34
Man landing on the moon	39	61
Travel to other stars	60	40

EXHIBIT VII

Who Is in Charge of What?

Listed below are a number of different projects now being sponsored by the Federal government. Which program - NASA or Military - is in charge of each project? (If you don't know, make your best guess. Please check only one program for each project.)

	Per Cent of All Respondents Indicating This Program in Charge of Each Project	
Project	NASA in Charge (Civilian)	Military in Charge
Mercury	54%*	46%
Nike	3	97
Weather satellites	86	14
Pioneer	51	49
Icarus (non-existent)	65	35
Explorer	47**	53**
Tiros	55	45
Discoverer	43	57
Vanguard	22**	78**

*Correct answer underlined.

**The correct answers for both of these projects are unclear. early Explorers were launched by the Von Braun group while still attached to the Army, but are now under NASA; Vanguard was originated and operated by the Office of Naval Research for the civilian International Geophysical Year program.

It is our belief that executives draw a distinction between civilian and military objectives, but not necessarily between the existing programs. For example, both the specific "compact nuclear power plant" and the general "economic payoff and research results for everyday life on earth," are very strongly associated with NASA. In view of past experience with the civilian by-products of military research, this particular preference for the civilian program may be unrealistic. However, it probably means no more than that they do succeed in associating civilian objectives with the civilian programs, and military objectives with the military program; that is the conservative interpretation of the data. With this in mind, one cannot conclude (as we shall see later) that these opinions in any way damn the military roundly. Rather, they may merely reflect traditional civilian distaste for and mistrust of military undertakings.

E. Level of Information

While respondents appear to draw a clear distinction between civilian and military objectives, and may be reasonably amenable to the notion of a separate program to serve each set of objectives, it would be a mistake, as we shall see, to assume that the distinctions made reflect detailed knowledge of the actual differences between the two programs.

We put our sample of executives to a tough test when we asked them to identify the various projects listed in Exhibit VII. The list consists of eight legitimate projects, and one "ringer," Icarus, which is nonexistent. The correct identification is underlined in the appropriate column. Project Explorer has two underlines, because the first of the Explorers was launched by the Von Braun team while it was still attached to the army. Vanguard also has dual status because it was originated and operated by the Office of Naval Research for the civilian International Geophysical Year Program.

If for these reasons we exclude the Explorer, Vanguard, and Icarus, there are six projects which our respondents could have identified correctly as being either civilian or military. We see that in only two of the six instances as many as 60% of the respondents identify a project correctly. The two clear correct identifications are: Nike (97%), an old, long-publicized antiaircraft weapon and not part of the space program; and weather satellites (86%), the very name of which suggests a civilian undertaking.

Interestingly, Tiros, which is the code name for the weather satellite, was correctly identified by only 55% of the respondents.

This test was extreme. Even the small minority (17%) of respondents who have personally spent time working in space-related business in the past month scarcely did any better than other executives in identifying these projects. But don't feel badly, even members of our own staff, who know which project is which, keep getting confused. Our rationale for including this list was to rule out the admittedly remote possibility that any sizable group in our sample consisted of "space buffs" who did, in fact, follow space news sufficiently closely to identify the various code-named projects.

A small group of such space buffs was, in fact, isolated. It consisted of 131 men who gave correct identifications to all four of the following: Mercury, Pioneer, Tiros,[9] and Discoverer. These four projects were selected as a criterion because the correct answer is relatively definite, because their names do not give the answer away, and because they are truly space projects.

The space buff is, as expected, more likely to come from a company that is involved in space business (51%, compared to 27% for the sample as a whole), and more likely to have devoted some personal time to space business in the preceding month (30%, compared to 17% for the sample as a whole). Thus, these 131 men -- out of the more than 1,700 respondents tabulated -- do seem to be especially knowledgeable about, and involved in, the space program. But even so, their attitudes toward the space program are virtually the same as the attitudes of other executives.

Though executives draw a clear distinction between civilian and military objectives, it is still an uncertain matter as to how much this distinction of objectives is based on a clear understanding of the actual activities of the two programs. Further research is needed to clear this muddle up.[10]

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[9]We have already pointed to the confusion that arises from the fact that Mercury is a NASA project, but the astronauts are all military men. Similarly, Tiros, the weather satellite, is a NASA project which enjoys participation by the Weather Bureau and by all three military services.

[10]The reader may remember our earlier reluctance to attach any clear meaning to the objectives which our respondents propose for the space program. We stick with our earlier assertion that we do not know what was going on in their minds when they selected the priority of these objectives. We are contending here, however, only that they are able to draw a distinction between a set of civilian and military objectives, and that they think very similarly about these two sets of objectives regardless of their own preference.

F. How Are We Doing?

Perhaps a more revealing test of what executives feel is their estimate of the progress of our national space research. When asked how they think the space program can best be accelerated, 5% of executives say we do not need to step up the program, and another 4% say we are already doing our best. At most, then, 10% appear to feel strongly that the space program does not need stepping up.

The wording of the question is extremely important here. We asked, "How do you think we can best step up the space program?" Though we offered categories indicating that the United States does not need to step up the program, the wording of the question rules out any except the most opinionated from choosing such answers.

Those interviewed by telephone do not seem less concerned with the space program than those responding by mail. However, the wording of the question was changed for the telephone survey, and we asked, "Would you say that we need to step up our space program, or that we are doing all right as is?" This new wording was biased in favor of "doing all right," since the status quo always seems to get some unearned preference. The answers of the telephone respondents: 58% in favor of stepping up the program; and 42% who think we are doing all right.

A comparison of our progress against that of Russia is viewed somewhat less pessimistically by executives: 35% think that the Russians are ahead; 22% think we are ahead; and 43% think we are about up with the Russians. In addition, there seems to be little doubt in the minds of executives that we have adequate resources to meet both our space program plans and the other needs of the country. Only 11% feel that we do not have enough manpower, money, or other economic resources.

However, say executives, the solution to our space research problems is not predominantly in allocating more money to the programs, although, as we shall see, they are not reluctant to granting more money for space research. What is of equal importance, say 70% of our respondents, is to make better use of present funds. Executives suggest that we need to make more efficient use of our research dollar, that we need a stronger sense of national purpose and effort, and that we need strong political leadership.

There is one problem with respect to our capacities that does cause

great concern: the ability of the Soviet Union to concentrate its efforts on priority objectives. As one executive interviewed expressed it, "Since they can aim their efforts at specific objectives, they can be formidable. We had better clarify our own political objectives and learn to concentrate our efforts." To do this, most executives admit, would require a strong government role in the space program. It seems reasonable to predict that the space program will continue to pose difficult problems of government-business relationships, especially in light of business attitudes which find government participation distasteful.

The general picture, then, is a consensus which holds that we are not doing as well as we could, but that the difficulty lies mainly neither with the resources we have nor the resources we have allocated to the space program, but rather with inefficient and ineffective use of resources. Perhaps there is a general overriding belief that the government never uses resources as efficiently as does private industry, though this belief does not prevent executives from suggesting that more money be spent on space research.

G. How Much?

If military superiority did not require exploration of outer space, the question was asked, which would you consider more important, space research or cutting taxes? To our surprise, 73% of our respondents choose space research. They also prefer space research to more leisure and consumer goods (96%), shorter working hours (97%), power plants and dams (61%), and foreign economic aid (59%); but not to new hospitals (42%), better education for our citizens (16%), or medical research (14%).[11] Clearly, space research is given a high economic priority even if military considerations are ruled out. Only health and education take precedence, and -- as many men indicate in written comments -- for some education is itself viewed as a precondition to space research.

With trepidation we asked our respondents to estimate (a) the present expenditure on civilian and military programs, (b) the amount they thought should be spent on each of these programs, and (c) the amount they expected would be spent five years from now. We say we did this with trepidation because of the uncertainty and frustration we ourselves felt in trying to

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[11] Some reasons for this variation are discussed in later sections of this report.

make such estimates. But our respondents were remarkably cooperative, and their answers to these questions are recorded in Exhibit VIII.

What is the correct answer? This is difficult to say. It is somewhat less difficult for NASA than for the military, since the over-all rate of spending for NASA and/or the NASA budget is a good set of figures for the civilian space program. At the time of the survey NASA was spending at a rate somewhat over $500 million a year. Its budget for the fiscal year 1961 had been announced and fairly well publicized at $900 million. Therefore, our respondents' modal estimate (given by 33%) is a reasonable figure. It will be noted, however, that the estimates are widely dispersed.

The military figure is more difficult to arrive at because it is hard to decide just what should be included. (See Exhibit IX.) A very narrow definition excluding ballistic missiles might yield a figure around $500,000. The addition of all ballistic missiles, on the other hand, would raise the figure to over $4.5 billion. But this figure includes IRBMs, which account for about $1 billion. Still another figure is the total military space/missile budget for the fiscal year 1961. This figure runs to about $7 billion, but includes such items as the construction of missile bases. On the whole, the most frequent response, $5 billion, is probably more reasonable than the next figure lower of $1 billion, and is certainly better than the higher figure of $10 billion. Again, the answers are widely dispersed.

We did not, however, expect accurate answers. What we were interested in was whether executives think we should be spending more or less for either of the programs, and whether or not they expect expenditures to increase over the next five years. If we compare Column 3 of Exhibit VIII with Column 1 we see that our respondents think that the civilian program should be getting more than it is. It appears that they are not equally inclined to raise the military space budget. Both budgets are expected to increase by 1965, but the civilian budget is expected to increase more rapidly than the military one.

Sometimes data assembled in this form can create false impressions. It is difficult to make a precise comparison of two columns containing ten categories each. On the other hand, a summary statistic such as an arithmetic average may be unduly affected by a few extreme cases. With this in mind, we reapproached the data with this explicit purpose: taking each person individually, regardless of his present budget estimates, what does he think should be done with the present budget? The results were an astounding

EXHIBIT VIII

Executives Estimate Space Program Spending

Although we cannot expect you to know exactly, how much money per year do you think the Federal government is now spending on NASA or Military space program projects? Please try to make the best guess you can. In addition, how much do you think should be spent? How much do you think will be spent in 1965? Please be certain to answer for both NASA and Military programs. (Please check each section only once for each program, however.)

Amount Spent per Year	Per Cent of All Respondents Giving Each Estimate for This Program					
	Now Spending		Should Spend		Will Spend in 1965	
	NASA	Military	NASA	Military	NASA	Military
Under $100 million	5%	1%	2%	4%	1%	1%
About $100 million	8	3	2	4	2	2
About $500 million	26	12	12	11	6	5
About $ 1 billion	33	25	29	24	21	16
About $ 5 billion	20	35	29	31	32	30
About $ 10 billion	6	12	14	14	17	20
About $ 15 billion	2	6	6	5	8	10
About $ 20 billion	1	3	3	4	6	7
About $ 25 billion	1	2	2	2	2	3
Over $ 25 billion	1	2	3	2	5	7

Note: Figures may add to slightly more than 100% because of upward rounding of percentages less than 2%.

EXHIBIT IX

Military Space and Missile Spending in Fiscal 1960

Space & astronautics:		
Early warning, reconnaissance, and other satellites; Project Dynasoar; space propulsion and power (with AEC); unprogramed space R & D		
	Subtotal	$490 million
Ballistic missiles:		
ICBMs; Atlas Titan, Minuteman		
IRBMs; Polaris (excluding submarines), Thor and Jupiter, Skybolt, Pershing		
Missile and satellite range construction and operation. (Charged to missiles rather than space)		
Ballistic missile administration		
	Subtotal	$3,210 million
Ballistic missile defense:		
Nike Zeus and ARPA studies, BMEWS radars		
	Subtotal	$570 million
	Total estimate	$4,270 million ± 10%

Note: Most amounts given are actual expenditures, although a few of the amounts are fiscal 1960 appropriations, which will not be spent until later years.

Source: Author's estimates based on published reports.

reaffirmation of our previous impression. Of all respondents, 71% think that the NASA budget should be higher than they presently estimate it is, while only 28% think the military budget should be raised. Only 3% think the NASA budget should be lowered, but 23% are in favor of lowering the military budget.

A partisan of the civilian space effort would have difficulty interpreting these data pessimistically. If our sample is unrepresentative, it would be in the direction of being a "select" group; but the very characteristics that would make our sample deviant also make it more influential. Hence, it seems warranted to conclude that the civilian space effort has considerable support in the business and professional community. It remains to be seen if this is fair-weather support.

However, there is certainly no need, even on the part of proponents of the military space program, to don the garb of the pessimist at this moment, for our telephone survey produced responses more favorable to the military. Asked, "Do you think we should be spending more, spending less, or is this (their estimate) about right?", nearly 50% favor increasing <u>both</u> civilian and military spending for space. Part of this response may have resulted from the confusion of the manner in which the question was asked, as well as the difficulty of giving an estimate rather than selecting among estimates (See Appendix B). On the other hand, if differences in question wording can produce such apparent differences in response, there is the clear suggestion that opinions are not well crystallized. This exception aside, however, both sets of data are favorable to the civilian program. At the least, these differences, coupled with the generally favorable attitude to the civilian program revealed in both surveys pose a thorny problem for future research.

H. <u>The Role of Private Industry</u>

Articulate spokesmen for the business community have very seriously raised the question of whether or not the space program threatens our free enterprise system. Mr. Cordiner, has put it this way:

> "I was surprised to learn how many people have simply taken for granted that space is a natural domain of the government.
>
> "As we step up our activities on the space frontier, many companies, universities, and individual citizens will become increasingly dependent on the political whims and necessities of the federal government. And if that drift continues without check, the

United States may find itself becoming the very society that it is struggling against."

General Gavin expresses equal concern:

"I believe that we have an economy with particular advantages of flexibility and capacity for innovation. The Russians may already have overplayed the advantages of a centralized economy. Agencies such as NASA should keep in-house activities to the necessary minimum and bring private business and industry in wherever possible. This, of necessity, is often a matter of judgment. However, I am acquainted with many of the men involved and have reason to place faith in them."

While some 62% of our respondents see or hope for a role for private industry in the space program, many of their comments have a wistful overtone unaccompanied by firm confidence. This wistfulness is especially evident when financing of research is discussed. It would seem that at the present time only a few of the largest and technically most advanced corporations with a long-range perspective are considering privately financed projects for the economic exploitation of space.

Here are some comments that speak for themselves:

"I don't see how business can get in with the heavy investment that is required now. Perhaps later when the technology is perfected, business could enter the picture." -- Owner, business services company.

"Outer space should be a government domain for all time. The program will always have to be controlled by the government. Private enterprise will participate through contracts, subcontracts, or managing government projects." -- Director, large industrial manufacturing firm.

"At this stage, our political and military needs are too urgent and pressing to allow private enterprise control. In addition, the costs are too great and the probability of investment return too remote for private interests to want to take the leading role. At the point when these factors become properly equated, if they ever are, then private enterprise should be allowed to enter the picture. It has virtues that should be exploited." -- President, large wholesaling company.

In the meantime, many executives expect to "live with" government financed space projects. Some 27% of our respondents indicate that they have a space contract or subcontract, or are planning on getting into the space business. To see how deeply our respondents are already involved in space activities, we asked executives to indicate the proportion of their individual time devoted to space or relevant business activities in the previous month. Some 13% have been devoting some time to space activities

(less than a quarter of their time), and 4% more than a quarter of their time; for a total of 17%.[12]

If the space budget grows in the future at the rate that has been projected for it - a several fold increase - the participation of private industry in government financed projects will probably be a considerable factor in American business. But there is little evidence from our survey that any appreciable segment of American business sees a concrete prospect for privately financed commercial enterprises in space.

On the contrary, a goodly number of executives (some 30%) clearly recognize that financing will undoubtedly be in the hands of the government. Their plea is that the government should make use of private industry facilities through research contracts, rather than set up its own facilities to carry out space research. Their view is that the government should be the initiating, supervising, and financing agency, and private industry should compete to carry out these plans and projects most efficiently. Here are some of their comments that point this out:

> "The government must recognize the role that private industry can play in space research. If the government sets up its own facilities, they are going to have to draw the talent away from private industry and introduce numerous employment problems. Some of us are going to get put out of business. Let's hope that they will decide to work through us, as they have in the past."
> -- President, small manufacturing company in automotive parts.

> "Private industry has a great deal of efficiency and competitive spirit to add to government programs. We can't finance them, but we can contract to carry them out." -- Treasurer, clothing manufacturing company.

I. Age and Education

As noted later, few differences in opinion appear among executives responding to this survey according to their position, industry, business function, or any other traditional dimension used in reporting past studies. Similarly, on most questions our respondents are quite alike in their responses regardless of their age or education. On a certain few questions,

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[12] Since it seems reasonable to assume that men involved in the space program would be more than likely to have returned this particular questionnaire, it appears to be a reasonable conclusion that only a very small portion of HBR subscribers are presently deeply concerned with the space program in their business role and thereby severely biased.

however, those who are older, and those who have less education show a trend toward conservatism about the space program that ranges from barely perceptible to moderately strong. On a very few questions, even, there are what might be called marked differences in orientation.

Older executives seem slightly less caught up in the romance and adventure of space exploration. There is a minor exception to this trend in that the older men are slightly more likely to subscribe to the notion that "After all, anything could happen. Look what has happened in the past." This we take to reflect the fact that they themselves have witnessed technological and scientific developments that younger men may be more likely to take for granted.

More typical of their reactions, however, is their greater likelihood to question the need to put a man in space. Only 5% of executives under 40 years of age question this program, while it was called into doubt by 23% of those over 60. Even those over 60 are not predominantly opposed to putting a man in space, but they do show less enthusiasm for the activity.

Older executives are: less likely to think we had lost much prestige to the USSR; more likely to say the government gets less for its research dollar than either private industry or the Russians; and less likely to suggest the allocation of additional funds in order to step up the space programs.

When it comes to the matter of allocating funds to the space program it is difficult to partial out the two factors which seem to be at work. Older men seem <u>both less committed</u> to the space program, <u>and more reluctant</u> to spend money. The two factors interact strongly when respondents are asked to choose between research in outer space (military considerations being ruled out) and cutting taxes. Among men under 40, 24% would cut taxes; but among men over 60 the proportion is 42%.

As indicated above, the space program also gets more support from the more highly educated executive: In general, it is the man with a high school education who is more conservative. The men with college and post graduate education are generally quite similar. For example, 27% of the men with high school education think "competing with Russia in a race for space is nonsense," while this is true of only 19% of the men with a college education, and 17% of those with post graduate education.

Men with less education are: less likely to think we have lost prestige; more likely to see our government program as less efficient than private

industry or the Russian program; and more likely to favor cutting taxes in preference to space research. In other words, in these respects the men of lesser education are like the older men. They are like the older men in another respect as well: while they are more conservative in support of the space program on a number of issues, the difference between them and other respondents is never so great that they present a fundamentally different picture.

These relationships of age and education to attitudes toward the space program may stem from several sources. Our disposition is to place most weight on the general conservatism which has often been observed to be positively correlated with age, and negatively correlated with education. We speak here only of relative conservatism. As we have pointed out more than once in the immediately preceding pages, it would be incorrect to say that any segment of our sample except possibly the small group of 34 "space haters," is generally conservative with respect to the space program.

The most plausible alternate explanation is that the attitudes of our respondents are not really a function of age and education but of position in the firm and of actual relationship to space activities in the course of one's work. The plausibility of this lies in the image of the young, highly educated technical man, working in a technical job in some industry such as electronics.

Unfortunately for this latter hypothesis we find very little relationship between responses to our questions and a man's position in his firm, his functional specialty, the industry he works in, the size of his firm, or -- in fact -- whether or not he personally has devoted any of his time to space related business in the preceding month. There are occasional tantalizing relationships, but none of a sufficient magnitude to challenge seriously the notion that what we are dealing with here predominantly are general attitudes toward things new and progressive, and to some extent toward the federal government. Certainly no alternate explanation would seem adequate to deal with the much stronger preference of the more highly educated men for foreign aid.

J. Space Haters

All of our data seem so favorable to the space program -- even the difference by age and education is between high and very high -- that we thought it would be interesting to locate a group, however small, of men

who feel quite differently. To locate this group we used the budgetary criterion. We sorted out all those men who suggest lowering both the civilian and the military budgets. They amount to only 34 persons, but they are an interesting group. For convenience we have called them "space haters."

Only 5% of the total sample think there is no need to step up the space program, but 31% of our special group think there is no such need.

Across the board they are less sanguine about the space program. They are less likely to subscribe to optimistic statements, more likely to subscribe to pessimistic statements, and give lower probability to possible payoffs. (The following percentages have the space haters in the numerator and the total sample in the denominator. Thus 57/43 would indicate that 57% of the space haters had given an affirmative answer in contrast to 43% of the entire sample.) Thus:

"The politicians in Washington are not really interested in scientific advancement, etc."	58/35
"Why bother putting men in space?"	44/9
"The country that controls outer space controls the destiny of the earth."	28/67
"This whole idea of competing with Russians in a race for space is nonsense."	57/19
Accurate long-range weather forecasting.	56/89
Revolutionary improvements in communications.	79/94
New fabricating materials.	50/71
Colonizing other planets ("never")	35/11

While we originally identified the space haters on the basis of their attitude toward space budgets, it is obvious that they have a more pessimistic attitude toward the space program in general than does the over-all sample. Of the space haters, 84% would cut taxes rather than continue space research, in contrast to 27% of the total sample.

The space haters are not a deviant group in terms of their "objective characteristics." They come from the same sorts of industries as the rest of the sample, earn about the same amount of money, have about the same education, tend to come from general management (46% compared to 40% of the entire sample), and from the same functions in business. They differ only in their attitudes toward the merits of the space program, and in the amount of money they are willing to allot. Their desire to decrease

the budgets, by the way, did not come from an overestimation of the existing budgets; their estimation of present budgets was almost identical to that of the remainder of the sample. Perhaps the main lesson to be learned from this special small group is that our questions have been answered seriously, and that the budgetary support for space research and for the civilian space program in particular is meaningfully related to the generally favorable attitudes expressed throughout the questionnaire. In effect, the space haters confirm all our previous points by exception!

K. Evaluation of Study: Some Conclusions

A certain saccharine song, popular once a year on a Sunday in spring, has been so cleverly assembled that, midway through, the singer discovers that the component parts, in sequence, spell "Mother." It has been our hope that the various parts of this survey should have as clear and unequivocal a meaning. This is not so. Hence, we feel compelled in closing to employ that most fragile of instruments, judgment.

Our respondents are almost entirely executives and professional men, in the main employed by American business. It must be assumed, then, that they are a select group in the population, more interested in the space program, better informed than the average citizen, and probably much more influential in the affairs of the country. Considering that they are, in this sense, a select group, they have shown that they can hardly regard themselves as well-informed. Actually, a sizable proportion (10%) wrote in comments lamenting the state of their knowledge.

An executive is simultaneously a business or professional man and a citizen. The weight of our data indicates that our respondents react to the space program as citizens rather than in their business or professional roles. Why can we not, as in other "Problems in Review" surveys, make inter-group comparisons on the basis of respondents' positions, functions, or industry classifications? In the usual survey, the attitudes of respondents vary considerably on the basis of these dimensions because the characteristic problem investigated is a business one. Therefore, individuals differ in their attitudes according to their status in the business community. But the space program is not a business problem in executives' minds; therefore our outstanding finding is the homogeneity of attitudes.

One of the purposes of this survey was to discern what basis of support or opposition to the space program might be found in the business and professional community. It will be remembered that 27% of executives indicate that their company has got or is intending to get into some space related activity. This figure, of course, cannot be translated directly into the proportion of companies involved in space business. Other and better data are available on that question. But, if we take either this 27% or the 17% who have personally been spending time on space matters (the two groups are largely overlapping), this means that about 80% of the sample have no direct involvement in the space program.

We also asked our sample their opinion as to the role that private enterprise should play in the space program. To no one's surprise, probably, they feel strongly that no activity with economic implications should forever remain exclusively in the government domain. But, equally strongly, they feel that the costs of the initial phases of research and development will be so expensive that they must be borne by the government. The recurrent phrase, "private business must be phased in as soon as possible," expresses a wish, not a demand. Certainly a few very large companies are thinking in concrete terms of possible economic exploitation of space, but they are hardly numerous enough to constitute a substantial source of political support for the program.

As citizens, our respondents are sanguine about the space program and seem quite willing to give the program financial support. To repeat, supporters of the space program cannot help but take some heart from our findings, especially if they are interested in the civilian space program. But what will this mean over the long haul? How stable is this basis of support? What will happen in a few years if the civilian space budget actually rises to $3 billion or more, especially if there is a business recession?

There are several reasons for asserting that the opinions of our sample are fragile and may change with time. Anyone who has talked with many of his friends or business acquaintances about the space program quickly discovers that only a few are really well informed. Some of our findings reinforce this impression, for even though our measures may have been crude, they are adequate to demonstrate that the level of knowledge is not high. Furthermore, the finding that opinions are remarkably homogeneous among different types of executives indicates that they are derived

from a prevailing ethos rather than anchored in the specific backgrounds and interests of the respondents. Finally, although the telephone survey mentioned earlier does not reveal any over-all bias in our mail survey, the minor changes in question wording dictated by the use of the telephone produce considerable differences in the answers to some questions. This is a sure sign that opinions are not well crystallized or firmly held.

Permit one of us a personal aside at this point. I have been privileged to be a member of a Brookings Institution study group under the direction of Dr. Donald Michael. The purpose of this group is, in part, to take a preliminary look at the probable prospects for social and economic payoffs from space. I hope it is a consolation to the conscientious executives who sweat through our long questionnaire if I admit my personal confusion on the issues we have been discussing. As an act of faith, I have proceeded on the assumption that we are warranted in making our expenditures on the space program. Yet I share the feelings which I sense in our respondents' replies -- those of having an inadequate comprehension of what is involved.

All in all, it is probably better to proceed on faith in such a bold venture than to hesitate or withdraw. But the leaders of business and government who are committed to the space program would be well advised to use the present faith and support as an opportunity to be capitalized on rather than as a stable basis of support on which to rely. A firm leadership which can spell out the issues, prospects, and costs can count on a receptive audience. But a leadership which rests content with the sort of support we have found in our data may well wake up to find that opinions have changed drastically.

Both explicitly and implicitly, I have been treating executives' enthusiasm for space research as a "good thing." As a consequence, I feel obliged to close with a caveat: Almost all of the objectives of the space programs -- pursuit of knowledge, military and political defense, economic growth, and the like -- are objectives which must be pursued at least in part by the older, more familiar, and less glamorous methods. There is the danger that overenthusiasm for "space" may produce an undesirable diversion of resources away from other activities and organizations. Thoughtful, responsible individuals in business, government, the sciences, and the professions have already voiced concern over the possibility of other vital activities being neglected because "space is our newest fad."

Part III: RESEARCH NEEDS

A. Introduction

The data obtained through the survey of Harvard Business Review subscribers can be viewed quite legitimately in very contrasting ways. On the one hand, one can evaluate the data in terms of what has been known up to this time about the attitudes of influential groups toward the space program. From this perspective, the study makes a marked contribution.

On the other hand, it is easy to make a big splash in an empty bucket. If one were to evaluate the data in terms of what one would like to know for purposes of shaping national policy, one might say that the survey does no more than reveal the problems of gathering data that would be adequate for policy needs. Such a judgment, however, would probably assume an unrealistic standard for "adequacy" of information. With this in mind, one must admit that all decisions are made on the basis of information which is to some degree inadequate.

This particular survey, consequently, should be viewed as hypothesis-generating research. Naturally, each of the particular survey findings suggests further specific inquiries. Many such specific avenues have been suggested in Parts I and II, and a few of them will be repeated here as examples. This section, then, will emphasize and discuss the need for certain broad lines of future research that are revealed by this survey. What will be discussed below is research which is realistic, which should produce information of value to the framers of national policy, but which will undoubtedly leave something to be desired from the standpoint of "completeness."

B. Research into the Meaning of Attitudes

The meaning of answers to a questionnaire, just as a man's utterances and behavior in all of life's varying situations, is rarely (if ever)

unambiguously clear. The answers to some of the questions in the HBR survey are sufficiently unclear so as to indicate a real need for further investigation.

This need is particularly apparent when one examines the reasons that an executive gives for supporting the space program, as well as the unstated reasons that seem to be implied in his answers to other questions. For example, research should be designed to investigate the reasoning used by an executive when he evaluates the space program objectives outlined in Part II. Such an investigation would have to deal with more than just these overtly expressed objectives, for the survey indicates that such factors as expectation of R & D payoff, general optimism about science, general suspicions about the military, and many other background ideas all play an important role in the way in which an executive will evaluate and support the space program. This research could be conducted through intensive qualitative personal interviews, detailed mail questionnaires such as the one devised for this study, or a judicious combination of the two approaches.

Becoming even more specific for a moment, it should be clear that the generally more favorable attitude toward a civilian space effort revealed in this study needs additional scrutiny. For example, what is the meaning of executives' differentiations as to the speed with which the civilian agency (as opposed to the military) will achieve given objectives? Does this differentiation merely reflect an ability to discern between "civilian" and "military" objectives, or does it reflect an evaluation of the relative potency or efficiency of programs conducted under these different leaderships? Similarly, does the tendency on the part of executives responding in this suvey to be willing to commit additional resources to civilian rather than to military programs indicate a preference for non-military space research? For that matter, do executives conceive of any space research as being truly non-military? In the same vein, does this willingness to commit resources to civilian programs reflect a preference for civilian control of space research (even military research) and a certain amount of anti-militarism, or does it reflect a desire to bring the expenditures on the civilian program into parity with military activities that they consider to be at an already satisfactory level? Naturally, each of the questions bears upon the others, and the investigation should go beyond an outline of the opinions held to an attempt to describe both the constellation and the interaction of these opinions.

Research into the meaning of attitudes is needed for more than just the reasons for support or nonsupport of the space program. For example, this survey indicates that it is entirely possible to obtain a more detailed outline of what executives expect of the space program; of what executives think the space program will or ought to demand in the way of a national effort; of the amount of leadership or concerted effort that businessmen think is necessary and will accept; of whether executives feel that the government should set up its own facilities for carrying out the research or whether the research should be carried out by private industry under government supervision; and of the most effective and most acceptable method for regulating such a government-private industry system.

In addition, research is needed to discover the meaning behind the optimism executives express about the possible benefits of space research. Is this optimism grounded in an unbounded faith in science, a product of past experience with R & D payoffs, or a combination of both? Will practical R & D benefits be needed to reinforce support for space research? Similarly, to what degree do executives consider space research an ideologically acceptable Keynesian pump for priming the economy and accepting government participation in sponsoring and encouraging technological progress.

Finally, research is needed into the interaction of opinions about space research with opinions and evaluations of other programs for achieving the same objectives. For example, to what degree does foreign aid conflict (if at all) with space research as a desirable means of winning the cold war? Again, our caveat: it would seem from the evidence presented in this study, that future research would have to go beyond an enumeration of the opinions to some attempt to study the dynamics, interactions, and changes in these opinions in order to be usable. Some suggestions appear in the sections that follow, and the data provided by the HBR survey can provide a fruitful guide for directing such inquiries.

C. Research into the Stability of Attitudes

Once the data appeared to present opinions that were very favorable to the space program, a special point was made of examining whatever evidence was available for evaluating the stability of these attitudes. These investigations are described in detail in Parts I and II of this report. In

sum, we conclude that there is some evidence of instability in these attitudes, or, at the least, that these attitudes are not firmly crystallized. As a result, we conclude that the present state of opinion offers an opportunity on which a vigorous leadership can capitalize, but it is not something to be regarded complacently.

Such apparent instability poses problems. First, present support for the space program may be a transitory phenomenon which will be displaced by some new "fad." Secondly, though there may be no long run trend away from support for space research, this support may be subject to marked short swings in response to such immediate events as a recession, a Soviet threat, a Soviet scientific achievement, and the like. In this second case, these swings in mood might have an effect on the ability of the authorities responsible to plan a smooth development for the program.

In effect, research is needed to discover the hardness or tenacity of executives' commitment to and opinions about space research. Referring to the suggestions for further research outlined in the previous section, this would mean that research would not only have to discover the state or level of these opinions and their interaction, but the strength and stability of both the individual opinions and the constellation of these opinions.

One can expect that some of the factors underlying support for the space program are more stable than others. For example, which is the stronger basis for optimism about space research: faith in pure science or faith due to past R & D payoff? With this in mind, research should be directed toward distinguishing between the stable and the ephemeral bases of support, and policy adjusted accordingly.

An illustration may be given of what such research and policy adjustment may mean in practice. The public information programs of the relevant agencies cannot give simultaneously equal stress to all facets of the program. Assume, for the moment, that research reveals that the objective of advancing purely scientific knowledge is the most stable basis for interest in the space program. This finding would suggest that special effort be made toward the scientific education of the relevant publics, particularly in view of the difficulties of conveying scientific information to the nonscientific public. True, one can say that "this is already being done." However, this is not an adequate response, since

there is always some latitude in the efforts that can be directed on behalf of priority goals. Finally, there is evidence in the HBR survey to indicate that the language, methods, and project names currently being used to communicate about space research present a very difficult to comprehend web of ideas.

D. Research into Changes in Attitudes Over Time

Change in attitude over time is related to, but far from identical with the type of attitude instability discussed in the preceding section. A stably held attitude of one moment may change because conditions change. In effect, further research is needed not only into the meaning, constellation, and stability at a given time of attitudes about the space program but also into the response of these attitudes to changes in conditions. In many respects, one of the best sources of insight into the meaning of attitudes is to observe them as they change or do not change in response to events. We are already handicapped in our understanding of the opinions presented in this study by the absence of relevant space age data.

For purposes of this discussion, it should be pointed out that changes of attitudes over time have a dual role with respect to the space program. On the one hand, the attitudes of influential groups are a factor having an impact on the space program itself. The appropriate authorities, therefore, have an interest in continued pulse taking on relevant publics.

On the other hand, the space program has an impact on the attitudes for relevant publics, and, as such, changes in attitude are an important social consequence of the space program. Let's examine one particular attitude as an illustration. A characteristic response to questions about the results of space research isthat it is impossible to anticipate the scientific and economic consequences of the program. This attitude seems to apply not only to the space program, but to science and research in general. Coupled with this unpredictability is an optimistic expectation that something positive will usually result. (Whether this optimism is based on faith or past experience is a question for research.) The space program will almost certainly affect this attitude configuration in one way or another, and consequently have an impact on the support that research and development will receive throughout the nation. For example,

if the apparent payoffs of the space program are less than expected, this may reduce public enthusiasm not only for the space program, but also for the National Science Foundation and/or R & D investment in industry. Another possibility, of course, is that such a "less-than-expected" achievement may produce a shift toward support of "practical" research which promises short run benefits. At the least, this example should suggest the nature of research into change of attitude over time that is needed.

E. Research into Comparative Data from Other Groups

Additional research need not be limited to creating wholly new efforts or surveys. A great deal of additional insight into the data supplied by the survey reported here could be achieved if suitable data from other influential groups were available for comparison. (Nor do we mean to suggest that the existing data might not be further examined in its own right.) For example, this survey could be modified or included as part of a study of the attitudes of other influential groups. Furthermore, our survey of executives produced enough surprises to suggest that similar information from other influential groups such as teachers, doctors, lawyers, and the like, would be very worth while for its own sake.

F. Research into Group Attitudes and Group Actions

Prior to the survey presented in this report, knowledge about the attitudes of business executives was derived mainly from the statements of involved and articulate spokesmen in the business community. Mr. Cordiner and Mr. Gavin, cited earlier in this report, are examples of such spokesmen.

At the same time, there is always the problem of trying to discern the degree to which such men are "spokesmen." We attempted to do some of this evaluation in our study by asking executives to comment on various views that have been put forth by such spokesmen in the past. Usually, however, few tests are available to policy formulators as to the representativeness of the views that these men promulgate.

True, such executives may speak for some special segment of business, or may be trying to lead or form business opinion to their liking. Their very vanguard position, however, ought to discourage one from assuming that their views are that of the mass of the business community. That is, one ought not to assume that these men represent a more intense expression

of commonly held views. This is usually not the case, for there is a tendency for policy makers to take the statements of the most articulate men as representing that of the entire group.

At the same time, it is quite easy to err in a completely opposite direction, and assume that attitudes revealed in a survey such as the one reported here can be translated directly into an enumeration of forces affecting public opinion. This is not so. Of course, such attitudes are unquestionably relevant to the support which men will give to various public policies, and even the act of expressing such attitudes in response to a questionnaire is in itself a form of support or opposition. A policy maker would be ill advised to ignore completely such attitudes. On the other hand, he must not blithely assume that these attitudes represent wholly effective influential forces, or that what influence is exerted is at all militant.

Perhaps an example is needed to make this clear. Attitudes are expressed through different actions according to the variations and differences in the circumstances requiring their expression. Whether or not they will even be expressed at all depends on the circumstances, the strength of the attitude, and the importance of the consequences to the individual. Experience with other issues would suggest the possibility that though a majority of business executives reporting in this survey favor space research over a cut in taxes, the majority of letters to the Congress may come from men who favor cutting taxes. The difference here is in the degree to which the strength and importance of a given attitude (and what the individual has at stake personally) has driven the individual to action of different kinds under different situations. That is, the amount of initiative needed and the ease of expressing opinions in these two situations are quite different.

Thus it is meaningful to think of both answers to a questionnaire and of writing to Congress as "expressions of opinion," but they are expressions of quite different intensity. Either expression taken alone will be a misleading guide to policy. It is suggested, therefore, that if attitudes toward the space program are to be studied either for guidance to the program or to measure the social impacts of the program, such study should not be restricted to verbal expressions in answer to survey questions.

Rather, such survey data should be studied in relation to relevant actions which businessmen or other important groups may take. Consequently, such activities as planned or actual investment in space related business; planning of space related business activities; disposition and ability to adopt R & D payoffs; political or community support or opposition to the space program as a whole or to specific parts of the program; general increases in business investment in R & D as a whole; greater or lesser support for international agencies and programs; and the like are all part of the matrix that must be examined thoroughly in order to understand and accurately outline the given state of opinion. Only through such an analysis can a proper basis for prediction or evaluation of behavior be established.