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THE HUMAN IMPLICATIONS OF SPACE ACTIVITIES†

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IT WILL BE of surprise to few to learn that the social scientist does have concepts which deal with totalities. The most familiar is that of environment; the aggregate of all external conditions, the context, the milieu. The social scientist includes in environment not only natural influences but also human ones; thus our activities related to space influence our environment.

Another social science wholistic concept, that concept of culture, is needed to demonstrate this. To the social scientist, culture not only refers to the opera but to all of the man-made part of environment. It includes material things, like man's production of railroads and rockets; it includes conceptual things, like man's production of beliefs and knowledge, traditions and customs, hopes and ambitions. Culture includes science and technology. Culture is all the means through which men bind themselves together and systematize their relationships. The influence of culture is simultaneous and continuous, but it is not deterministic since men, unlike ants or bees, often do not get the word, or do not get it at the same time, or—even if they do—may choose to ignore, reject, or reinterpret it. Nonetheless, since man's works and ideas are passed from generation to generation, culture is cumulative and, therefore, much of it is neither relevant nor appropriate.

Man employs his culture in a stabilizing manner to keep civilization on course and in a deflecting manner in order to steer. Traditions, such as religion, customs, and common law, provide the stabilization and enable human beasts to get along with, rather than eat, one another. Science and technology are the part of culture which enable man to steer, to adjust to change, and even to change himself.

The ability to consciously free himself from the rigid bonds of tradition and to rationally adjust to varying environments or to modify his environment is relatively recent in man's many civilizations. Thus, science and technology have introduced flexibility and maneuverability into man's kit of cultural controls. Science has empowered man to verify ideas; thereby substituting knowledge for belief and, therefore, the ability to free himself from authoritarian imposition of tradition. Similarly, technology has enabled man to free himself from the traditionally sanctioned bondage of labor and to solve his age-old problems of food, clothing, and shelter.

Now, how is any of this relevant to space activities?

The space program—partly because it has been operating under forced draft and partly because it deals with concepts, capabilities, and possibilities which are, for the most part, new to man—has the effect of accelerating the production of scientific knowledge and technological capability; of

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widening horizons and improving steering equipment. In so doing, space activities are expanding the portion of man's culture which facilitates flexibility and maneuverability and, since it is adding to man's total reservoir of knowledge, it is both obsoleting previously held knowledge and substituting knowledge for previously held beliefs.

Is this good?

Some would say "No." No because it extends the differences among men, societies, and nations. This view should not be treated lightly. Socially speaking, due in no small part to space activities, the world is fast becoming tighter and less tolerant of differences.

Some whose culture sanctions progress (whatever that is), would be inclined to say "Yes." Yes because it expands the possible; it permits the testing of the feasibility of alternatives and the probability of results without requiring man to have to endure the experience unless he decides he wants to. But even these marvelous capacities are not without their difficulties.

Man has evolved in response to the flux of events, both natural and social, and, as a result, he is largely a *reacting* creature rather than an *acting* one. His historic, evolutionary struggle has taken place precisely around this dichotomy. He evolved his traditions to explain and to justify having to react to forces he could not, or thought he could not, control. Until the development of science, his ability to intentionally, rationally control events required that he first experience them, learn from experience, and pass his learning on to subsequent generations. The accumulation of this learning parallels the development of his civilizations. The process has been slow because it has entailed unlearning the mystical explanations of his traditions and learning that cause and effect are not related through magic. Unlearning is more difficult than learning and millennia of tradition support and sanction his beliefs. Although through his science he has suddenly made possible the intentional, rational control of his future, he is not prepared for the capability. Much of his psychological, social, economic, political, and international difficulties arise from his inability to obtain concensuses in the selection among alternative, culturally sanctioned goals. The selection of goals is dependent upon his sense of worth and his concepts of value, which are rooted in his cultures. Man's traditions, beliefs, customs, ethics, moralities, and such—the basic regulators of his behavior—are grounded in his pre-scientific civilizations. Values such as these are emotionally based and, unlike cognitive knowledge, are neither cumulative nor, in all probability, evolutionary. Parenthetically, I might add that all of the major religions of the world are pre-scientific.

Although man is not simply a product of his environment, his environment, unlike that of other species, is internalized through the agency of his accumulated cultures; therefore, the values which guide his actions are extremely resistant to rational revision. They are related to conditions which have their origins in the remote past and have persisted over long periods of time. They are largely related to survival problems, such as the provision of food, clothing, shelter, health, defense, and conduct—both personal and communal. So encompassing are these origins that, outside the context of traditional human needs, the concept of value is almost without meaning.

This is precisely the problem the space program has placed before man. International conflict spawned a technology which has given man a capability he did not seek. The capability is related to purposes which, in turn, are apparently unrelated to traditional human needs. And so, the cycle has begun again. In establishing a space program man reacted to events. Once established, he was confronted with having to act, if possible, premeditatedly and rationally. It is understandable that he has hesitated on the edge of unimaginable potentialities. What calculus of values can he use to weigh the alternatives between space exploration and those goals related to traditional human needs? Though the space program, through its scientific and technological developments, has enhanced man's capability to visualize and, possibly, to control his future, it has not contributed at all to his ability to emotionally evaluate the alternative goals which may be within his grasp.

What difference does it make? The space program exists. It has been sanctioned by the values of a number of secondary goals which are related to traditional human needs; defense, international prestige, stimulation of the nation's economy, raising the nation's educational aspirations, improving the nation's educational plant and teaching system, unfettering the human mind by the acceptance of these dazzling new goals, and so forth. In fact, the program's momentum is so great and some of the secondary benefits so important that stopping it could hardly be considered tenable.

Nevertheless, the difference it makes is that actions justified upon the value of secondary goals can waste and misdirect both human and natural energy and resources, and can confuse ends and means.

A pragmatist would answer this contention by saying that a pluralistic society, such as ours is, finds its goals through the advocacy of its partisans and through the equilibrium of the forces they are able to enlist. Has not politics been called the art of the possible? If we did not do through indirection what we cannot do by direction, would we do anything?

I find such answers to be sophistry. How long would it take before direction and indirection became mixed up? Before the right hand did not know what the left hand was doing? Before intent became so confused that discontent prevailed?

Also, the pragmatic answer implies the existence of some coherent force in the society which keeps the score and sees to it that direction and indirection do not become interchanged. This argument survives from classical economics; from Adam Smith's "invisible hand" which he believed regulated the economy through the equilibrium which would prevail as the actions of many competing small enterprises counterbalanced one another's influence. There is some doubt as to his correctness even in the 18th century of which he wrote. The growth of the federal government's regulatory role in the latter part of the 19th century and the first half of the 20th hardly occurred because an "invisible hand" was present to provide coherence. But now that the regulatory role is so established and the government's budget amounts to twenty per cent of the gross national product, it might be argued that coherence is supplied by the government.

To the contrary, one of the greatest difficulties this nation has had in governing itself has been to maintain continuity of policy. Perhaps the

most cherished prerogative of the Congress is that of *not* being bound by the decisions of previous Congresses or even of the prior session of the same Congress. Even the Supreme Court, which has the Constitution and all of judicial precedent to guide it, makes sweeping reinterpretations of prior policy. And, of course, it is the very nature of the executive branch to be transient.

So it seems to me that an activity as potent as space, which makes major demands on our human and natural resources and which potentially foments a cultural and social revolution unless confronted forthrightly and on its own merits, will lead to wastage at the least and to chaos at the worst. The history of atomic energy provides a current analogy.

The significance of continuity of policy need hardly be emphasized for industrial planners. Long term investment can scarcely be expected to be made by private business without a reasonable degree of assurance of the possibility of recapturing at least its outlay, to say nothing of some profit. Since the space market—at least at this stage of its development—is the federal government, some assurance of governmental intent, at least for the period required to amortize investment, is the sine qua non of establishing a space industry. Is it conceivable that this nation could achieve the goals of the Space Act[1] without a space industry? Perhaps, if the government were to carry on itself, through a system of government arsenals. But, since private enterprise has already been brought into the act to assist the government in implementing its policies, it would seem reasonable to expect continuity of policy or reimbursement for legitimate investment losses to be appropriate. This may appear to be tilting at windmills, but it recently took the herculean efforts of the Space Administrator to prevent the program from being cut much below planned levels.

The cost-plus-fixed-fee contract served the purposes of both involving private enterprise in public, non-market business and of tacitly acknowledging the government's continuing responsibility to the participating enterprises. Tightening up of government-contractor relationships via the incentive and low bid contracts has the salutory effect, no doubt, of enhancing efficiency and effectiveness of the entire program, but it also means compacting, narrowing, or—in some cases—truncating corporate growth and corporate initiative, the very quality originally sought in the decision to build the space program through the medium of private enterprise. To the corporation this means reordering and redirecting its activity and, possibly, taking losses which cannot be written off in taxes.

More important than the effect of policy through indirection upon the space industry and the financial community which underlies it, are the effects upon society itself. The space industry is not created out of whole cloth but directly out of the lives of the people who comprise it, and indirectly out of the lives of the people who in one way or another functionally support it, or who are affected by it. Much has been made of the impact of the benefits and detriments of the establishment or demise of the governmentally-sponsored space industry on particular geographic areas; therefore, I mention it now simply to indicate its relevance, and will come back to it later in a somewhat different context. I prefer now to bore a bit deeper into the social and cultural effects, both real and potential.

[1] National Aeronautics and Space Act of 1958, 72 Stat. 426, 42 U.S.C. § 2451 (1958).

Without entering into the numbers game of the space program's present and future demand for highly educated and trained manpower, it can hardly be denied that the demands are and will continue to be considerable. Policy through indirection, of course, fools us into not being certain whether the requirements will increase, decrease, remain static, or of the types of changes which might occur. Bad as this is for efficiently managing public, educational, or industrial affairs, it is very much worse, I suggest, for the management of personal and family affairs. One illustration: —space science is and, if the nation continues its present policy, will continue to be intensely developmental in character. It is sufficiently different from scientific and technological activity of civilian industry to have necessitated the establishment of a wide spectrum of specialized occupations which are unique to it. The similarities to the missiles industry is sufficiently irrelevant to my illustration so that I believe it can be overlooked. C. Guy Ferguson, the Manpower Systems Officer of NASA, wrote in the May 1963 issue of *Higher Education*, "It should be emphasized that the aerospace research and development specialities are not mere combinations of academic degree categories. Rather they are an entirely new pattern of occupations with only minor relationships to the various academic fields."[2] He then went on to cite 118 occupational specialties as they then existed in NASA. I have no doubt that the list would be different today and will continue to differ as space flight technology develops.

The pace of scientific and technological development has been so great in the program that premium is placed upon currency and relevancy of knowledge and skills rather than upon work experience. This has given the program a youth orientation since the new knowledge and skills developed through the massive research and development effort are both consolidated and retransmitted through the universities. The youthful character of the scientific and technological personnel of the nation's space activities will continue to prevail as long as the technology remains primarily developmental and their knowledge will probably become more esoteric as the technology becomes more refined and mature.

To the individual and his immediate family, participation in space activities mean accepting the risks of uniqueness. It means investing not only limited and usually scarce family resources but the preparatory years of sons' and, at an increasing rate, daughters' lives in acquiring knowledge and in developing skills which have an extremely high obsolescence rate. In recognition of this, both industry and government offer rewards which are higher than are those offered by all but a few other lines of endeavor, and these have their own peculiar drawbacks. The individual, in assuming the challenge of these dramatic occupations, knowingly or not, also assumes the burden of keeping up-to-date with the changes in his selected field—including changes which might so redefine his field as to effectively eliminate it. Should this happen, he will be in the position of having to go through the process of requalification and reinitiation of employment at a less attractive employment age, as well as having to pull up stakes and move to a new employment location. I do not mean to overdramatize this issue. The entire society is undergoing rapid change and the problem of keeping relevant is becoming characteristic of the society.

[2] Higher Education, May 1963, p. 4.

Nevertheless, in the case of non-market, intensely developmental industries, the government has a special relationship with the individuals who have qualified for employment in highly obsolescent occupations.

These people are, in effect, dedicating their careers to a government cause. Continuity of policy is uniquely important to them. They have invested, not only their lives but also the lives of their dependents in it. Policy by indirection offers them inadequate information or even misinformation about the riskiness of their gamble not only initially but at every stage of the game. Here the nation has committed itself to doing things which require knowledge and skills not now existing, which may never exist in the civilian job market, and which are of short effective duration. Furthermore, the government has offered qualified youth extensive inducements directly through scholarships, fellowships, research grants, and premium salaries; and indirectly through publicity, aggrandizing the program, underwriting the establishment of employment centers in the most desirable places, and financing the construction of highly attractive educational plants and systems. The old saw of the government not owing them a living does not quite fit. In effect, the American tradition of the state existing to serve the needs of its citizens has, in this case, been reversed. Certain citizens are being induced to serve the needs of the state. The summons to "Ask not what your country can do for you—ask what you can do for your country" and the new frontier of space calls forth patriotic adventurers. For other occupations in which a similar situation prevails, the government has traditionally accepted specific responsibilities toward the personnel involved. The career armed forces or the Public Health Service are cases in point.

Policy by indirection can lead to inversions and serious upsets in values we have held in great esteem for some time. It can also lead to the negation of the very values it has intended to support through secondary benefits, and even to the destruction of the goals it has indirectly sought. For example, the use of the space program as a mechanism for the management of the economy can entail the precise characteristics of national planning which this nation has long rejected. The use of space funds and the medium of the negotiated contract to selectively stimulate specific geographic areas of the nation can involve disarrangement of the existing geographic configuration of the country's industrial organization, the structure of investment upon which it rests, and the entire public, commercial, and private activities and investments which are related to it but which include criteria in the selection of contractor which are irrelevant to the goals of the space program itself. The decision to pursue the program through the medium of private enterprise was made presumably to obtain the benefits of creative initiative which we believe to be inherent in free competitive enterprise. The procedure of requesting proposals and selecting contractors on the basis of merit and capability was evolved as the most tenable means of equitably bringing to bear the unique advantanges of private enterprise on the public goal of developing this wholly new technology. Inclusion of selection criteria, irrelevant to the purposes of the space program, such as something called "over-riding economic considerations," distorts the essence of the benefit sought by the procedure —the creative initiative of free competitive private enterprise. And so

indirection and direction become interchanged. Instead of open poker, the game becomes closed with several cards wild and only the dealer knowing which.

Arbitrary and after-the-fact introduction of economic considerations into a game of merit disenchants the players and estranges those who are considering coming into the game; thereby inhibiting the healthy growth of the space industry. The government is involved as an economic competitor in the private economic system without being constrained by the rules of the game.

Policy by indirection, centering on the possible, does effectuate action but, since it takes little account of long term effects, results in building a society on the shambles of its past mistakes. The condition of our cities amply illustrates this point. To rebuild their centers would cost trillions of dollars it has been estimated.

To a society facing wonderous new opportunity, and with the dilemma of a rapidly growing capability to control its future and a static capacity to evaluate alternative goals, policy by indirection is of little assistance. Such policy avoids directly confronting the lack of cultural development of the ability to evaluate alternatives that are new to it. The space program, originating within the defense and foreign policy security screen, grew to its pre-Apollo size without requiring decisions on the part of the electorate. The initial acceptance of President Kennedy's man-in-space recommendation can be attributed to the nation's traditional acceptance of the President's defense and foreign policy recommendations; but, as the implications of opportunity and expense involved in space exploration become further understood by society, the dilemma posed above should become apparent and the inadequacy of policy by indirection should be recognized. Still, the grip of pragmatism is so strong in American society that cultural evolution has to hurdle both the impatient who, negating democracy, believe man to be incapable of effective evaluation of alternatives and, therefore, must have his goals given to him—and that these goals must be concealed by a sugar coat of secondary benefits; and the compromisers who, demeaning democracy, believe that obtaining consensus is so complicated that social advance can only be achieved through secondary mechanisms.

My thesis is that opening the possibility of space exploration outmodes all forms of pragmatic indirection—whether authoritarian or liberal—and makes mandatory the evolution of the value system and the ability to apply it to new alternatives. I suggest that the first step in this direction is to accept the concept of the establishment of policy through premeditated, rational direction, in which the alternative goals are clear to all in terms of costs and benefits—primary and secondary—and in which the rules of operation of the system for making and executing decisions is openly understood by all.

As far as the space program is concerned, the achievement of this condition requires a clear-cut understanding by society in general and NASA in particular of the difference between using the space program to induce the development of secondary consequences which are thought to be desirable by those temporarily in power, and the introspective study of the possible alternative consequences of space activities. Only thus can society

obtain the knowledge necessary to evaluate alternatives and to prepare for, adjust to, or prevent changes which might be brought about by space activities. To fulfill so complicated an objective all governmental agencies which have a hand in the formation or effectuation of the space program, or of any program which portends extensive social and cultural change, should be required to sponsor introspective research into the potential effects of their programs upon society.

This suggestion should not be confused with research performed within the agencies in support of agency operational policy. The introspective research I call upon the agencies to sponsor is aimed at assisting the electorate and the Congress in the formulation of national policy as to the conduct of space activities.

I am not the first to sound this call. In 1958, prior to the passage of the Space Act, the Senate's Special Committee on Space and Astronautics wrote:

> Exploration is our national imperative. Yet the processes of government are, by their nature, often ineffective and inadequate for the task of fostering the zest for aggressive inquiry, search, and pioneering that is required.
>
> If we were to vest in any agency the total responsibility for our progress into space, we would entangle ourselves in the delusions of a latter-day Maginot Line. Where so sensitive a resource as the human mind is the ultimate margin of our security, we do well to look askance at absolutism in any form.
>
> It behooves us, as a nation, not to become obsessed with illusive grants of authority to ourselves, not to overuse the word "control." We can concern ourselves with control when control is—as it is not now—our most pressing problem. Our need now, and for the foreseeable future, is to foster effort, on our own part and the part of all freemen. This factor is foremost among those which should guide us in formulating a national space policy and in implementing a national space program. . . .
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> The potential is awesome. However, when we contemplate vesting absolute control over our space effort in one agency, awe can easily become anxiety. In haste to grant such an agency authority and control to resolve the relatively minor problems of priority and efficiency of our present primitive stage of development, we might, without such intent, vest in such agency a role which would become wholly alien to our liberties. There must be provision for continuous review of the policy under which our space program is directed.
>
> When we deal with space policy, we are dealing with national policy, in the broadest possible range. Involved is far, far more than the phasing of projects, the resolution of jurisdictions, or the selection of planetary targets. The agency provided for implementing policy must be cognizant of national capabilities and national needs. For policy guidance, there must be the highest order of competence outside the technical realm on matters of profound consequence to national directions.[3]

All institutions concerned with the well-being of mankind should, as they deem appropriate, pay similar introspective attention to the problems and opportunities man is creating through the awe-inspiring advance of science and technology.

Space activities are accelerating the rapid alteration this society has been experiencing, thus throwing additional stress and strain on the

[3] S. Rep. No. 1701, 85th Cong., 2d Sess. 3 (1958).

social mechanisms of adaptation, adjustment, and control. Pressure is brought to bear initially on selective sectors of the social order, but it will become more pervasive as space activities elaborate. To demonstrate this extension of influence I shall differentiate space activities into categories defined by degree of uniqueness to conventional human affairs or by degree of involvement with the existing social order and the culture.

The first category, least unique and most involved, includes activities oriented towards the substitution or extension of existing conventional human affairs. They are focused on existing problems of man, and, although they are in space, they are earth and man oriented. Activities related to the communications, weather, geodetic, and navigational satellites are in this group.

The second, more unique and less involved in the existing social order and culture, include the activities oriented toward exploring the upper atmosphere and the earth's immediate space environment. These are focused on extending man's knowledge of his surroundings and are relatable, therefore, to known possible needs of man. Space probes and the rocket plane are examples.

In the third category are activities which utilize some of the knowledge developed by the first two for the purpose of extending man's understanding of the solar system and the universe. The Ranger, Surveyor, and Mariner experimentations are examples.

The fourth comprise the activities directed toward placing man in space with the ability to remain there for extended periods of time and to transport himself in that medium. These activities might be compared with man's slow development of his maritime technology or rapid development of his air flight technology. The Mercury and Gemini programs illustrate the initial stages of this category.

Lastly come the activities oriented toward the manned exploration of other bodies, such as the Moon and Mars. The development of moon maps and moon vehicles, space suits, power units, and other logistical needs comprise current activities in this category.

Of the space activities I have placed in the first category—those directed toward the extension of, or the substitution for existing human activities, or toward the solution of existing human problems—the provision of instantaneous international communication and of world-wide weather information is, perhaps, of greatest immediate concern. Communication and weather forecasting are so influential in so many of man's activities that major improvements in them, whether procedural or substantive, will pervade virtually all of human relations.

Satellite communication will make it possible for persons in discrete cultures to directly hear or view the domestic broadcasts of one another's countries. Persons with varying degrees of intercultural sophistication, knowledge of world events, or social processes will be able to obtain unguided personal impressions of life in other countries. Such impressions could be subject to only personal interpretation and will certainly influence personal action. Acculturation—painful in process, remarkable in result—will be tremendously intensified. Social structures, values, aspirations, customs, definitions of reality will be placed in juxtaposition. The social context of human affiairs will literally be set on a different scope.

For example, public sentiments will have a chance to crystalize on international issues before national policies can be formed and diplomatic exchange accomplished.

Other activities in this category will have similar effects. To illustrate, world-wide weather observation and forecasting will make man more aware of the anachronistic unsuitability of existing political divisions of the world for serving common interests.

And if, as in the case of the second category of uniqueness, the expansion of knowledge of the earth's atmosphere and the immediate space environment enables man to modify weather, international alertness to what has been a passively shared physical environment will be enlivened by passionately self-interested controversy. Thus category two will drive home the spearhead of acculturation. Massive demonstrations of man's control over nature, so unconsciously accepted by western civilization, will clash with other cultural concepts of reality and man's place in the scheme of things. Man's sense of the possible and the impossible could scarcely avoid being greatly altered. Man's grasp of the potency of science and of the power of the scientist will change, not only foreign cultures, but, possibly even more, our own.

I find it difficult to visualize specific social and cultural consequences of the third category of uniqueness, the expansion of knowledge of the solar system and the universe. Since the earth's atmosphere is opaque to the majority of the electromagnetic spectrum and since atmospheric turbulence so impedes observation that the smallest object that can be seen on the moon with the most powerful telescope is half a mile in diameter, man's view of the heavens has been severely limited. Placing telescopes outside the earth's atmosphere and transmitting their pictures to earth by means of high resolution television may well expose a considerably different universe than that with which man is familiar. However, the new view will be both intellectualized, coming via the astronomer, and indirect, coming via photographs, so its impact is difficult to assess. Man has long involved the heavens in his basic belief systems. How the expansion of knowledge of the physical composition and laws of operation of the universe will affect belief systems is open to speculation. Since I included the efforts to discern intelligent signals from other solar systems in this category, I would like to add that, should such signals be intercepted, many beliefs will be subject to shattering revision—as will many other things. Should this event occur, the significance of the scientist's contribution will be lost on few although the nature of his contribution will, very likely, be misinterpreted by many.

The fourth category, that of placing man in space, is fraught with implications of social and cultural consequences. The actions necessary to achieve this objective have stimulated a tremendous amount of basic and applied research directed toward expanding knowledge of man, his body systems, and the parameters of his psycho-physical relationship with the environment. An array of new devices have been produced for enabling him to function in the life-destroying environments of outer space.

Some of the societal consequences of the activity to place man in space are visible in the intensification of psychological pressure upon the persons engaged in the process. The pressure upon the astronauts has been high-

lighted but, as usual, we have kept our eye on the ball carrier and ignored the line. So narrow are the tolerances of response time and accuracy of personal performance involved that artificial devices have had to be developed to regulate and integrate the actions of the participants.

Many examples exist. One will have to suffice. When the rocket which orbited Astronaut Leroy Gordon Cooper had risen but two inches off the ground it tripped a signal which set in motion a world-wide man-machine system which had the capability of enabling Cooper to re-enter the atmosphere at six second, or 30 mile intervals in a 30,000 mile orbit, and to be picked up wheresoever he would have been likely to land anywhere in the world. Such impressive capability involved the flawless interweaving of millions of precisely interrelated contributory actions of thousands of people stationed around the world.

To achieve this integration of activities, all pertinent knowledge had to be repeatedly differentiated into bits of information and programmed into a computer operated, world-wide network planning and control system which included man as components in the man-machine system. To participate in such a system required the acceptance of much sharper cleavages of specialization than have previously been employed, as well as tolerating impersonal, rational, external control of personal conduct. It remains to be seen whether appreciation of social values—individualism, freedom, personal responsibility; to cite a few—can be maintained by persons tapered by the constrictions of specialization and inhibited by the compression of man-machine coordination.

These coordinating mechanisms regulate and pace human intellectual processes much as assembly lines do human physical processes. This has been recognized for some time. Variations of them are required to be used in the developmental and production contracts of the National Aeronautics and Space Administration and the Department of Defense. The ability of these systems to achieve planned goals is so striking that they are being adopted, where feasible, for use by both industry and government.

We shall have to wait a few years before we can really analyze the effects of the fifth category, the exploration of other planets. However, explorations in the past have provided mankind with many of his heroes who, in turn, have strongly influenced the character traits and physical capacities man has idealized. Should man explore other planets, there is no doubt that much of the human race will vicariously participate via satellite television.

With these few examples I have tried to demonstrate the nature of the introspective study which is required if society is to be able to identify and understand the opportunities and problems man faces in undertaking a space program and, therefore, something of the social and cultural content of the alternatives before him. Such study will provide a social science equivalent of the exploration of alternatives and probabilities that physical science has opened for man in its own field of inquiry.

Knowledge generated by such study might assist man apply his existing value system to the alternatives offered by modern science and technology, but it can have little influence in altering the value system itself. I do have some thoughts on confronting the problem of assisting man evolve his value system, but before discussing it I shall offer an illustration of how

the existing value system might be applied to the potentialities of the space age.

To evaluate space goals in terms of traditional needs man might fall back on the concept of social utility. However, if he seeks to understand the social utility of the man-in-space program, he must study his needs within the context of a broader time scale than the budget cycle, within a broader period of development than the current collection of social problems, and within a broader range of interests than those of the citizens of one country—be they soothsayers or scientists.

The man-in-space program seeks to compress within a few decades the development of a transportation and related communications technology and industry for interplanetary space which is comparable with the maritime technology and industry which man developed for two or more thousand years. It is in the nature of modern Western society and culture to set goals and to organize to fulfill them. Thus, air transportation and communication were similarly conceptualized and achieved within a period of a few decades.

In the early stages of the development of a new technology, social utility is difficult to visualize only if an attempt is made to relate the fully developed new technology to current social need. As a result of this, the utility of going to the moon may not be readily apparent. However, the technology which would make possible this comparison does not exist. Forty years from now it might. Forty years from now, if man continues to press for its development, he might be able to move cargoes to and from the moon, and to and from the other bodies, possibly.

Forty years from now, the best estimates indicate that the population of the world will have doubled. That factor also applies to this country. In terms of expenditures for national resources, what seems economic today will almost certainly look very different forty years from today. If the growth trend produces a population of this magnitude by the year 2000, should it be expected to suddenly decline? Possibly. Ways are known to make it decline, but if they have not been successfully used by 2010, 2020, 2030? It would seem likely that some growth control will eventually be established. But the essential point is that the value of an interplanetary transportation and communications technology and industry will probably be different, within the social context of the period when such might exist, than its value within the social context of today when they do not exist. Indeed, mankind will be fortunate if the appropriate technology and industry are available when needed. From this viewpoint the justification of today's space activities might be more readily perceived if they were considered to be investments rather than expenditures.

If this is all unconvincingly remote, may I suggest that many who are living today will be living during the period discussed and for those who are not, their children will be.

To further emphasize the seriousness of this type of thinking; it should not be forgotten that the heavy demand man has already made on his nonrenewable resources has been made primarily by Western civilization, by a handful of humanity. The effects of the revolution of rising expectations throughout the have-not populations of the world should add exponentially to the pressure on resources of the earth.

I willingly grant that resource demand might be supplied by new means other than those offered by space technology. However, I have not offered this example in order to justify the space program, but to illustrate how existing values and traditional needs might be applied to the selection of some alternatives presented by the development of a mature space capability.

With the dawning of the space age man is reaching beyond the environmental boundaries of his own evolution. As science and technology are freeing man from the limitations of his body, space is portending emancipation from his natural environment and is challenging him to renew his physical evolution. Eric Hoffer points out that, that which is most human is least physical. Does the exploration or colonization of other planets by man require that he take along a microcosm of the natural environment in which he evolved? Or are other solutions conceivable? Is such a question unrealistic to a civilization on the brink of interplanetary transportation? Are traditional values capable of answering such questions? If not, how might man evolve his value systems to fit the civilization he is creating?

I do not know the answer to these questions, but I am sure I share the thoughts of many in hoping that scientific method offers the avenue for search. Yet, scientific method has had little application in the social sciences. Not because social scientists are unfamiliar with its powers or lack the vision for its application; but because, in the brilliant insight of Norbert Weiner, the signal to noise ratio is equal to one. Man has been unable to obtain an impersonal and objective perspective on himself. Oh, he has tried. And he has, to some degree, succeeded. But hypothesis and verification are inhibited by the limitations of empiricism as well as by the myriad of interacting variables which define social action. The greatest maturity so far attained in the social sciences has been in psychology since the limitations of empirical research are most readily overcome in dealing with the behavior of individuals. Man, however, is a social being and the interaction of individuals increases in complexity enormously as the size and hetrogenity of groups increase. Statistical analysis has been inhibited by inabilities; inability to obtain statistically significant populations, to understand the actions of large groups, to be able to study their conduct over long enough periods of time, and by inability to obtain repetitions of events in order to study frequency of response, and so on.

Space activities present man with the opportunity to overcome some of the limitations which have retarded social science. Universal and simultaneous stimuli are possible through the agency of space events. It is now feasible to subject mankind to empirical study; to compare the psychological, social, and cultural response of man to common and simultaneous stimuli—stimuli which are new to the experience of all and to which new patterns of reaction will form. All significant factors of the stimuli can be known beforehand; universal observation can be controlled and prepared for in advance; repetition of experiments in order to provide verification can be made at will; concurrent recording, analysis, and interpretation is mechanically possible. Existing space computation and communication systems offer means for data processing and experimental control, a capability which will mature as the systems become more sophisti-

cated. The unused time of the system can be placed to this use and a use can be made of obsolete equipment as new equipment replaces old.

Should this recommendation be implemented, in whole or in part, the systems which man has produced in *reaction* to international conflict would be used for premeditated, rational *action* to solve the very conflicts which brought them into being. Thus the weapons and space competition would be recast into holding actions, forestalling war while providing international social science with means and time for evolving communities of interest—the value structure of peace and the indispensable condition for man's space adventure.