ON THE INTERNATIONAL IMPLICATIONS OF OUTER SPACE*

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THOUGH only a few years old, the Russian-American "space race" is in full swing and it is clear, even at this early stage of outer space technology, that it will present both countries with new opportunities and new dangers.

From the American viewpoint we are especially interested in these related questions: First, how will outer space activities affect the external situation within which the United States seeks to promote its security and welfare? Second, how can the United States manipulate space developments in order to improve its security and welfare? And third, how should the United States concert its space policy with other elements of its foreign, defense, and domestic policies?

The formulation of an effective space policy presupposes answers to the first question. However, we of course know extremely little about the nature and consequences of outer space technology as it will evolve in the future. Though we must rely on predictions, our ability to forecast developments is exceedingly frail. The precise technological nature of astronautical developments—let alone their political, military, and economic implications—is largely a matter of guesswork, and fanciful guesswork at that. But, since we cannot do without a policy, conjecture we must.

The present article does not attempt to formulate policy. It merely presents some thoughts,[1] necessarily very speculative, on the international implications of outer space developments during the next twenty-five years. To the extent that these speculations suggest answers, these answers should not be taken too seriously, for they may be based on

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[1] The treatment is selective. For example, it neglects much of the current discussion of international space co-operation, a subject on which there is considerable literature; e.g., Philip C. Jessup and Howard J. Taubenfeld, *Controls for Outer Space*, New York, 1959.

assumptions that turn out to be wrong. It is believed, however, that some of the questions raised deserve interest and continuing study.

I. The Analytical Objectives

The international system is a system of state actors with certain characteristics—that is, capabilities and intentions—who act within a given setting or arena. During the next twenty-five years, of course, the capabilities and intentions of the actors may undergo many and substantial changes which have nothing to do with outer space activities. We are not speculating here about such changes, although these might impinge very much on the development and consequences of space technology and exploration (as would, for instance, the collapse of the Soviet system of government, or the outbreak of thermonuclear war, or any number of other events). In other words, we assume for analytical purposes that the present structure of the international system will stay roughly the same during the next twenty-five years, although we allow for some gradual changes in the capabilities of actors (assuming that certain recent trends continue).[2] More precisely, we are concerned with possible changes in actors' intentions and capabilities brought about by evolving activities in outer space.

Our question then is: How much will advancing space technology and development affect the intentions and/or capabilities of actors in the system, and hence perhaps also the operation of the system itself?

II. Assumptions

We are concerned with activities in outer space—that is, with developments inaugurated by Sputnik rather than by the first ICBM's. These missiles intrude upon outer space, but in the following we are interested in shots into or from outer space rather than from one point on the earth to another.

Regarding the next twenty-five years or so, I make the following assumptions about outer space developments. Though these assumptions are not wholly arbitrary—they are based on my reading of the available literature—they may turn out to be false predictions. I assume that many kinds of satellites will be developed, and that some degree of travel *within* the solar system may occur, including travel by manned vehicles to, say, the moon and possibly the nearer planets. For what

[2] Thorough procedure would require that, first, we treat the present international system as being incapable of any changes except those resulting from space development (this as the only independent variable); and that, second, we run various *other independent* changes successively through the analysis.

seems to me to be good scientific and engineering reasoning, I do *not* assume that, during the period, there will be interstellar travel by manned vehicles. Hence, such problems as the following are excluded: the encounter of other than the most primitive forms of life in outer space; and the colonization of other stars, except possibly for small stations on the moon and the nearer planets.

III. The Possibility of a Space Race

It is probable that, in the course of the next two or three decades, the United States and Soviet Russia will run a "space race" very similar to the arms race they are engaged in now. Both races are in a crucial sense research and development contests. In the competitive cold-war situation, military and prestige considerations will impel both nations to press ahead with space activities, with neither being able to afford quitting the race.

Though improbable, it is nevertheless *possible* that one country will outclass the other in outer space. If so, the USSR is at present the more likely candidate for pre-eminence, and this for the same reasons that seem at present to make a Soviet lead in military capability a distinct possibility. Among these reasons are, notably, effective concentration of specific resources (e.g., scientists) on particular tasks that are centrally determined; effective allocation of general resources to the rapid accumulation of certain special resources (again, e.g., scientists); and—according to general impression, though little hard evidence—relatively short lead times in research and development. The chances are, however, that the efforts of the two countries will yield approximately equal national capabilities, i.e., that neither will forge ahead of the other all across the board in space capability.

If pursued with a competitive vigor similar to that shaping recent defense programs, space programs will obviously be very expensive, with research and development expenditures accounting for even a larger proportion of the total than they have in recent defense expenditures, and with a high rate of equipment obsolescence, etc. If space activities are conducted on a large scale and on top (and actually as part) of the arms race, it is clear that only a few countries will be able to muster the resources for effective participation in the outer space race.

For some time to come, the participants will still be the Big Two, augmented perhaps by exploitation of the capabilities of their respective allies. However, national economic capability for participation in the space race is a function not only of a nation's or alliance's aggregate

economic capacity but also (a) of the proportion of that capacity diverted to space activity (which involves a political decision), and (b) of the efficiency with which the resources so allocated are employed. Thus, a country such as China may become a formidable participant long before the 25-year period is over, while the United Kingdom, for instance, will probably remain a lesser "space power." For the reason indicated under (a) above, Communist China is indeed more likely to emerge as a full-fledged third participant than is a Western democratic country.[3]

This does not mean that outer space activities are likely to be entirely monopolized by the Big Two and eventually perhaps by a Big Three or Four. There will be "fourth countries" all along that will be able to participate in outer space activities on a small scale and will have varying astronautical capabilities for using space. This will be facilitated to some extent by international co-operation. Thus the United States has bilateral arrangements with Britain and Canada for launching their payloads with U.S. rockets. The Soviet Union might similarly assist China and other Communist countries. But a comprehensive and complex outer space system (or series of systems) will be too costly for all but a few nations or coalitions.

There is, of course, one major alternative to an unrestrained competitive race in outer space development, and that is the internationalization or supranationalization of this development under the United Nations. *Internationalization* would permit national activities but subject them to strict international control. *Supranationalization* would mean the exclusive development of outer space activities by a specialized agency of the United Nations. An effective degree of international regulation, including inspected preclusion of military uses, would still permit competition for national prestige but would dampen the motivation for the competitive race. Supranationalization would do away with national rivalry. Should this happen, the pace of outer space development would no doubt be slower than under competitive conditions, even though supranationalization might eliminate some of the duplicative wastes of international rivalry. Presumably, development would be slower because the big nations would be reluctant to allocate as large financial outlays to a United Nations program as they would to national programs. And they would be apt to spend less on international programs because these would serve some of their real or imagined *national* interests (e.g.,

[3] At this point, it is difficult even to speculate about a possible fourth within twenty-five years. Neither Japan nor India is likely to have a sufficient resource base. This would leave some West European *combine* as a noteworthy possibility.

military superiority, prestige) to a lesser degree than national programs might.

If the development of outer space activities were internationalized or supranationalized, most of the problems mentioned in this article would not arise or would take on a quite different complexion. As a side effect, this would also serve to enhance the position of the United Nations and the chances that other than outer space activities would in time be internationalized or supranationalized. In fact, the history of mankind probably would be grossly different under this alternative from what it is likely to be under the competitive assumption.

For the larger part of outer space activities, however, effective internationalization or supranationalization will probably be shunned by the Big Two. This is *likely* to happen because either or both may hope to outdo the other under competitive conditions and because, even at this early stage, it would be difficult (though perhaps not impossible) to separate outer space research and development from military research and development and to segregate military from non-military uses of outer space; and a decision to internationalize outer space development would therefore presuppose a far-reaching agreement on arms control and arms-development control.[4]

On the other hand, the initial assumptions on scientific and technological (tacitly also economic!) feasibility exclude very powerful pressures toward internationalization. For instance, if it became possible within the envisaged time period for one or several nations to manipulate substantially the weather conditions of other countries, the competitive situation would hardly remain tolerable for long (unless some powerful deterrent inhibited nations from using their weather-changing capability). There would then emerge a strong pressure either toward internationalization by voluntary agreement or toward one power achieving supremacy in the system and becoming the single organizer.

[4] The Russians have made this point repeatedly. For example: "The American proposals on prohibiting the military use of outer space, while preserving nuclear weapons and U.S. military bases in foreign territories, in fact aim not at disarmament, but at a redistribution of armaments. . . . It is all too obvious that such proposals cannot win the support of the Soviet Union and other peaceful countries, which work by deeds and not words alone for disarmament that would guarantee genuine security to all countries, big and small. For it is not the space rocket as such that endangers the security of mankind, but the nuclear warhead which may be delivered by a space rocket, a rocket of any possible range, a military aircraft, etc. Clearly, the disarmament of outer space cannot be divorced from disarmament on Earth."—Y. Korovin, Corresponding Member, Academy of Sciences of the USSR, "On the Neutralization and Demilitarization of Outer Space," *International Affairs* (Soviet Society for the Popularization of Political and Scientific Knowledge), No. 12 (December 1959), pp. 82-83.

IV. Economic Costs and Gains

The question arises of whether substantial economic implications of advancing space technology might have important international political consequences. Here, the possibilities range from the receipt of vast net gains from space activities, at one extreme, to the economic exhaustion of the main contestants for space supremacy, at the other extreme. My conclusion is that, after about twenty-five years, the more likely outcomes will be far from the extremes and not too far from the middle of the range, at which neither net gains nor losses would accrue from space activities. Over the entire period, the most likely economic outcome is substantial, but bearable, net losses to mankind or to the main rivals for outer space supremacy. (Under the competitive assumption, the economic benefits would tend to be more diffused throughout mankind than the costs.)

While space activities under competitive conditions will be rather costly to the main rivals, costs will surely fall short of anything disastrous. Economic exhaustion, after all, could mean only that costs were substituted for investment to such an extent that economic stagnation occurred, or for private consumption to such an extent that popular dissatisfaction endangered internal political stability. The governments of the Big Two are unlikely to choose such a level of outlays, even though total expenditures on defense and space activities (to some degree inseparable categories) were to exceed current proportions of gross national products.

On the basis of present evidence, on the other hand, it is hard to credit the outer space enthusiasts who promise vast economic benefits. Colonization of other stars is ruled out by the initial assumptions; fantastic transportation costs will rule out anything like "mineral" or "agricultural" exploitation in outer space. Improved weather forecasting through satellites should be a great boon to farming and some other economic activities and reduce losses caused by storms, but in view of all the determinants of agricultural productivity, the eventual net gain, though substantial, is unlikely to be revolutionary. It will compare with the results of pest control. (I do not believe active weather manipulation to be feasible within the period concerned.) Similarly, communication satellites may greatly cut the costs of telephonic, radio, and television communication across and between continents. However, during the next two or three decades at least, these and other economic benefits may not turn out to be *net* advantages to mankind (or certainly to the main space powers); and if there should be net economies, they will

most likely be marginal in relation to the production of national incomes, or of world income.

The greatest economic advantages from advancing outer space activities may eventually be derived from the facilitation of scientific breakthroughs which lead to vastly cheaper energy. But even if gross energy were virtually costless, it is hard to see how the economic results the world over could be revolutionary. It does not seem worthwhile to speculate about such "windfalls," since true scientific breakthroughs are unpredictable.

V. Military Changes

Conceivably, changes in military capabilities brought about by space technology could profoundly affect international relations during the next twenty-five years. Military representatives have made strong but exceedingly vague statements about the importance of "space power." According to some of them, that nation will become the dominant power on earth which becomes the dominant power *farthest out* in outer space. But as long as the term "space power" is left undefined, this sounds like a nebulous myth, or at best like a mechanical extension of airpower doctrine at its most vacuous.

Among the military questions that could be raised, perhaps the most important from our point of view are the following: (1) Would a lead in space technology by one of the Big Two (later on perhaps "Big Few") confer decisive military superiority over the other (or others)?[5] (2) Would military space power (whatever that means) consolidate or diminish the present or imminent "balance of terror," so far as it is based on a convincing threat of mutual annihilation?

My tentative answer to Question (1) is, on the whole, negative and twofold. First, and as mentioned in the foregoing, it is improbable that one of the main contestants for space power will forge ahead of the other substantially and clearly (meaning, visibly to all) in space research and development in operational systems. To repeat, I also believe that, should the improbable happen, it is more likely to be the Soviet Union which outstrips the United States, unless we manage to improve our research and development performance. Second, at this point it is hard, though not impossible, to foresee military uses of space technology that would be of decisive importance—that, if possessed by only one of the Big Two, would give it clear-cut military supremacy over the other.

[5] For reasons stated above, especially expense, the chances are slim that a smaller country will outflank the Big Two militarily by means of successful and yet cheap research and development in space technology.

Admittedly, the military value of the use of outer space is likely to be greater if only one power enjoys this capability than if nations are more or less matched in this respect. However, a significant monopoly or anything approaching it seems improbable.[6]

TECHNICAL FACILITIES

The main military uses foreseen at present are three. First, satellites are expected to improve weather forecasting, earth mapping, navigation aids, and communication facilities that are especially important for the effective use of widely dispersed military units. They may improve the functioning of air offense and defense systems. These advances would obviously upgrade military planning and operations, but they would scarcely do so with *revolutionary* military effects. One consequence of better communication—permitting dependable control of dispersed military units by governments and top-level commands—might be a reduction in the danger of accidental war. On the other hand, it has been asserted that space craft might be mistaken by a nation for hostile ICBM's, and thus, in the absence of international filing or registration, that space travel will increase the risk of accidental war. This assertion seems far-fetched. What is in question here is a mistaken assumption of an attack. But would an aggressor fire off *one* ICBM to attack another country? If it did so deliberately, rather than by accident, it would do so for some bargaining purpose, and the shot would then be accompanied or preceded by verbal statements, and possibly by assurances that no full-scale attack was involved. If this is rational behavior for an aggressor, the expectations of other countries would be complementary and this type of danger of accidental war should thus be slight. After all, all countries have a common interest in avoiding an accidental outbreak of nuclear war. Incidentally, the same considerations apply to the possibility of inadvertent releases of, or from, bomb satellites. The danger of accidental nuclear war arising from equipment or communication failures seems great only if salvos, rather than single shots, are involved. That some degree of such danger exists is not, however, contested, especially as long as nuclear retaliatory systems are very vulnerable to surprise attack.

[6] A transitory monopoly is of course likely, in the sense that one country will be first to put a military satellite into orbit. It is improbable, however, that the initial satellites will produce substantial military effects, because their numbers are apt to be small and their performance characteristics relatively imperfect in the early stages of development.

RECONNAISSANCE SATELLITES

Second, there are expected to be reconnaissance satellites for purposes of military intelligence and, particularly, early warning of surprise attacks. The advantages which such satellites will offer are as yet unclear and uncertain. My tentative impression is that these advantages, though also tending to upgrade military capabilities, are unlikely to entail very important changes in military capabilities over the longer run.

At first blush, reconnaissance satellites seem to promise especially great benefits to the United States, which finds it much harder to secure intelligence about the Communist countries than the latter do in gathering information about the United States. However, the advantages appear less striking on second thought. The utility of reconnaissance satellites will depend on when they become operational, on what they will see, on Soviet basing practices, on the kinds of coverage they might give and, of course, on other sources of intelligence.

To begin with the matter of warning time when the opponent has launched a missile salvo, virtually instantaneous warning may be obtained by less elaborate means now under development and apparently nearing completion (e.g., Project *Tepee*).[7] And continuous military surveillance of a country from satellites will hardly give advance warning of an *impending* attack when missiles rather than planes constitute the main attacking force. Knowing that it was under surveillance, an aggressor would not give away his plans by such measures as visible evacuation of urban populations. His inability to do so would, however, tend to increase the aggressor's damage from retaliation and this would tend to diminish the chances of his deciding on a surprise blow.

Advance warning of a missile salvo would offer lesser benefits if a large proportion of our own retaliatory forces were fairly invulnerable to enemy attack. In that event the high probability of mutual destruction would make all-out thermonuclear war less likely. Moreover, our retaliatory forces would then benefit less from an alert preceding action, though the more advance warnings were received, the more the damage to our civilian population would be reduced. At this stage it seems

[7] Even a small increase in warning time after hostile ICBM's have been launched is of great benefit to a vulnerable deterrent force (e.g., planes on soft bases). This advantage may be precious to the United States—particularly by obviating more costly measures for shortening reaction time (e.g., airborne alert)—during a short period in the early 1960's when Soviet Russia has acquired a large force of ICBM's and the less vulnerable *Minuteman* and *Polaris* systems are not yet operational in sufficient numbers. Reconnaissance satellites are also reputed to be less subject than the *Tepee* to degradation by jamming. On the other hand, the reconnaissance satellite may not be operational before this phase of American vulnerability has passed, whereas *Tepee* will be ready in time.

probable that our retaliatory forces will come to be fairly invulnerable against counterforce attack by the mid-1960's, although whether we will avail ourselves sufficiently of the technological possibilities depends on timely decisions to make the necessary expenditures. Effective reconnaissance satellites will probably not become operational before the mid-1960's.

It also seems doubtful that reconnaissance satellites will afford us good intelligence on missile sites already installed or in the process of being installed—that is, intelligence on certain kinds of military *capabilities*. The expectation of reconnaissance satellites may induce the opponent to install fixed missile sites before these satellites become operational. Once installed, solid-fuel missiles, emplaced in underground sites, and activity on the site can be camouflaged. Knowing himself to be under satellite surveillance, the opponent would seek to install new fixed bases in areas and in ways which would make them hard to detect from outer space (e.g., in industrial and mining areas). Why should the opponent co-operate with our intelligence efforts by, for example, putting new missile bases in virgin territory? He will try to beat our intelligence system and, though he cannot do this without incurring some extra costs, they are unlikely to be substantial. It is also probable that reconnaissance satellites will have low value when it comes to keeping effective track of mobile delivery systems, i.e., submarines, railroads, and barges. For all these reasons, incidentally, satellites would seem to have limited utility as internationally established means for obstructing surprise attack. And the value of whatever intelligence about missile bases reconnaissance satellites might produce would diminish as Soviet retaliatory forces as a whole achieved a high degree of invulnerability against knock-out attack.

Reconnaissance satellites seem potentially perhaps more valuable as a source of advance warning of conventional types of attack, involving considerable troop movements and air force deployments. But it is comparatively easy to get intelligence of preparation for large-scale surface attacks by other means. Satellites would seem to have good intelligence value *during* war. This is obvious in the case of surface hostilities, but it also holds true in the case of thermonuclear warfare, when such satellites might give information on target destruction.

It is also said that through reconnaissance satellites we might garner other types of valuable information—for example, about the Soviet economic system. Though this is likely, the utility of such intelligence operations depends on the yield of other available sources of information, which is rather good for many kinds of data.

It is possible that, when fully developed, reconnaissance satellites will perform better than it is now safe to expect. But in any event they will function as one of many sources of information. On the other hand, it seems probable that, whatever their military utility, it will probably be greater for the United States than for the Soviet Union, which is able to gather so much military intelligence from American publications and, presumably, from agents in the United States.

BOMB SATELLITES

Third, there is the possibility of firing thermonuclear warheads from satellites (or from the moon).[8] Bomb satellites are feasible scientifically and are likely to be developed. Yet it is difficult now to predict their military properties. Will it be possible to provide them with dependable and sensitive communication systems for aiming and firing shots? Will satellite-launched missiles give less warning time of attack than those launched from the surface of the earth? Will they be more or less vulnerable to destruction than terrestrial launching facilities? Regarding these and other characteristics, including costs, we are at present unable to compare bomb satellites with other delivery systems under development.

Substantial differences in performance and costs could certainly be extremely important. Suppose, for instance, that—as many people now predict—delivery systems on earth become virtually invulnerable to simultaneous attack (for reasons of numbers and diversity as well as hardness and mobility) so that an effective deterrent standoff ensues. Suppose now that bomb satellites are introduced and possess a degree of performance reliability and accuracy that will render delivery means on earth highly vulnerable to attack from outer space. In that event, decisive military superiority would accrue to one power if it alone were equipped with an adequate number of bomb satellites. To repeat, however, it seems improbable, on grounds of technology and competitive endeavor, that one power alone will be able suddenly to introduce bomb satellites of such perfection.

Another problem might arise from popular reaction to the knowledge of bomb satellites passing "over" national territories. Of course, we do not know the nature of these reactions and how they might differ from country to country. The nature of such reactions, and national differences among them, might matter if, for example, a population panicked or became disposed to yield to threats by other countries, thus

[8] Lt. Col. S. E. Singer, "The Military Potential of the Moon," *Air University Quarterly*, XI (1959), pp. 31-53.

upsetting any existing balance of power. The identification of bomb satellites might present still another, and eerie, problem. Would we know which satellites put into orbit by other nations were bomb satellites? And would other countries know which of ours were of this type?

VI. The Balance of Deterrence

There remains Question (2), which is of course interrelated with Question (1). How may the advent of bomb satellites affect the relative balance of thermonuclear deterrence in the longer-range future? Will it make the balance less or more delicate? Much will depend on the relative vulnerability of retaliatory forces, on earth and in space, to a simultaneous surprise attack that would be effective enough to spare the attacker substantial counterdamage and give him military domination.

At this stage, of course, we do not know how vulnerable bomb satellites will be. Leaving aside such properties as accuracy, reliability, and yield, their military worth will vary inversely with their relative vulnerability. If they were less easily attacked and disabled than launching systems on earth, they could become a sort of "space-borne alert." Yet they may turn out to be vulnerable. Although they will be moving, will they not move like horses on a merry-go-round? The feasibility of an anti-satellite missile certainly cannot be ruled out. On the other hand, such a missile may prove difficult to develop and expensive to produce and operate in adequate numbers, and this latter impediment might be compounded if missile-carrying satellites could be protected by the use of decoys. It may also become technologically possible to make their orbits less predictable. At this point, these questions cannot be resolved and our analysis must proceed on the basis of alternative assumptions.

Whether or not thermonuclear deterrent systems on earth will be vulnerable to a first strike, we do not know either. Arms technology is dynamic and may present us with surprises, and much depends on how different countries avail themselves of the technological possibilities, especially on their willingness to make large expenditures. Looking at the long-range future, however, the technological chances appear at this time to favor relative safety for retaliatory strategic forces—especially if they are composed of interlocking weapons systems of considerable diversity in terms of hardness and mobility, and also if they are made up of large numbers of weapons which an opponent would have to hit simultaneously.

On this assumption, the balance of terror would gain stability which,

be it noted, is not necessarily identical with over-all military stability. Stability on the strategic level, resulting from invulnerable deterrent postures, may make for instability as far as conventional or limited hostilities are concerned. Conversely, if retaliatory forces remain vulnerable or become so again—thus permitting the pursuit of counterforce strategies—the strategic balance will be unstable, but the fear of touching off a mutually destructive exchange of strategic weapons, when relatively minor objectives are at stake, will tend to inhibit lesser forms of aggression.

In the event that bomb satellites have characteristics of accuracy and mechanical dependability unsuitable for effective attack on the terrestrial retaliatory forces of an opponent, the outer space weapon might still be valuable by adding to the threat against the opponent's population and economy. The greater its own invulnerability and the greater in degree the vulnerability of earthbound systems, the more valuable the outer space weapon would be as an addition to "passive" deterrents. If the safety of the terrestrial components left something to be desired, bomb satellites would add to deterrent safety either by being less vulnerable or, even if equally or somewhat more vulnerable, by adding deterrent diversity, thereby complicating attacks by an opponent and thus upgrading the over-all capability to deter. Conversely, bomb satellites would tend to have little value if the deterrent systems on earth were highly secure. Moreover, if the deterrent worth of the outer space weapon were distinctly marginal, its value would in part depend on comparative costs. Should satellites be much more expensive than terrestrial facilities, it would be more efficient to buy more of the latter in order to increase deterrent capacity. On the other hand, in the event terrestrial systems were highly vulnerable to attack and the deterrent worth of bomb satellites was substantial, or decisive, an unstable deterrent system might be turned into a stable one with possible repercussions on the probability and destructiveness of limited wars, as indicated above. Such stability would be especially strong if the outer space retaliatory system were in the possession of all thermonuclear powers, since this condition, compared with a preceding stage characterized by highly vulnerable terrestrial forces, would reduce the danger of nuclear war being precipitated by accident or pre-emptive intent. In this case there would be an increasing tendency to place the "passive" deterrence system in outer space.

It can be asked whether bomb satellites might come to constitute effective counterforce weapons against retaliatory forces on earth. If the latter had been fairly invulnerable to salvo attack before, the intro-

duction of the outer space launchers would upset a stable deterrent situation in the event that terrestrial systems were highly vulnerable to the space weapon. This is, however, a most improbable development for several reasons. As already indicated, invulnerability is a function of many factors. It rests not only on the intrinsic protection which each weapon (missile launcher or plane) derives from hardened sites or mobility on land or undersea, but also on the numbers and weapon diversity of the entire retaliatory capability. Invulnerability also depends upon the opponent's capability: on the characteristics of his weapons (performance dependability, accuracy, nuclear payload), their numbers and control, and on the accuracy of his intelligence. Since terrestrial systems are developing delivery accuracies, payloads and, in time, dependability which will leave little room for practical improvement, it is most unlikely that bomb satellites could become decisive on these grounds; and it is equally improbable that they would become incomparably cheaper, and hence more numerous, than terrestrial weapons. Finally, on the assumption that all great nuclear powers develop bomb satellites, an all-out counterforce attack would have to be directed against the opponent's retaliatory weapons in outer space as well as on earth.

The placement of retaliatory weapons in outer space is bound to entail other consequences which are difficult to anticipate. As already mentioned, there may be problems of communication with bomb satellites, of the outer space system going out of kilter, of the identification of military satellites, and so forth. If bomb satellites are not markedly inferior to terrestrial launching facilities in terms of performance and costs, they would seem to offer the advantage that any counterforce attack on one's retaliatory system would not cause incidental, though heavy, damage to one's population and economy to the extent that one's strategic forces were based in outer space.

However, for this very reason, outer space would lend itself to the relative encouragement of military demonstrations and indeed to limited strategic warfare. As long as exchanges of hostile blows were confined to outer space (assuming that this became technically feasible), the penalty for a first strike would be less severe than if such attacks were directed against terrestrial targets, because the attacked nation, not wishing to initiate a mutual destruction of population, would presumably limit its counteraction to outer space targets. This is, of course, tantamount to saying that bomb satellites would tend to add to deterrent capability only as far as attacks on terrestrial targets were concerned. Such developments would introduce a measure of instability

into the deterrent situation and permit the use of strategic military demonstrations for purposes of political bargaining.

The above considerations are inevitably fanciful. But many of the problems raised will become urgent with the passage of time, and such urgency must be anticipated now, as best we can, if we wish to plan research and development for outer space technology with foresight. Actual developments may bring surprises which will alter present expectations of the military value of outer space activities. At present, however, technological factors justify the tentative conclusion—which we should stand ready to revise in the light of new knowledge—that military developments of *revolutionary* impact are unlikely. Yet because such developments are possible, neither Soviet Russia nor the United States will wish to run the risk of substantial military benefits being monopolized by the other. The continuation of the outer space race is therefore virtually certain. As Lieutenant General Bernard A. Schriever stated recently, "We should get it firmly in our minds that the development of an operational capability in space—that is, our ability to use it in a practical way—is not simply an adventure. . . . My really pressing concern is the direct and immediate importance of exploiting the advantage that space offers to our vital military deterrent posture."[9]

VII. Prestige

Scientific and technological prestige will be a major objective motivating nations to participate in and, indeed, try to excel in space activities. In the present age, scientific and technological achievement is valued highly. And it will be valued increasingly in the sense that, as additional societies undergo modernization, they will modernize the relevant parts of their value patterns. Such achievement is taken as a sign of national "vigor" and—because of the exceedingly close (actual or assumed) relationship between such achievements and military potential, if not military capability—also as the symbol, if not the substance, of military power. Space activities being especially glamorous, considerable advantages of international prestige are likely to accrue to the nation which assumes leadership in this enterprise. The Soviet Union has understood this and derived great propaganda benefits from its early space successes, thus rendering world public opinion still more sensitive to spectacular space activities. Although some American officials, including President Eisenhower, have affirmed that in our outer space activities we should not engage in a prestige race with the Soviet Union, it is clear to others that we are so engaged. Thus Mr. George V. Allen, director

[9] *New York Times*, December 21, 1959, p. 5.

of the United States Information Agency, declared to the House Science and Astronautics Committee: ". . . our space program has an importance far beyond the field of the activity itself, in that it bears on almost every aspect of our relations with people of other countries and on their view of us as compared with the U.S.S.R. Our space program may be considered as a measure of our vitality and our ability to compete with a formidable rival, and as a criterion of our ability to maintain technological eminence worthy of emulation by other peoples."[10]

Prestige accruing from activities in outer space is an important factor in the creation and leadership of coalitions[11] and, in democratic as well as in non-democratic countries, in the domestic political strength of governments. Indeed, nations may compete for space stations just as in the past they competed for colonies, even at times (as in the last quarter of the nineteenth century) when colonies seemed hardly to confer any important military or economic advantages except to certain groups. (And there will now be groups, in the United States and elsewhere, which will find space development advantageous to themselves.) Nations then so competed largely because, as the benefited groups successfully managed to suggest, colonies were accepted as symbols of status and power.

The prestige effects may indeed turn out to be the major consequence of outer space activities in the international system. One has only to imagine the impact if Communist China appeared suddenly as the third space power, and countries that are now "neutral" in the East-West conflict were disposed to generalize from Communist space successes about the superiority of Communist technology and of the social and economic system which achieved such competence in one generation. Preoccupation with the prestige effect would be greatly reinforced if leadership in space exploration were widely equated with preponderant military strength, and outer space obviously lends itself to the demonstration of military capabilities. Space success might thus stiffen the negotiating attitudes of governments even though this were not warranted by the hard military facts. The USSR and the United States, and perhaps some other countries as well, may for these reasons continue to vie for outer space supremacy even though doing so constitutes a net drain on economic resources and is of insignificant or marginal worth in terms of real military strength.

[10] *Ibid.*, January 23, 1960. See also the statement by Mr. Livingston T. Merchant, Under Secretary of State, before the same committee, *Washington Post*, January 21, 1960.

[11] Gabriel A. Almond, "Public Opinion and the Development of Space Technology," *Proceedings* of the RAND Conference on Outer Space, to be published in the fall of 1960.

VIII. United Nations and International Regulation

As stated in the foregoing, it seems at present highly improbable that outer space activity will be tightly internationalized or supranationalized, in the sense that all or most of such activity would become the monopoly of an operating specialized agency under the United Nations, an agency which would of course draw personnel and finance from member nations on some such basis as that developed by the International Bank or the International Monetary Fund. For the Great Powers it would be somewhat more economical from the point of view of budget outlays to favor such a non-competitive arrangement; and the great advantage would be, of course, that of minimizing international conflict resulting from outer space activities. However, such a development is highly improbable, because the Great Powers could expect to forgo prestige advantages, possible military advantages, and at least some degree of military privacy, if they internationalized the development of outer space.

However, it is of course possible for the UN or some other international body to regulate to some extent the non-military space activities carried on by individual nations. Indeed, concerning some of these activities, functional regulation and co-operation should confer such obvious net benefits to all that a great deal of international regulation and co-operation is probable, if not certain. On the basis of the foregoing analysis, we may expect this to be increasingly the case, the more some combination of the following conditions is given: (a) the purpose of the activity is peaceful (non-military); (b) the activity is very expensive; (c) the activity is not particularly prestigious, but rather routine; and (d) co-operation is an operational requisite (e.g., television).

Such activities as the operation of weather satellites, communication of weather information, the non-military use of communication satellites, and perhaps certain other scientific activities might well be readily regulated. Similarly (and concurrently), some kind of international space code or law is likely to develop concerning at least certain aspects of space activities, such as radio communication, satellite tracking, space navigation, re-entry, accidents, and satellite broadcasting.

Regulation of some aspects of exploratory space travel—manned or unmanned—is also likely to be agreed upon (e.g., registration) as long as international regulation does not seriously interfere with efficient national planning, the acquisition of prestige, or the exploration of military advantages.

International agreement on where outer space begins (and where

national control over the upper airspace ends) seems to me less likely as long as the balance of national advantage or disadvantage on this matter appears unclear. However, absence of such agreement may not be very important in international politics. The situation in this respect may come to be much like that of disagreement on the extent of territorial waters.

I will not speculate here on the question of whether some outer space activities will be set up jointly by the Great Powers in execution of an agreement on arms control—for instance, the use of satellites for monitoring a bomb test agreement, or action in line with President Eisenhower's proposals of January 1957 for open sky and space control. Obviously, the probability of such joint outer space activity depends entirely on the probability of arms control. However, I would suppose that any international control of military activities would raise appreciably the chances that outer space activities would become subjected to international regulation.

In the absence of international arms control, international regulation of, or co-operation on, certain aspects of outer space activities is likely to become extensive, but will confine itself to a wide range of technical functions and evade the crucial issue of the inspected control of military uses.[12]

IX. Sources of Conflict

On the basis of the criteria suggested above, I doubt that the Great Powers will readily agree on advance regulation of space stations on the moon or other planets. The need for doing so now does not seem to be especially compelling or advantageous. But the prospect for such agreement would improve as soon as some of the critical conditions were clearly met; for example, if it were clarified that a moon station would confer little or no military advantage. The question that must now be raised is whether the lack of agreement or regulation would be conducive to international conflict.

Suppose, in the absence of advance agreement, one of the Great Powers should succeed in establishing a manned station on the moon. Let us also assume that any artificial satellites then in existence added only marginally—and, among the powers, equally—to the strategic capabilities of the big nations, and that these capabilities were fairly invulnerable to attack. This condition would seem to imply that a moon station

[12] This assumption is in line with the modest proposals of the *ad hoc* committee of the U.N. General Assembly—a committee which was boycotted by the USSR. Cf. Jessup and Taubenfeld, *op.cit.*, pp. 260ff.

would also be of minor military significance. But so presumably would the opposite condition—namely, that artificial satellites were of great military value. In other words, we assume in the following that moon stations would not upset the balance of military capabilities based on earth and artificial satellites. If the United States were first on the moon, the most likely situation to develop would be one resembling that on the Antarctic mass—that is, no claim to sovereignty over the entire satellite. But suppose the USSR succeeded in doing so first, and declared the moon to be henceforth part of the socialist camp and denied to capitalist exploitation.[13] What might happen then?

Of course, if one nation did thus claim occupation of, and sovereignty over, the moon (or a planet)—in a sense establishing a new colonial frontier reminiscent of previous centuries—the claim would be either accepted, ignored, or formally rejected. In the last case, it might perhaps be effectively challenged, then or subsequently, depending on the value of the object claimed, the military power situation on earth, and some residual factors such as world public opinion. Indeed, we may generalize tentatively in the following fashion.

If possession of a moon station were of small value, no exclusive claim to moon sovereignty would be likely to be made, the prestige of getting there first having been secured in any case. On the other hand, it is hard to imagine that possession of an exclusive lunar base, or exclusive control over the moon, could be a prize valuable enough to justify waging all-out war over it, even if the challenging power expected to be "victorious" in such a war. If the challenging power expected to achieve military victory without surprise attack (!) and without much damage to itself, it would have decisive military supremacy to begin with; and if the problem arose at all (which is improbable), the challenged power or powers would give in. On the other hand, if the challenging power could not achieve military victory without large damage to itself, the value of sovereignty over the moon would obviously have to be very great for the challenge to be more than verbal.

Let us now suppose that control over the moon is considered, for some reason or other, to be of considerable value. Suppose A claims control over the moon after having established a station there. B will refuse to recognize the claim and will protest it. But if A and B can deter one another from going to all-out war, probably nothing further

[13] I do not mean to say that the Soviet Union would be likely to take this course. Thus far, both the United States and Russia have declared repeatedly that there can be no valid claims to sovereignty in outer space. Though the governments of both countries may be temporizing in this matter, as well as playing up to sensitive public opinion, little advantage would probably accrue, at least during the next twenty-five years, to the first country that made such a claim.

will happen on earth. This will be true even if B is *marginally* more powerful militarily, in the sense that it would receive a lesser degree of damage than A (marginal superiority being operationally insignificant).

But what if subsequently B also establishes a lunar station in defiance of A's claim to sovereignty? What will then ensue seems to be unpredictable. One possibility, however, is that limited war will occur in outer space, which is in some ways an ideal theater for limited hostilities. Under the assumed conditions, however, the outcome of such limited conflicts would settle only relatively insignificant military issues in outer space. They could hardly settle *basic* issues on earth. More precisely, they would settle issues in outer space which it would be inconvenient, risky, or mutually too destructive to settle on earth.

Another question relates to national reactions to the artificial military satellites of another power (or other powers), be they reconnaissance or missile-launching systems. I am unable to discover any criteria on the basis of which possible responses could be predicted. If I am right in the foregoing—namely, in assuming that reconnaissance satellites will not be very important militarily—then there would be no rational reason other than prestige for a country to consider serious steps against the satellite-launching power, unless public opinion lent a "Sword of Damocles" effect to military satellites and reacted to them sharply.[14] And the prestige motivation would disappear if both powers maintained such satellites.

Similarly, if both Big Powers maintained bomb satellites, there is no rational reason for governments to react to them differently than to missile-launching systems on the surface of the earth, including the oceans. Dangerous situations, however, might arise during the transition period when one nation succeeds in putting military satellites into orbit and the other possesses a strong counterforce capability. The latter might then threaten to use this capability if the military satellites were not abandoned. However, this would be a very risky course of action. It is unlikely to be pursued unless military satellites are considered to be of crucial importance—which the first bomb satellites probably will not be—and unless the lagging power has little confidence of matching the opponent's satellite performance before he gains a dangerous military advantage. And it furthermore seems likely at this stage that retaliatory forces will have become less vulnerable, and counterforce capabilities will have diminished, by the time operational bomb satellites make their appearance.

[14] The "Sword of Damocles" effect was pointed out by Louis Halle.

There are sundry other kinds of conflict to which the exploration and use of outer space might give rise. For example, how would communication satellites affect international and national propaganda, and, in this respect, the Iron Curtain? Would one country's communication system (civil and military) become so dependent upon communication satellites that this dependency would engender new and important vulnerabilities to hostile action? Outer space activities may generate these and other sources of conflict, but these conflicts either are at present unpredictable or are of a lesser order than those discussed above.

X. Conclusion

At this stage it seems reasonable to conclude, albeit tentatively, that outer space activities during the next twenty-five years are unlikely to produce revolutionary changes in world affairs. There will of course be substantial accretions to scientific knowledge. There should be economic benefits, though probably no economic net benefits for the world as a whole, and still less chance of them for the major space-exploring nations.

Though it is difficult to speculate about military uses, we have discovered only one possible case in which the military results would be truly upsetting: if one space power alone develops an effective counterforce capability by going into outer space. Yet this is the least likely contingency. The most probable contingencies are either that bomb satellites will have little military significance or that they will add to the stability of a system of relatively secure deterrent forces—in which case, again, the control of lesser aggression through the threat of strategic retaliation will lack credibility. For the same reason it is probable that conflicts arising in outer space will not touch off a round of mutual annihilation on earth.

The prestige factor is likely to be of great consequence in international politics, unless the magnitude of national prestige gains, and of their repercussions on international and national balances of power, are minimized by competitive national efforts that will make it difficult for one country or alliance to monopolize outer space prestige. However, conspicuous Communist success, even though shared with the United States, may well benefit the Communist bloc in the eyes of many observers, who will attribute it not to the allocation of special effort and ample resources to outer space technology rather than to alternative uses, but to the excellence of the Communist system as a whole.