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EARTH SATELLITES AND FOREIGN POLICY

By Lloyd V. Berkner

FROM the vantage point of 2100 A.D., the year 1957 will most certainly stand in history as the year of man's progression from a two-dimensional to a three-dimensional geography. It may well stand, also, as the point in time at which intellectual achievement forged ahead of weapons and national wealth as instruments of national policy.

The earth satellite is a magnificent expression of man's intellectual growth—of his ability to manipulate to his own purposes the very laws that govern his universe. In the message of President Bronk of the U.S. Academy of Sciences to Nesmeyanov, President of the Academy of Sciences of the U.S.S.R., the widespread view of American scientists of the real meaning of the event was aptly expressed:

> On behalf of the National Academy of Sciences of the U.S.A., I wish to congratulate you and your Academy of Sciences, U.S.S.R., for the great achievement of placing an earth satellite in orbit. This is a brilliant contribution to the furtherance of science for which scientists everywhere will be grateful.

We should not make the mistake of seeing in the satellite merely the symbol of a foreign Power's military progress. It does, of course, represent important advances in military capability. But quite irrespective of the usual interaction of scientific and military strength, the satellite symbolizes an intellectual attainment that may dominate the period immediately ahead as the most powerful single instrument of national policy. We should examine this view closely, or we may unwittingly miss the opportunity to realize its great potentialities.

Since the instrumented satellite represents very advanced science and technology, I should like to review some of its special scientific properties. We must remember that we on the earth are sandwiched between an insulating atmosphere above and the earth beneath. The protective atmosphere above admits but a single octave of light and a few octaves of radio waves from the heavenly bodies. These restricted radiations, together with a few meteors and cosmic rays that penetrate this blanket of atmosphere, have given us an almost monochromatic view of the universe—of the space through which the Earth is coursing

on its orbit. Yet this almost colorless view has provided the clues from which the laws of motion were formulated—laws that govern much of present-day engineering. It has stimulated our realization of the laws of relativity that have led us to nuclear energy.

The artificial satellite now permits us to see the universe for the first time in its full range of "color." I use the word "color" in the special sense that the satellite broadens the range of our vision of the occupants of space from a narrow spectrum of vision to the whole spectrum of nature—from the shortest to the longest wave lengths, from the lowest to the highest particle energies. This new, chromatic view lets us see the sun and the stars in quite a new way, with the view from the satellite translated to our senses on the earth through intermediate radio channels that are easily controlled and interpreted.

Future satellites will be ideal platforms from which telescopes of every variety can be employed by a diversity of new methods to examine and explore the sun and the universe and the space around us. The artificial satellites move through the tenuous cloud of particles that extend from the sun's corona through the earth's orbit. It moves through space in which the cosmic rays are as yet uncontaminated by collisions in the atmosphere, in space swept by intense streams of particles from the sun and the meteoric dust of space. These can now be examined at first hand.

Man's satellite looks back at the earth and scans it twice each day. For the first time man can see terrestrial phenomena on a planetary scale. He will learn how many storms disturb the weather at any time and how and where they form, move and disintegrate. The driving energy of the great atmospheric heat engine that produces our weather from the heat of the sun will be measured within the year. The great reservoirs of heat and cold whose flow is sometimes inhibited and then subsequently overflows with catastrophic results can be watched in detail. Certainly, a revolution in our knowledge and control of the weather is impending. As the satellite scans the earth, particle streams can be measured as they impinge on the atmosphere, and the flashing of aurorae will be observed in their full range of color from outside the atmosphere of planet earth. The distortions of the geomagnetic field can be measured, and their origins traced and identified. Geography and geodesy can be learned with precision. Certainly, then, the instrumented earth satellite is not a

"stunt"—it is a superlative scientific tool that, in skillful hands, will vastly enlarge man's vision of his environment. By escaping into space, man has dropped the "gray" monochromatic vision of the insect—he can now see the full glory of the whole range of color that the universe provides. His knowledge and comprehension and eventually his control of his environment will grow accordingly.

The satellite is the first step towards man's dream of interplanetary travel—a dream that is now almost within his grasp. Quite aside from the adventure, quite aside from unevaluated ideas of occupying other planets, the scientific knowledge to be acquired in such exploration is prodigious. That there are some forms of plant life and perhaps even animal life on Mars, for example, seems quite certain. The differences in evolutionary patterns under presumably independent circumstances could easily provide basic keys to the origin of life itself. This is but a single example of a wide range of extraordinary scientific vistas that will be opened to the interplanetary voyager. The satellite is but one step removed from the space platforms from which future interplanetary travel may well be launched. Scientists of the Soviet Union have announced their intention of taking such a step.

The satellite, then, should be properly viewed as a major advance in man's opportunity for growth. Command of its techniques is symbolic of the highest skills in a wide range of scientific disciplines. The vital point is not so much that the Soviet satellite preceded that of the United States, heretofore credited as the leader of world technology; it is that the United States, for the first time, finds a challenging competitor in the most advanced scientific fields. The achievement of the Soviet satellite has demonstrated to Americans what they refused to believe before, that they are in a race for intellectual leadership when they hadn't realized that there was a race, or even that another nation had the capability to challenge their technology. In the complacency of our assumed technological lead, we have confused our high standards of living and material prosperity with intellectual stature. It is an extravagant and dangerous mistake.

The race for intellectual preëminence has as its objective the creation of a new instrument of national policy to supplement the traditional instruments of military power and of national wealth. Intellectual stature contributes to both the latter, but

it should not be confused with them, for it is potentially a new and powerful instrument of national policy in itself.

Now that we are forced to think of the earth as a planet in the scientific sense, there are even more impelling reasons to view it thus in a political sense as well. Let us look back for a moment at the instruments of national policy in the pre-*sputnik* era. Predominant physical strength has always been a deciding factor in combat between individuals, tribes and nations. With the advance of civilization, however, man found that productive capacity was also an essential instrument of national policy, and therefore a second prerequisite to world leadership. Of course, national wealth became more and more essential to a strong military machine as the conduct of war became more totally demanding on the resources of a nation; but as an instrument of policy national wealth was much more than this. It could control and direct the flow of the world's goods and the growth of the world's sources of power. In time of peace, the franc or the mark or the pound sterling or the dollar was inevitably a major instrument of policy when coördinated with the requisite military strength. As late as the first quarter of the twentieth century, this was enough.

But again looking back from the vantage point of the year 2100, what do we find the situation to have been at mid-twentieth century? We find that a subtle change has taken place. First of all, military power has tended to become absolute and relatively easy to acquire. Both the United States and the U.S.S.R. have acquired the power to destroy a people and all its wealth by a single blow. The same power is easily acquirable by any nation of substantial strength. The blast, fire and radioactive fall-out of a single overnight attack by a thousand modern weapons suitably directed can decimate the population of any nation, level its factories and render its land at least temporarily uninhabitable.

The principal contenders, the Soviet bloc and the West, can ill afford to tap this power, since its use by either side means instant retaliation by the other and leaves little doubt as to the ultimate destruction of both. One side dares not allow the other an appreciable military advantage lest he put it to use and escape unscathed. So while *military advantage* becomes a vital objective of both contenders, military power as an instrument of policy is, at least for the time being, noticeably weakened. In the face of near total destruction, neither side can have the confidence of

victory essential to useful employment of the more total aspects of military strength as effective tools of policy.

This is not to say that military force cannot or will not be used, but that its employment is sufficiently dangerous to the user in its present total form to imply that it can be used only with the greatest circumspection and for compelling motives. Therefore, this instrument of policy is not so readily adaptable as it once was for use in solving most world problems. The fact that it can be used only in extreme situations has encouraged the Soviet bloc to resort to creeping and less provocative means of encroaching on the ideals and interests of the West. While jealously guarding its military stature in this critical situation, an intelligent national leadership therefore is forced to look for additional and more applicable instruments of national policy.

At mid-twentieth century we find that a second major change is occurring in the traditional instruments of policy. Education is beginning to penetrate even the most backward areas of the world. Restive peoples of underdeveloped areas, yearning for material improvements and outlets for political expression, have given their support almost blindly to movements and leaders that promise quick attainment of these ends. The desire for freedom from external political control, besides being a fundamental human urge, seems also to be becoming more practicable. The phenomenal growth of science is shifting the relative values of natural resources. The one-time imperialist nations are beginning to develop new resources to substitute for some of those that they have had to look for overseas; on the other hand, colonial areas can dream of self-sufficiency based on the new resources that science promises to provide from previously worthless materials. Coal will no longer be so vital a national resource when uranium affords much greater sources of energy. The two metals, copper and iron, that for so long dominated civilization, are less important in a multi-metal world. Entirely new structural materials are available cheaply in the form of plastics and other polymers. Simpler means of sanitation, antibiotics, pest control and exotic medication raise world-wide health standards. In short, the aspirations of underdeveloped peoples now seem to them to be attainable.

Now the problem has become the need for capital in the underdeveloped countries—countries with new-won freedom but radically unbalanced economic resources. Two sources of capital or

its equivalent seem open to them: from the West, with its traditional system of free enterprise, or from the Communist-dominated Soviet bloc. The methods of Communism are suspect because they substitute a new form of even more drastic slavery for the old imperialism. Foreign investment by the West is also suspect, not only because it is reminiscent of imperialism, but also because historically it has been used as an instrument of policy. Moreover, for complex reasons largely inherent in the very conditions of economic backwardness, such foreign aid and capital as has been poured into the underdeveloped areas has not accomplished as much as was hoped for, either by the givers or the receivers.

In view of the reduced effectiveness of both military power and national wealth as instruments of policy, a kind of power vacuum has appeared. Clearly, the side that can effectively develop a new instrument will enjoy a powerful advantage. The Soviet Union seems to have found one in scientific achievement as a basis for claiming intellectual leadership.

The potentialities of intellectual leadership which we enjoyed after World War II were never fully recognized or exploited. The most conspicuous example of this failure was in connection with the extraordinary development of nuclear energy out of the most abstract processes of human thought coupled with superb experimental skill. The discovery captured the imagination of men everywhere, coming as it did at a time when the world's sources of fossil fuels were dwindling. But we did not understand the political significance of this intellectual attainment and failed to capitalize fully on the opportunity. The discovery of nuclear energy could have brought a flood of leaders and students from abroad to the feet of our teachers, and thus could have provided unbounded opportunities to demonstrate the advantages of Western methods. But we clothed our new developments in a shroud of secrecy, imposed by our preoccupation with military security. Although the secrecy has gradually been lifted, the opportunity for us to exercise real leadership in this field has meantime been seriously limited.

The Soviet Union, however, saw an opportunity for leadership based on recognized intellectual stature. It had already expanded its science teaching and its research institutes, an action that the West misinterpreted as relating solely to military power. But it meant more than this, as the satellite was to demonstrate. Dostoievsky's lame German cooper endlessly constructing his

"same old moon . . . on Gorokhovaia Street" has at last been justified. And now his moon circles the earth for all to see.

Leaders of the Soviet bloc are now capitalizing on intellectual leadership as a means of acquiring an essential element of what Milovan Djilas calls "the inherent need of those in power to be recognizable prototypes of brilliance and might."[1] Their ready political and propagandistic exploitation of the great achievement of Soviet scientists upon launching the first earth satellites illustrates clearly their recognition of the advantages that scientific leadership can confer.

The advantage to be acquired from emphasis on science and technology has led to subordination of Communist doctrine to science when the two conflict. The battle between the theory of relativity and Communism was short-lived—science won. Lysenko triumphed briefly in the struggle over predetermination in genetics, but he was then repudiated and Soviet genetics is recovering. These are indications that where science and Communism conflict, the present Soviet leadership is willing to subordinate political doctrine to science—an extraordinary spectacle in a totalitarian state.

Soviet scientists now equal in numbers those in the United States. During the short period of concentrated expansion of their scientific effort, the Soviets have not attained qualitative leadership in most fields of science and technology; but they can easily do so in the next few years unless the West reassesses the scope and scale of its own effort. A wealth of opportunities equal in challenge to the *sputnik* is waiting to be realized. To find and exploit the limits of man's control of weather is but a single example.

There are intellectual fields in addition to science where the Russians have a brilliant tradition; and the Soviets have begun to show a desire to capitalize on the advantages that this tradition can provide. The Bolshoi Theater testifies, as the once-brilliant Moscow Art Theater did before, to the Russian talent in the theatrical arts. In music, not even the heavy hand of political doctrine could permanently suppress the genius of Prokofiev and Shostakovich. And certainly a people that produced Pushkin, Turgenev, Tolstoy, Dostoievsky, Chekhov and Gorky have inherited great intellectual potentials which, though dormant, might again be released. In sum there are strong artistic and lit-

[1] "The New Class." New York: Praeger, 1957.

erary traditions in Russia which could provide a fertile ground for political leaders prepared to use a wide range of cultural achievements in the service of their policy and propaganda.

In view of this, we need to inquire whether Western governments and the free societies they represent are geared to deal with the new situation. Consistent national policies for the development of science and technology must be instituted, and imaginative new efforts must be made to provide wider and better education in all the disciplines and for the encouragement of literature and the arts. And we must learn to use achievements in these fields to show the world the merit of the political system in which they have matured. Certainly we have not entirely neglected this field. For example, of the more than 40,000 foreign students receiving higher education in the United States last year, nearly 2,000 were directly aided by such programs as Smith-Mundt and Fulbright, and many more were aided by private sources. The foreign development and medical programs of the Rockefeller, Ford and other foundations have been significant. President Eisenhower's Atoms for Peace program has helped emphasize American intellectual stature both by training young scientists and providing research materials.

But in face of the organized Soviet effort to capture the imagination of the world through demonstrations of scientific achievement, these efforts, fine as they are, do not suffice. Science and technology, like literature and the arts, are too much a part of the fabric of international intercourse to be ignored by diplomacy. One suspects that diplomatic instruments can grow obsolete in the same way that military machines do.

The interaction between science and foreign policy was discussed extensively in Washington as early as 1950, when a special survey by the Department of State in collaboration with the National Academy of Sciences produced the report entitled "Science and Foreign Relations." It advocated the establishment of an office of Science Advisor to the Secretary of State and the appointment of scientific attachés to certain posts abroad.

From 1951 to 1953 the plan was partially implemented; then it was suddenly dropped as an economy measure; attachés and appropriations were withdrawn; a science advisor was not reappointed. The Department of State refused to acknowledge that the plan had been abandoned but insisted that "it was held in abeyance." The office of science advisor was reduced to a single

economist who had had much to do with organizing the original plan, and who, as Acting Science Advisor, has done a herculean job in holding the few remaining pieces of the project together.

The plan was so promising that its abandonment caused much surprise and led to a discussion in scientific journals. The influential *Chemical and Engineering News* said on January 9, 1956:

> . . . the attachés report glowingly of their work and of the program's reception abroad. The Ambassadors and other mission officers have been cordial and helpful. Some Ambassadors relied directly on the science attachés for detailed advice and guidance on scientific matters affecting foreign relations. Good working relations were established between science attachés and other officers of the embassies with whom they frequently had to work on matters of common interest. U.S. science attaché work found wide acceptance among scientists and others in foreign countries. The scientists who have served abroad believe they have something unique to offer toward foreign relations.

The duality of the problem of science and foreign relations was clearly put by Professor W. Albert Noyes, Jr., in his acceptance of the Willard Gibbs Medal of the American Chemical Society on May 24, 1957: "We must distinguish clearly," he said, "between the utilization of expert scientific knowledge to aid in broad foreign policy decisions, and the development of foreign policy on matters which affect mainly science and scientists."

With respect to the former, it is hardly necessary to mention that a little timely scientific advice to the Department of State on the *sputnik* would have been worth the cost of the whole program of science attachés and a fully-staffed scientific division within the Department. There was world-wide interest in the preliminary announcements regarding the launching of a Soviet satellite. Yet our policy-makers seem to have had no appreciation of the international reaction that would follow the accomplishment of that scientific feat.

The impact of foreign policy decisions on science is well-illustrated in the matter of international scientific meetings. It has always been the rule in international, non-governmental scientific organizations that any bona fide scientific group from any country would be recognized. This tradition has been accepted by American scientists because it keeps politics out of science. The People's Republic of China is represented by its academy of sciences in an increasing number of international scientific organizations. Since no truly international organization can accept an invitation to meet in any country that excludes some of its mem-

bers, our ban on the entry of Communist scientists into the United States prevents any meetings of such organizations from being held in this country.

In the meantime, however, Moscow is inviting all scientific organizations willing to come. Consequently, many important international scientific meetings, such as assemblies of the International Astronomical Union, the Special Committee for the International Geophysical Year, and so on, will be held in Moscow in 1958. The effect of our attitude is to increase the importance of Moscow as a scientific capital and on occasion to isolate American scientists unless they will travel to Moscow. This type of dictation by the Department of State serves neither the purposes of American foreign policy nor American science.

Science and technology enter into almost every policy judgment that must be made in the day-to-day conduct of foreign affairs. In planning the expenditure of our foreign aid funds we have allotted only minor support to Asian universities, yet the results of that support provide some of the brightest spots in the whole program. Further modest grants or specialized assistance might catalyze major successes, but recommendations for these by American scholars have often gone unheeded. The Russians have sent hundreds of first-rate scientists and teachers abroad and it is necessary for us to match them in this respect. Again, a few thousand dollars invested in needed laboratory equipment would directly influence the training and perhaps the orientation of future leaders. We should not forget that the ranks of foreign political leaders include many scientists and engineers. As Professor William H. Forbes reminds us:

> Scientists in all countries are increasing in numbers and in cultural and political importance. The subjects with which they deal have long had great economic impact and have now a rapidly increasing significance in matters of government and of international relations. Scientists are already considerably more internationally minded than most other groups and are therefore easier to make contact with, especially if the contact is made by scientists. This presents opportunities for international coöperation which should be utilized.[2]

Our overemphasis on military as contrasted to intellectual activity abroad is demonstrated by the fact that in 1957 there were more than 500 military attachés assigned to our foreign missions —and not one scientific attaché. This is not to suggest that in the present international situation we do not need to maintain our

[2] "The Rôle of Science Attachés," *Bulletin of Atomic Scientists*, October 1957.

military strength at its fullest capability; without this shield there would be no opportunity for other forms of action. But equally we must not neglect essential measures in other realms of human activity that may be decisive in the final determination of events.

The great danger of the present world military position lies in the fact that it is not, as some assert, a stalemate; it is a state of unstable equilibrium. This is why a change of power like that represented by the advent of the I.C.B.M. and demonstrated by the satellite has been viewed with so much alarm. In our concern for our military position we have tended to miss the significance of the satellite as a Soviet bid to gain power by capturing man's imagination.

The instability of the armaments situation can only grow worse if present technological trends continue and no political controls are devised. As large numbers of fast-flying missiles come into the possession of both sides, ready for use, critical command will tend to devolve to lower and lower echelons. To some extent this is already occurring. If we are going to be able to retaliate effectively it will become less and less practicable to assemble the Congress, or to call together the Cabinet or even for the President to be consulted when missiles with the ultimate destructive power are seen flying toward us. Effective retaliation must be *instant* indeed. Who at that moment will hold the fate of the world in his hands? In the face of such degeneration of command, agreement on effective forms for the control of absolute weapons is the alternative to ultimate destruction.

Meanwhile, with military strength less effective as an instrument of policy, let us seek other measures to protect and to extend the realm of freedom. We have the chance to earn the right to leadership through demonstrating intellectual preëminence. We enjoy the advantages of a free society where diversity of interest and individual initiative are incalculable assets. But we must be aware that there is a race and that we are in it. A race for intellectual preëminence is not in itself undesirable, for it is regenerative in character; like the intellectual challenges faced in the past it can, in the long pull, bring only benefit to man.