countervailing systems by NATO — such as the cruise missile, the Pershing II, and a new-generation MRBM — all of which have been the object of controversy both in Western Europe and the United States? In any event, the momentum now enjoyed by the Soviet Union in the deployment of such systems could not be reversed short of a crash program in the Atlantic Alliance. But as SALT negotiations proceed, especially in light of the precedent set by the SALT II Protocol, pressures may grow for delays in NATO theater nuclear modernization until SALT III has been completed, during which time the Western bargaining position with respect to the Soviet Union will have worsened. As has been the experience with SALT II at the strategic level, the effect of SALT III would be to legitimize a Eurostrategic imbalance that heavily favors the Soviet Union. Presumably, also as with the case of SALT II, meaningful reductions in Eurostrategic forces would be relegated to some more distant time, perhaps a SALT IV. Thus the SALT negotiating process and the resulting treaties remain, at best, peripheral to the security needs of the United States and its allies and, as worst, detrimental to their efforts to maintain a political and strategic posture adequate to meet their security needs in the years ahead.

Near Earth Orbital Space: Implications for American Foreign Policy

OLIVER WILLIAM HENNIGAN, JR.

A great deal has been said about the technological marvels that are a direct result of the American space program. Teflon-coated pots and pans, electronic calculators, microcircuits, super-glues, insulation advances and new alloys are just a few of the fruits of the American space effort. Just about every American is familiar with these products; but some consider them relatively expensive when contrasted with the tremendous amount of research and development money that went into their making. Such expenditures have been justified not by these tangible benefits but by the prestige and satisfaction of successful manned exploration. Although the American citizen is proud of, if not completely satisfied with, his country's past performance in space, he now expects greater benefits from future missions.

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The space transportation system (STS) is intended to turn these great expectations into realities while adding to the ever-growing body of aeronautical and astronautical science, thus advancing the United States' role in space.

The focal point of the American space program is the space shuttle, part of the amalgam of systems making up the STS. The shuttle is a reusable vehicle with a large cargo capacity of 65,000 pounds, capable of carrying a variety of payloads into near-earth orbit for a fraction of the cost of present systems. From the American taxpayer's point of view, gains made by the shuttle program should lead to economic benefits and a heightened standard of living for all Americans. Unfortunately, space policy planners are soon to face a multitude of problems that, if not dealt with quickly, will restrict American access to space and the potential benefits deriving from it.

One problem is the limited number of missions that will be possible, even with the vast increase in capability the shuttle will provide. Space shuttle customers will include a number of foreign countries and companies, since NASA's shuttle policy encourages selling cargo space to foreign as well as domestic users in order to offset development and operating costs, and to provide a service for countries unable to finance such systems on their own. Many foreign users will operate through American contractors such as McDonnell-Douglas, Rockwell International, Boeing and Hughes. Thus a great deal of cargo space will be open to foreign business and foreign national interests. NASA must plan carefully, with an eye to both the American taxpayer, who has had to foot a large part of the bill, and the foreign user, who has an interest in guaranteed access to shuttle cargo space.

Although NASA has generally done an excellent job of developing and testing U.S. space hardware, it has been less successful in selling the STS to businesses and to the public at large. An improved NASA educational program should emphasize not only space-related gadgetry but also less tangible benefits that are now obvious only to a few concerned, highly motivated spectators. A case in point is the valuable discovery of a gigantic copper lode in Nevada, found as a result of photographs taken on the Skylab Mission of 1973-1974. This mineral wealth has been estimated to be greater than the $2.4 billion cost of the entire mission.[1] In light of the well-publicized crash of the Skylab, this news could be used to assuage the American taxpayer and government officials who felt Skylab to be little more than a piece of Chicken Little chicanery.

Another attractive selling point in this period of scarce and expensive energy is the potential gain in energy resources due to space development. Space-based photography will be of great service in this endeavor. For instance, satellite pic-

1. *Interavia*, December 1978, p. 1159.

tures of sagebrush patterns in northwestern Wyoming and southeastern Montana may point to hidden deposits of uranium, according to the United States Geological Survey.[2] Geologists have found that medium-density vegetation, mostly sagebrush, appears to be associated with the underlying rock formations into which ground water flows, carrying dissolved uranium. Satellite photos will enable scientists to locate these deposits and quickly determine whether they are suitable for commercial use.

American agriculture will also gain by taking advantage of space systems. National Oceanic and Atmospheric Administration studies indicate that their spacecraft could save industry and government millions of dollars by providing basic weather services. Among projected savings are up to $45 million annually for Florida fruit growers who, by utilizing satellite data to observe the progression of frost, could gauge whether and when to begin taking protective measures. One firm in the Hawaiian sugar industry estimated that $1 million each year could be saved by using spacecraft imagery to aid in the timing of sugar cane field burning.[3] The shuttle will improve these benefits, not only by its comparatively low cost and the increased number of satellites it will be able to put into orbit, but also by its ability to increase the resolution of optical systems capable of being boosted into orbit. This is due to its greatly reduced vibration levels, once a hindrance to placing delicate electronic optical devices in space. Due to its spacious cargo bay, and to the ability of its crew to manually inspect payloads before they are put into orbit, the shuttle will be able to carry satellites that do not have to be the finely crafted jewels of today, but more sensible, "work-a-day" models and, hence, cheaper ones. In due time, these savings will be passed on to consumers in the form of lower food prices.

Many observers are also aware of the effect that space-generated solar power could have on the future of space activity. In the weightless environment of geosynchronous orbit, huge ten-by-five kilometer space platforms covered with solar cell arrays could generate massive amounts of electrical power to be beamed back to earth by microwave transmitters. Given the need for non-depletable energy sources, the advantages inherent in solar power satellites (SPS) should not be ignored. Although large-scale SPSs would require far more efficient lift capacity than the shuttle can provide, the shuttle can enable us to do the necessary testing of such a system before deciding whether to commit large sums to its actual production.

At first glance these prospects appear to be fundamentally of domestic importance. Yet they may have far-reaching international repercussions. For instance, advance knowledge of the size and timing of grain harvests and

2. *The New York Times,* 10 December 1979, p. A-21.
3. *Aviation Week and Space Technology,* 12 February 1979, p. 28.

knowledge of uncharted mineral deposits could be of great importance in making decisions about foreign aid and foreign investment. The use of SPS systems to provide advanced industrialized nations with even more energy could become a major bone of contention with Third World countries. Continued friendly relations will call for solutions that keep the interests of Third World governments in mind. Solar power satellites will appear to be a direct threat to oil-exporting nations, and an expensive and/or unobtainable benefit to the poorer LDCs.

One way they may choose to fight back is by raising legal objections to the use of geosynchronous zones. A geostationary or "geosynchronous" orbit implies the ability to remain positioned in an orbital "slot," from which the satellite's position relative to the earth's surface does not change. For a satellite to do so, it must be located above the equator at a height of 22,300 miles. At the moment, there is only a vague legal definition of the boundary between air space, which is controlled by the state over which it lies, and outer space, which is an international zone akin to the high seas. Whether the lower limits of outer space should be set as low as possible to maximize opportunites for its unfettered use, or as high as possible to maximize the extent of national sovereignty, remains unresolved. Throughout the international debate, the United States has adopted the former attitude. NASA's Deputy Director of International Affairs has stated that NASA has never sought other countries' permission before overflying their territories with remote sensing devices.[4] In general, the U.S. has taken a libertarian attitude toward the use of space as well as the results of that use.

The principle of laissez faire in space is epitomized by the American Landsat (short for "land satellite") system. Landsats, originally known as ERTS (Earth Resource Technology Satellites), are improved and enlarged versions of the earlier NIMBUS weather satellites. The original plan was to launch two of the spacecraft in successive years (1972-1973) as an experiment in systematically surveying the earth's surface in order to study the health of crops and determine the potential use and development of land and ocean areas. The dramatic flow of vivid, revealing photographs sent back from the moment it became operational caused such a sensation in the 50 countries participating in the experiment that the program was given top priority.[5] The result was a third Landsat (Landsat 3), launched on 5 March 1978.[6] The U.S. Government's libertarian attitude toward the orbiting Landsat is typified by its handling of the retrieved data. This information is processed by the U.S. Department of the Interior, through its Earth Resources Observation Satellite Center at Sioux Falls,

4. *Interavia*, December 1978, p. 1166.
5. *Ibid.*, p. 1153.
6. *Interavia*, December 1978, p. 1159.

South Dakota, where anyone can request and obtain Landsat imagery of a particular location at cost. Buyers are not even asked to identify themselves.[7]

Foreign interest has been particularly intense. During 1975 alone, countries as geographically and politically diverse as Chile, Zaire and Iran decided to build and operate their own ground stations to receive Landsat data.[8] As it now stands, this program appears to offer substantial benefits to all parties. But Third World countries—not to mention the Soviet Bloc—are not so pleased about the potential effects of such widespread aerial photography and are adamant in their demands for a more equitable sharing of space-based benefits as well as limitations on access to space. During the Bogota Conference of 1976, held in Bogota, Colombia, ten equatorial LDCs proposed that national sovereignty be extended as far as the 22,300 mile distance required for geostationary orbit. So far, most geosynchronous satellites have been utilized mainly by the developed nations, none of which are equatorial. However, with the spread of communications technology to LDCs, competition for claims on scarce geosynchronous orbital positions can only intensify, since these positions are necessary for communications satellites. A crisis in communications planning, for both developed and underdeveloped countries, may therefore be brewing for the future.

As this paper goes to print, a conference among the 154 member countries of the International Telecommunications Union has just finished reviewing the entire table of frequency allocations, as well as the regulatory rules and procedures governing the use of the electromagnetic spectrum—the air-waves or frequencies on which radio, telephone and computer-originated signals are carried around the world. The decisions ultimately reached are to govern the field of electronic communication for the rest of this century. The LDCs hope to challenge the first-come-first-served policies traditionally applied to use of the spectrum. Just as many equatorial LDCs wish to assert what they claim to be their geosynchronous orbit rights, they are also challenging the allocation of radio frequencies with an eye toward expanded LDC usage.

The overall goal of the less-developed nations at WARC-79, the ITU Conference in Geneva, was to open the spectrum so as to allow flexible frequency allocations, maximum sharing of frequencies, and maximum international accommodation and cooperation. In general, the LDCs fear that the limited number of available frequencies will be preempted for use by the industrialized world before the LDCs can develop an advanced telecommunications industry and compete effectively for the various wavelengths. The issue is complicated by the problem of allocating radio bands for the major national short-wave

7. *Ibid.*, p. 1166.
8. Reginald Turnill, *The Observer's Space Flight Directory*, p. 153.

broadcasters such as the BBC, Voice of America, and Radio Moscow, which many LDCs see as provocative and neo-imperialist.

The United States, along with other countries, has resisted such plans. In 1978 Dr. Abbott Washburn, Commissioner of the FCC, clearly stated his opposition to any great change in the allocation procedures:

> Carving up the spectrum and orbital slots on a country-by-country basis, in response to the "we want our share" psychology expressed . . . by the LDCs would result in wasteful and inefficient use of the spectrum. The U.S. position is that frequency assignments should be based on demonstrated need and ability-to-utilize. We oppose preassignment allotment plans because they prevent optimal use of the spectrum and because they do not encourage adoption of spectrum-saving technologies and spectrum-saving patterns of use.[9]

Preliminary reports from the conference indicate that a final decision on the LDCs' demands has been postponed for several years.

The developed world's primary rationale for frequency allocation is demonstrated need and the ability to utilize. Although the needs of LDCs are certainly expanding, their ability to utilize the frequency bands still does not exist. However, it might be argued that this too is about to change. For one thing, the U.S. Agency for International Development has recently been authorized to invest in communications projects for developing countries.[10] Furthermore, the new capabilities of the space shuttle, with its low dollars-per-pound delivery costs (somewhere in the vicinity of $300 per pound, compared to thousands of dollars for current systems), will make possible the relatively cheap placement of telecommunications equipment in orbit for use by LDCs.[11] For political as well as economic reasons, the United States may wish to consider a softening of its telecommunications policy. Admittedly, reallocation would in the short run prove to be time-consuming as well as confusing for a large number of user states, both old and new. However, the long-run advantages need to be clearly thought out by American policy planners, because the ability-to-utilize argument is primarily based on the probably transient American lead in space. Even today the U.S. by no means has a monopoly on near-earth space flight.

9. Commissioner Abbott Washburn, "Noontime Remarks," the Edward R. Murrow Center of Public Diplomacy, The Fletcher School of Law and Diplomacy, Tufts University, Medford, Massachusetts, 26 October 1978, p. 9.
10. Anne W. Branscomb, "Waves of the Future: Making WARC Work," *Foreign Policy*, (Spring 1979), p. 147.
11. Clarke Covington, "Solar Power and the Future in Space," *Journal of the Royal United Services Institute for Defense Studies*, Vol. 124, No. 1, (March 1979), p. 18.

When the LDCs, not to mention other customers, become active buyers of space hardware, as they surely will, they will have a choice of countries with whom they may contract for orbital satellite placement and purchases of equipment. Aside from the Soviet Union, which offers an alternative to those countries that are politically acceptable to it, and whose booster technology is more expensive and less efficient than that of the United States, other countries are also entering the space market. Articles Six and Nine of the Outer Space Treaty of 1967 acknowledge the propriety of the private use of outer space. In states with a private enterprise system, "private" use can only be understood as commercial use. Such commercial activities by private enterprises, which are offered to any client throughout the world, may be the only possibility for LDCs to participate in the use of outer space because they currently lack the financial and technological means to develop their own satellite-lift capabilities. If they can hire private corporations for such a purpose they will be in a position to use space for themselves, thus increasing the number of states participating in the use of outer space.

The initial participating corporations, at least for the rest of this century, will of necessity be government-backed or -owned organizations. Foremost among these will be the European aerospace companies who, acting on a proposal by the French National Space Agency (CNES), have formed the first commercial satellite-launching organization, which will have an estimated capitalization of $70 million. The new corporation has been primarily designed to take over the Ariane Launcher Program from the European Space Agency (ESA).[12] The countries and companies participating in the new venture believe that only a commercial entity will be able to build less costly launchers that can compete successfully against NASA's shuttle with its low freight costs.

More competition exists in the form of an ambitious Japanese fifteen-year space plan. Japan's Space Activities Commission has proposed a schedule that would call for the expenditure of over $14 billion on new space projects, including survey missions to the Moon, Mars and Venus and the flight of Japanese astronauts on the American STS.[13] Included in the plan is an intensive effort to upgrade Japan's solid-propellant booster technology, upper stage booster systems and orbital maneuvering systems — technological subsystems that would enable Japan to effectively compete with the American space shuttle as early as 1985.[14]

Even the People's Republic of China has announced plans to develop manned space flight capability, including a modern space research center. According to Fang Yi, China's Deputy Prime Minister for Science and

12. *Aviation Week and Space Technology*, 9 July 1979, p. 18.
13. *Aviation Week and Space Technology*, 29 March 1978, p. 25.
14. *Ibid.*

Technology, China plans to build its own skylab space surveyors and scientific applications satellites, circumstances permitting, within the next seven years.[15] Such a program necessarily includes the development of boosters and ground support systems that would be competitive with those of American, Russian, European and Japanese satellite placement consortia. A coordinated Chinese-Japanese space program is another possibility.

The attractiveness of non-U.S. systems such as the Ariane Launcher is enhanced by certain deficiencies in the space shuttle, most notably its inability to place payloads in geosynchronous orbit. As it now stands, the shuttle can go no higher than 250-300 miles. The development of a 'space tug' to bridge the distance between the shuttle's low-earth orbit and the geosynchronous orbit required for many communications and surveillance satellites has been delayed by parsimonious NASA budgets. This would appear to leave the United States with a dilemma. Should it adhere to the position espoused by the FCC, Third World countries may take their business elsewhere, thereby damaging American pride and prestige, not to mention American business. On the other hand, new frequency allocations, by encouraging Third World interest and investment, may in the long run stimulate American aerospace business to a degree as yet unforeseen, however inefficient the resulting use of the spectrum.

The overall position of the STS in the future of space is self-evident. In the realm of international politics its impact on the foreign and domestic policies of user governments will be of a very high order. Both the United States and the Soviet Union realize this. "More and more," said President Carter recently, "space is becoming a place to work — an extension of our environment."[16] Indeed, the present Administration proposes that the major thrust in space ventures over the next ten years should be in the directions that promise tangible benefits for mankind, and that a maximum effort should be made to share the technology and resources already available, both within the United States and internationally. Private enterprise as well as government initiative will ensure the success of a move in this direction, providing copious benefits for both the United States and its partners and allies abroad.

Contrary to the position of the free world on equitable space utilization, the Soviet Union has gone so far as to suggest that a state monopoly be created within each country to control the exploration and use of outer space. This principle was stated in a proposal by the Soviets which expressly provided that "all activities shall be carried out solely and exclusively by states."[17] Obviously the Soviets do not wish to see private enterprise gain a foothold in space. A large number of competing space freight companies would limit the restraints

15. *Ibid.*, 23 September 1978, p. 9.
16. *Interavia*, December 1978, p. 1150.
17. Draft of 10.9. 1962, United Nations Document A/AC 195/L.2.

that the Soviets could impose on governments utilizing Soviet lift capability, and lower the revenues of such an operation.

With regard to the space shuttle — the most crucial element of the STS — the Soviets have gone so far as to tell the United States that it considers the shuttle to be an anti-satellite (ASAT) weapon.[18] It is indeed possible to design shuttle payloads which could act as ASAT devices. The United States has embarked on a multi-year, $400-500 million ASAT technology program to overcome the ten-year lead held by the Soviets in this area;[19] and the shuttle may figure prominently in the plan, although no hint of this development has yet surfaced. With regard to known Department of Defense plans, the main mission of the shuttle is earth observation and reconnaissance. On a typical high altitude mission, the shuttle could carry a new large-format camera normally used to assist in exploration for oil and mineral resources. If this camera were launched into polar orbit from Vandenburg AFB in California the entire globe could be covered by two eight-day shuttle flights.[20] Soviet complaints about the shuttle may be directed against this mission rather than hypothetical ASAT uses, since updated photo reconnaissance could easily detect Soviet attempts to foil the SALT II verification procedures.

One of the most serious problems confronting the potential users of outer space is precisely the development of weaponry designed for use outside the atmosphere. The economic and political value of space has only been touched upon briefly in this essay. Soviet development of an effective ASAT capability endangers the entire STS Program. Nuclear weapons have already been prohibited by the Outer Space Treaty of 1967. Unfortunately, no mention was made of conventional weapons systems as at the time no need for such a prohibition was foreseen. However, if the Soviets continue to insist that the STS is nothing more than a glorified ASAT system, it will be extremely difficult to negotiate a meaningful space arms control agreement that does not seriously limit the peaceful uses of space.

At present, the threat of ground-based ASAT weapons is more serious than the threat of space-based systems. Any attempt by the superpowers at space arms control should focus on putting a ceiling on current, i.e., ground-based, space weapons before attempting to restrict the deployment of new weapons in outer space, such as particle beam devices or laser platforms. In negotiating a feasible treaty, both the U.S. and U.S.S.R. should consider primarily those systems which have been expressly designed for ASAT missions, without hindering those which have only incidental ASAT capabilities, e.g., the shuttle and the Soviet remote-controlled Salyut Space capsules and space freighters.

18. *Aviation Week and Space Technology,* 17 April 1978, p. 17.
19. *Aviation Week and Space Technology,* 6 February 1978, p. 18.
20. Les Aspin, "The Verification of the SALT II Agreement," *Scientific American,* Vol. 240, No. 2 (February 1979), p. 43.