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The political economy of U.S. space policy: National and transnational dimensions

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THE POLITICAL ECONOMY OF U.S. SPACE POLICY: NATIONAL AND TRANSNATIONAL DIMENSIONS

by

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Abstract

THE POLITICAL ECONOMY OF U.S. SPACE POLICY:
NATIONAL AND TRANSNATIONAL DIMENSIONS

by

Marie Antoinette Manca

Adviser: Professor Dankwart A. Rustow

U.S. space policy was shaped through a series of ad hoc responses to what might be considered *apurposive* political, economic, and fortuitous events at both the global and domestic levels. It did not evolve according to a carefully thought out long-range plan based on scientific, business, and defense interests. Cold War realities provided the first strong impetus toward the development of U.S. space policy. The launch of Sputnik I and the *perceived threat* the Soviet satellite posed for U.S. national security gave rise to the Mercury, Gemini, and Apollo programs and the landing of men on the Moon.

As we approach the 21st century, space systems and the nations that have access to them are increasing both in number and technological sophistication. In light of growing proliferation and globalization processes, policy is mainly determined by transnational financial and security imperatives. This study analyzes the linkages between the global

space marketplace, economics, international relations, technology, national security, and public policy. It does so at the *macro* level by tracing the evolution of U.S. space policy within the context of the global political economy. At the *micro* level, through a case study on Hughes Aircraft Company's successful effort in convincing the Reagan administration to change its long-standing policy concerning launches of high technology equipment on Chinese boosters, it highlights the role of firms and the complex interfacing of market and other factors in the making of policy.

The nonlinear way U.S. space policy has evolved within the context of a rapidly changing, technology driven environment, raises questions as to the relevance of the models to be used in illuminating such a turbulent reality. Models which are basically linear and state-centered, as developed in the past international relations literature, may be less than effective in explaining turbulent change. Part III of the study addresses these theoretical questions and maintains the need to shift to a multidimensional nonlinear global perspective that encompasses states, economic/market, technology, environmental, and population factors. It is argued that the latter perspective would seem to afford a better analytical vehicle than one-dimensional, state-centered models.

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My greatest debt is to Lina Manca without whom this study would not have been possible.

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INTRODUCTION. SPACE AND THE PROCESSES OF GLOBALIZATION

> *...because of the transnationalization of finance, of knowledge, and of production and trade, there is now a growing but still largely unfilled need for research ventures that overflow state boundaries and transcend the divisions between international business and international relations.*
>
> *Susan Strange*[1]

> *'Internationalization' refers simply to the increasing geographical spread of economic activities across national boundaries; as such, it is not a new phenomenon. 'Globalization' of economic activity is qualitatively different. It is a more advanced and complex form of internationalization which implies a degree of functional integration between internationally dispersed economic activities. Globalization is a much more recent phenomenon than internationalization; however, it is emerging as the norm in a growing range of economic activities.*
>
> *Peter Dicken*[2]

An Interlinked Global Reality

The progressive globalization of the world economy is being increasingly recognized today. However, as recently as 1986, Peter Drucker still felt the need to argue that the world economy was not changing but had already changed and that it was "the world economy in control, rather than the macro-economics of the nation-state on which most economic

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[1]Susan Strange, "An Eclectic Approach," in: The New International Political Economy, ed. Craig N. Murphy and Roger Tooze (Boulder, CO: Lynne Rienner Publishers, Inc., 1991), p.47.

[2]Peter Dicken, Global Shift: The Internationalization of Economic Activity, second edition (New York: The Guilford Press, 1992), p.1.

theory exclusively focuses."[3] Currently, with the world of transnational money movements, exchange rate and credit transactions turning over on a daily basis many times the volume of world trade, few would deny that fundamental changes have taken place. Already in 1986, as Drucker indicates, the Eurodollar market alone accounted for over $300 billion in daily flows, more than 25 times the volume of trade. Today, foreign exchange flows have reached the trillion dollar mark with at least 90% not connected to trade in goods and services or capital investments in foreign plants. As has been pointed out, the volume of foreign exchange trading is now "several hundred times" in excess of the volume of trade.[4]

One of the major themes in this study, however, is that globalization processes are not limited to the economic sphere but affect all areas of human activity, ranging from politics to science and culture, and that through complex interaction and feedback flows, these processes are spurring

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[3]Peter Drucker, "The Changed World Economy," in Foreign Affairs (Spring 1986) 64:768.
Drucker points to three major changes that modified the very nature of the world economy: the uncoupling of the primary products economy from the industrial economy, the uncoupling of production from employment, and the loosening of the link between trade and capital movements with the latter coming to play the leading role on the world economic stage.

[4]Paul Kennedy, Preparing for the Twenty-First Century (New York: Random House, 1993), pp.51-55).

growing interaction and linkage between divergent areas of human endeavor. Given this highly dynamic nonlinear interlinked reality, older linear theoretical models are increasingly unable to adequately illuminate it, giving rise to the sense of failure that pervades not only the theoretical literature of international relations and political science generally, but also that of other disciplines, ranging from economics to physics. We will discuss this further below.

Within the context of the accelerating interconnection between disparate realms of human activity, outer space, once relegated to the sphere of scientists and those who dreamt of exploring and conquering new worlds, has become a domain increasingly integrated into every area of human enterprise ranging from communications and business to defense and security. Our goal in this study, therefore, is to seek to illuminate the forces driving U.S. policy in the space area and the correlations between the global space marketplace, economics, international politics, technology, national security, and public policy.

The desire of rising beyond the confines of earth and navigating the heavens toward the outer reaches of our universe has been a enduring aspect of our civilization. From the myth of Icarus' winged flight toward the sun to Leonardo's drawings of winged machines and on to the development of today's powerful rockets and shuttles, man has aspired to explore the galaxies to better understand the universe and his position in it. However, while in the past space was indeed the domain of scientists, astronomers, and dreamers of new worlds, in the 20th century, with the rapid advance in technology, it has increasingly become the domain of military strategists and large-scale business interests.

Major policy decisions in the space area often have not been the result of long-range, objective planning, based on a rational determination of purpose, means, and ends, but rather evolved in response to a series of political, economic, or other unforeseen events that occurred in the global or domestic arena. Over the long term, three major events molded the direction of U.S. space policy. In the first instance, the shock of the unexpected launch of Sputnik I in 1957 propelled the U.S. to develop the Mercury, Gemini, and Apollo manned flight programs and to attain the technological feat of landing a man on the moon in the brief span of 11 years. Cold War realities, whether actual or psychological as opposed to rational long-term planning, governed this first phase of U.S. space policy. Subsequently, as we will see below, economic and employment considerations played a role in determining the second major phase of U.S. space policy which was based on the development of the space shuttle. And, more recently, the third major new direction in space policy was provoked by the explosion of the space shuttle Challenger. The tragedy forced the U.S. to reevaluate its total reliance on the shuttle for all space transportation and provided a stimulus to diversification and commercialization of U.S. space activity.

Today, as we leave a bipolar world behind and move toward a multipolar one, and as space systems and the nations that have access to them increase in number and technological sophistication, policy is increasingly molded by economic and security imperatives of a different nature. As ideological barriers drop and the global economy imposes its constraints on the once highly independent space programs of the two superpowers, we are witnessing both at the political/governmental and at the business/market levels an accelerating tendency toward transnationalism and global alliances. In this context, it is apparent that the traditional state-centric analytical divisions adhered to in the traditional political science literature between security, politics, economics, business, science and technology have eroded as the globalization of human activity has blurred former lines of demarcation between disciplines and areas.

In the ensuing pages, we will analyze the unfolding of policy at the *macro* level, encompassing a longer time-frame, through an investigation of the history of the U.S. space program from its inception in the late 1950's to date. Conversely, to gain a picture of an aspect of policy making at the *micro* level, the study will include a case study of a specific policy: the Reagan Administration's controversial landmark decision in 1988 to license three Hughes Aircraft Company satellites for launch on Chinese boosters. This decision, brought about through the active lobbying of Hughes Aircraft Company and allied interests, illustrates how *firms can become transnational forces for change* in governmental policy. It reinforces political economist Susan Strange's contention that more attention should be paid to "developing a perception of the firm in its transnational context--as a political actor developing and nurturing relationships with governments, with international agencies, with other enterprises, with its bankers, and with university research centers."[5]

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[5]In this connection, Professor Strange feels that our business schools have for the most part neglected the study of the external relations of firms with other hierarchies in favor of the more traditional focus on the internal functioning of the hierarchical firm and its maximization of profit. This approach does not give sufficient recognition to the changed nature of the global economy in which the state is no longer the only or in some cases even the primary arbiter of power. She points out that "...in the literature developed in and used by the business schools, these new interfirm relationships are poorly researched and analyzed. Theories of the firm, like theories of the state, are essentially inward looking. They ask how the 'firm' functions and what motivates its management to function as it does. This reflects a body of theoretical literature built around two basic hypotheses: the enterprise operates as hierarchy and the hierarchy's use of power is justified by the end to which it is put, which is the maximization of profit for the enterprise, enhanced, if

The Changing Nature of the Space Variable

The space variable has assumed increasing importance in both the security and business spheres in a variety of ways: (a) space is one of the areas that best exemplifies the intensifying trend toward the intermeshing of business/economics, technology, and politics on a global scale, or what might be referred to as the globalization of both decision making and the marketplace; (b) space, moreover, is a new frontier of human endeavor, and the conquest of new frontiers throughout the centuries has been a harbinger of change and civilizational advance; (c) additionally, outer space represents the place where a quantum leap in future technological evolution and human scientific and economic advances will probably occur.

Most significantly, the Long March booster decision brought about by Hughes Aircraft Company highlights the importance of the growing trend in government-firm relations

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possible, by internalizing benefits and externalizing costs." (p.46) A new focus, she feels, would require that scholars and observers free themselves from the "old, comfortable statebound view of the firm's environment." (p.47) In her opinion, it also necessitates that the analyst have a grounding in something beyond business studies and old neoclassical economic theory, whether this be "international relations, international history, ...international organization ... or political science, development economics, or economic history." (p.47)
"An Eclectic Approach," in: The New International Political Economy, ed. Craig N. Murphy and Roger Tooze (Boulder, CO: Lynne Rienner Publishers, Inc., 1991).

and negotiations in the making of policy mentioned earlier. Moreover, it constitutes an important watershed in U.S. international trade policy toward China in a technology-sensitive area. The approval won by Hughes represents the first time that the U.S. government decided to license commercial launches by a non-free world government involving U.S.-made satellites, albeit with significant safeguards. As such, it is one of the initial signs of changing structural trends arising from the "deeper currents of history," to use the French historian Fernand Braudel's terms.[6]

We are now witnessing an acceleration of these trends as, under the pressure of firms and governments, many restrictions on trade and high technology products are being lifted with regard to the former Soviet Union and Eastern bloc countries.[7] If the process of democratization in the

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[6]In his work The Mediterranean and the Mediterranean World in the Age of Philip II, Braudel speaks of the need to examine the "hidden balance of forces, the physics of Spanish policy" and to pay heed to the deeper flows of structural history, the history of the longue durée as opposed to short-term phenomena. As he indicates, "Still waters run deep and we should not be misled by surface flurries." (New York: Harper and Row, 1972), Vol. II, p.1242.

[7]For example, despite both the Reagan and Bush administrations' initial hard line against the use of Soviet boosters, the process of lifting restrictions on the use of the Soviet Zenit rocket at the new Australian Cape York space facility began to be set in motion in 1990 with the license granted to an American company, the USBI Division of United Technologies Corporation, to run the facility. See: John H. Cushman, Jr., "U.S. Ready to Let Satellites Go Up on Soviet Rockets," The New York Times, July 8, 1990, pp.1,12.

former Soviet Empire continues to unfold, it is likely that the boosters of the new Commonwealth of Independent States will eventually be integrated into the international space marketplace.[8]

The Long March decision additionally points to some of the significant changes that are taking place in global market structures. In terms of policy making, for example, the decision represents an intriguing illustration of the rise of global "issue networks."[9] U.S. satellite builders

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[8]While the formal demise of the Soviet Union on December 25, 1991 and the formation of the Commonwealth of Independent States may accelerate the trend toward closer cooperation with the U.S. and Western nations, the uncertain progress of relations between the republics of the former Union and the question of control of nuclear weapons is likely to still mandate a cautious approach toward close cooperation in high technology areas such as space.

Nonetheless, proposals for a closer working relationship between the U.S. and the Russian Republic have emerged also in the Strategic Defense Initiative Organization (SDIO) in the Pentagon. Dangers of Third World nuclear proliferation have provided an incentive for cooperation on SDI and ABM systems. SDIO has proposed collaboration with the Russians in six areas in which the latter are ahead. This would also aid in providing jobs for over 1000 Russian scientists, thus helping to avert a possible brain drain of scientists to Third World countries desiring to develop their own nuclear programs.
"SDIO Plans to Acquire Russian ABM Technology, Specialists," Aviation Week and Space Technology, 10 February 1992, pp.18-20. For further discussion of these trends, see Chapters 3-6, esp. pp.78ff and 137ff.

[9]I am here extending the concept of issue networks elaborated by Hugh Heclo to comprise the idea of alliances or networks at the global level that have developed as a result of mutual interests and areas of expertise/activity. Heclo develops his concept of issue networks with a different focus
(continued...)

found themselves allied with Chinese and Soviet commercial launch interests, while the nascent U.S. commercial launch industry and the European launch organization, Arianespace, in principle have been opposed to these commercial ventures due to fear of losing market share. Other transnational interests are involved in that the satellites, while built by Hughes, are owned by foreign groups. Two of the satellites were purchased by the Australian telecommunications firm Aussat and were launched in 1992.[10] The third satellite, purchased by a British-Chinese consortium called AsiaSat, is a reconditioned Westar-VI satellite that was recovered in

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[9](...continued)
and in reference to the domestic area. Going beyond earlier models of "iron triangles" and subgovernments (Freeman 1965, et al.), which imply small groups of autonomous participants in the policy making process, he indicates that "The many new policy commitments of the last twenty years have brought about a play of influence that is many-stranded and loose...More than ever, policy making is becoming an intramural activity among expert issue-watchers, their networks, and their network of networks. In this situation, any neat distinction between the governmental structure and its environment tends to break down." This latter comment is also applicable to the global arena.
See: "Issue Networks and the Executive Establishment," in The New American Political System, ed. Anthony King (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1978), pp.105-6.

[10]Aussat was acquired by Optus Communications in late 1991. The Aussat/Optus B1 satellite was launched in August 1992 from the Xichang launch site in the southwest province of Sichuan and entered into full commercial service in December. Aussat/Optus B2 was launched December 22, 1992 but did not achieve orbit due to what is believed to be a booster problem, although investigators have still not determined the precise cause of the failure. A replacement satellite, Optus 3, is scheduled to be launched in approximately 18 months. See Chapter 7, pp.161 ff. and especially p.176.

orbit by the U.S. Space Shuttle in 1984. It was successfully launched in China on April 7, 1990. Hughes Aircraft Company, General Electric and other satellite builders actively lobbied Congress and the Administration to reconsider U.S. policy banning the use of Chinese and Soviet launchers by U.S. companies. Conversely, the Chinese and the Soviets actively lobbied the U.S. and other Western nations to lift restrictions on the use of their boosters.[11] The new Commonwealth of Independent States, successor entity to the Soviet Union, is continuing to press for closer integration of its space program with Western ones.

The Question of Theoretical Approach

In policy analysis, the question of approach often remains unarticulated or manifests itself in terms of a series of somewhat fuzzy assumptions that lack clear definition or cognizance of intellectual roots. Yet, if the purpose of political analysis is to seek to shed light on the course of human events and from there to achieve some understanding that might provide a solid foundation for policy making, then the way the analysis is conducted and the paradigm(s) employed (whether consciously or unconsciously) become of

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[11]See: Theresa M. Foley, "Satellite Builders Want Change in U.S. Anti-Proton Policy," Aviation Week and Space Technology (September 28, 1987, Vol.127, No.13), p.138; and "Reagan Approves Use of Chinese Booster to Launch U.S. Satellites," Aviation Week and Space Technology (September 19, 1988, Vol.129, No.12), p.22.

paramount importance in determining both the assumptions and the types of questions asked (input) and conclusions arrived at (output). The conceptual question of theoretical approach affects both the analytical endeavor and conclusions reached. Aaron Wildavsky makes a similar point when he writes:

> Facts do matter, even if they are not all that matters; but more important is the theoretical frame that makes the available facts more or less persuasive. The questions we ask, our attention-directing and information-rejecting frameworks, help determine the answer we seek.[12]

The issue of *which* approach may best illuminate events is a problem common to any attempt to arrive at an interpretation of reality. It is a conundrum that has been central to all of human philosophical and social thought and has especially afflicted the social sciences since their emergence as separate disciplines and increasing specialization in the twentieth century. One might also venture that since the question of approach is tied to the ongoing process of an evolving world view, with concomitant paradigm shifts (to use Thomas Kuhn's terms),[13] it is not likely to be resolved in any definitive way. In other words, as new historical realities unfold, an existing approach will likely need to be

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[12]Aaron Wildavsky, Searching for Safety (New Brunswick, NJ: Transaction Publishers, 1988), p. 206.

[13]For a discussion of Kuhn's concept of paradigm shift see pp.189f.

modified to encompass a novel set of parameters and variables or a different series of correlations between existing ones. Just as in the sciences theories build on each other and change, so in the social sciences it is necessary to adapt theory to new circumstances and realities.[14]

The question of models and approach has become problematical in our times. As mentioned, there is a widespread sense of failure in the theoretical literature of many disciplines because current models do not seem to adequately illuminate our turbulent late 20th century reality. Why is this so?

A Turbulent World Picture

We are living in a period of accelerating political and social transitions fueled by extreme disparities in development and consumption, geometrically rising population figures, large national debts and economic insecurity, evolving multipolarity, third world arms races and dangers of nuclear proliferation, the centripetal globalization of problems on the one hand and centrifugal movements toward individual diversity, freedom, self-determination and

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[14]It should be noted that while an approach shapes the interpretation of events, it is at the same time influenced by the world of outside phenomena. This leads to a constant feedback loop between the subjective world of the observer and the external world of phenomena.

recognition of national heritage around the world on the other. Ironically, those factors that would in the long term be seen as global unifying forces, such as the influence of information media and technology, have in the short term helped spur the centrifugal elements at work. The revolution in communications has revealed to disinherited masses how their luckier brothers in other parts of the world live and has confirmed the fears of those nations outside of the mainstream of the global market economy that their future was destined to deteriorate without major social and political changes and policy realignments. It has also created problems of governance, particularly for post-Communist and Developing World leaders as their populations acquired knowledge of preferable socio-economic options. To paraphrase an off-the-record comment of one leader of a Latin American nation, before people knew of only one way of life and they accepted it. Now they know there are different ways of living and their expectations have changed. Leaders who cannot meet those expectations will find it very difficult to govern.

The contradictory influences connected with the advance of information technology may be seen also in the resentment and alarm felt by many nations around the world at what they felt was the suppression of their own local cultural values by the culturally homogenizing impact of largely U.S. television programming expressing Western values. What many observers did not fully think through or foresee, however, was the speed at which the ideological messages embodied in the Western images and distant voices succeeded in destabilizing and revolutionizing those nations. It was not widely anticipated, for instance, how the criss-crossing influences and interaction of the information media, failed communist economic and social policies, and the economic pressures created by the post World-War II arms races, could aggregate and combine in the late 1980's leading to the precipitous fall of the Berlin wall and the momentous changes in the former Soviet Union and Eastern Europe. This aggregation of forces succeeded in creating an accelerating movement toward what might be termed a sudden bifurcation or break in the order of the past. As against an orderly linear evolution of events, such a dynamical aggregation of forces produces *nonlinear* and discontinuous development with the accompanying turbulence which denotes destabilized systems and transitional stages toward an eventual new order of things. *Unintended or unforeseen consequences created by forces that impinge on one another and combine are one of the driving engines of rapid change in our time*. The resulting concatenations of feedback processes tend to make long-term analytical prediction impossible.

Guiding Assumptions and Methodology

In terms of policy analysis, how does the global context of turbulence and rapid change affect the area of outer space decision making and policy implementation? The major hypothesis guiding this study is that in a situation of high flux characterizing transitional phases in socio-political and economic affairs on a global scale, it is necessary to develop a policy vision that is not only global in nature, but one that also approaches turbulence and radical socio-political discontinuity from a different perspective. This perspective, if it is to deal with dynamical real-world systems, must be "nonlinear" and *multidimensional*. It would require the correlation of sometimes disparate or *remotely* connected variables as a major part of its analytical endeavor.

Linkages and correlations would also be sought across a variety of disciplinary areas, ranging from politics and economics to technology. *Such a multidimensional perspective would actively seek the conditions of the possible underlying connections or interactions of diverse variables, not only in terms of present historical time but also with an eye on different historical time frameworks or cycles*. In other words, this analytical outlook would focus on *the dynamics of interaction and nonlinear aggregation of events on a global or systems level*, across a variety of inter-related fields. It would favor an "eclectic" view such as the one put forth by Susan Strange[15] as opposed to a linear sectoral approach, such as the "state-centered" ones that have characterized international relations theory to date.[16]

While, as indicated, we will discuss the theoretical dimension further in later chapters, we should note that this study is guided by three major interlinked assumptions. These assumptions postulate that:

> a) a globalization of "national" reality has taken place and therefore the distinction between domestic and international policy making has been blurred to the point where it is difficult to separate one from the other: in most instances a dynamic tension between global and domestic factors determines the course of both foreign *and* domestic policy making.
>
> b) a "multi-dimensional" systems perspective which will go beyond the narrow confines of a single approach or highly specialized analysis and seek to combine insights from different approaches and disciplines may be more helpful in shedding light on the complex political/economic/technological reality of our times than a narrower sectoral approach.

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[15]For a discussion of Susan Strange's work, see pp.226f.

[16]See, for example, the work of: Hedley Bull, The Anarchical Society: A Study of Order in World Politics. New York: Columbia University Press, 1977; Richard C. Snyder, H.W. Bruck and Burton Sapin, eds. Foreign Policy Decision-Making: An Approach to the Study of International Politics. New York: The Free Press, 1962; Kenneth N. Waltz, Theory of International Politics. New York: Random House and Newbery Award Records, Inc., 1979.
For further discussion of the state-centered approach, see pp.195 ff.

c) the science/technology variable should be an integral part of political analysis as science and technology have assumed a dominant role in global society and are fostering integration of societal process and change at an increasingly rapid rate.

In the following pages, I will first seek to analyze the evolution of U.S. space policy and the Long March booster decision within the context of accelerating globalization processes and transformations that have been described as "sea-changes" by one group of experts.[17] We will approach the subject both from a longer time frame (represented by the inception of space policy in the late 1950's to date) so as to gain a sense of the multidimensional or macro aspects of the development of space policy. At the same time, we will examine policy making limited to the shorter time frame afforded by the case study of a single decision, that pertaining to the Chinese Long March boosters, which permits us to gain a greater sense of the highly integrated political and economic nature of decisionmaking in an increasingly globalized reality. Subsequently, we will discuss some of the theoretical questions that we have alluded to in the preceding pages and their significance for the role of the social scientist working in today's turbulent reality.

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[17] Nicholas X. Rizopoulos, ed., Sea-Changes: American Foreign Policy in a World Transformed (New York: Council on Foreign Relations Press, 1990).

Part I of the study deals with the background and development of U.S. space policy. *Chapter One* examines the roots of the U.S. space program and its early evolution based on superpower rivalry and national security considerations. *Chapter Two* highlights the military space program of the Soviet Union/CIS which was the catalytic agent in the genesis and subsequent formation of the U.S. program. It also discusses changes that are occurring in the Soviet/CIS program as a result of the demise of the Soviet Empire and these may affect U.S. space policy. *Chapter Three* discusses the U.S. military space program and the current dangers posed by the growing proliferation of nations with space systems and/or space technology.

Part II of the study focuses on the U.S. civilian space program and examines the new trends and issues in space business/commercialization. In *Chapter Four* the discussion centers on the development of civilian space policy and the creation and growth of the National Aeronautics and Space Administration. The chapter highlights the discontinuous and nonlinear aspect of policy making in the area of space. It notes how policy progressed from the spectacular U.S. achievements of placing men on the Moon within a eleven-year time frame based on a reaction to the Soviet challenge, to a shuttle policy dangerously limited in vision in the 1970s and early 1980's. *Chapter Five* continues the discussion of how the U.S. program lost the élan and sense of direction of its earlier vision and how in the latter part of 1980s and at the beginning of the 1990s, a new bearing and feeling of purpose emerged in U.S. space activity. The chapter examines how this new policy outlook came about and what it portends for future U.S. activity in the space arena. *Chapter Six* instead looks at the commercial dimension of space activity. It discusses the growing trends toward transnationalism and cooperation between East and West in the space area, which are harbingers of new directions and are likely to spur increased activity in space. *Chapter Seven* reverts from a macro perspective to the micro analysis of space policy through a case study of a watershed decision concerning the licensing of three Hughes Aircraft Company satellites for launch on Chinese boosters. The decision brings to the fore the new importance of government-firm relations and negotiations with regard to the policy making process in the space area, and illuminates the interlinking of the business, trade, national security, foreign relations, and technological issues involved.

Part III deals with the theoretical dimension of our inquiry. *Chapter Eight* examines the theoretical fragmentation and sense of failure facing political science as a discipline and seeks to identify some of its causes. *Chapter Nine* discusses different approaches that might prove to be more successful in illuminating the turbulent reality of our contemporary world than the state-centered, prediction-oriented ones put forth in the traditional literature. The *Conclusion* seeks to further probe the interfacing of the practical aspects of space policy making with theoretical considerations. It addresses the question of the new role of the political analyst in a world in which long-term prediction is no longer viewed as the paramount aim of inquiry since it is not an attainable goal within the context of the turbulent, nonlinear reality of our times.

PART I. THE BIRTH OF SPACE POLICY: THE MILITARY DIMENSION

CHAPTER 1. NATIONAL SECURITY AND THE EVOLUTION OF U.S. SPACE POLICY

Nature has accordingly again used the unsociableness of men, and even of great societies and political bodies, her creatures of this kind, as a means to work out through their mutual antagonism a condition of rest and security. She works through wars, through the strain of never–relaxed preparation for them.... All wars are, accordingly, so many attempts––not indeed, in the intentions of men––to bring about new relations between the nations; and by destruction, or at least dismemberment, of them all to form new political corporations.
Immanuel Kant[18]

If the Soviets control space they can control the Earth, as in the past centuries the nations that controlled the seas dominated the continents.
John F. Kennedy[19]

Space policy reflects the complexities and contradictions inherent in most human endeavors. Since it permeates to some degree all aspects of our lives ranging from telecommunications and defense to commerce and scientific discovery, the economic demands space makes on budgets and resources are often at odds with the those of earthly programs and needs. There are three basic aspects to space policy which are closely interrelated: policy concerned with (a) military

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[18] Idea of a Universal History from a Cosmopolitan Point of View, in Theories of History, Patrick Gardiner, ed. (New York: The Free Press of Glencoe, 1959), p.28.

[19] Quoted in: Nicholas L. Johnson, Soviet Military Strategy in Space (London: Jane's Publishing Company Limited, 1987), p.27.

payloads and activity, (b) civilian/commercial activity, and (c) scientific research. Discussion of policy matters in these three areas is most often compartmentalized and takes place either in terms of specialized issues confined to the specific sector, or antagonistically in terms of competition for limited budget funds. As opposed to a strictly fragmented sectoral approach, however, to obtain a sense of policy evolution we will first look at the development of space policy from the all-encompassing perspective of national security which determined its initial direction and character. In this and the following two chapters we will begin by examining the defense origins and evolution of space policy. To obtain a broader perspective, we will also briefly look at the Soviet military space program which provided the stimulus for the implementation of the U.S. program. Following our discussion of military space, we will examine the civilian and business aspects of space activity.

As indicated, U.S. space policy at the outset arose as a product of national security concerns.[20] While there is

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[20]A somewhat different scientific and cultural matrix gave rise to the Soviet space program. An interesting perspective is offered by Michael Holquist who attributes the origins of the Soviet space program to philosophical vision as well to as security considerations. Holquist has traced ideas that were instrumental in shaping Soviet space research back to the philosopher and librarian Nikolai Fyodorov (1828-1903) who in turn became a guiding influence on the work of Konstantin Tsiolkovsky (1857-1935). Tsiolkovsky, Holquist (continued...)

a tendency to treat the military and civilian areas of space separately, it might be argued that not only the military sector but also the civilian commercial and scientific ones are intimately linked through national security: the first to military security, the second to economic security, and the third to the more general aspect of security involved in the

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[20](...continued) points out, is considered to be the "greatest pioneering genius of modern space research" whose work in aerodynamics, rocket engineering, fuels, and other space related technologies helped the Soviet Union to become the first nation to put a satellite (4 October 1957), the dog Laika (3 November 1957), and a cosmonaut, Yuri Gagarin (12 April 1961), into orbit. Fyodorov, admired by Dostoyevsky, Tolstoy and other leading intellectuals of his time, developed an outlook which he described as "the philosophy of the common task." He espoused an animistic concept of the universe in which all matter is considered to have life, from rocks to galaxies and humans. Lifeforms are simply differentiated by existence in different dimensions of time, velocity, space and consciousness. Human beings are considered to be inhabitants of the cosmos as opposed to being viewed simply as a life species specific to earth. As the exponents of the highest degree of consciousness, they also have the ethical duty to bring order to and regulate the chaotic workings of the universe which can lead to entropy and death. The common task, for Fyodorov, is to overcome death. One aspect of this, in his mind, is to seek to resurrect those who have died, an idea, Holquist points out, that influenced Dostoyevsky in the Brothers Karamazov. This is also one of the reasons for Fyodorov's interest in science, which he viewed as the means to this end. Cosmonautics in particular would permit human beings to find additional planets to settle and feed the newly resurrected. Such ideas of space colonization, the discovery of raw materials that will lead to renewed prosperity and freedom from want, Holquist indicates, inspired Tsiolkovsky's scientific work. As he notes: "... it is in the philosophy of Fyodorov and the technical breakthroughs of Tsiolkovsky that this utopian aspect of space travel finds its most potent manifestation, for without Tsiolkovsky there would have been no Soviet space program." (p.4)
"The Philosophical Bases of Soviet Space Exploration," The Key Reporter (Winter 1985-86), pp. 2-4.

extension of scientific knowledge and understanding.[21] This latter form of security is achieved both by looking *downward* from a satellite to identify ecological, agricultural, geological and other problems facing the inhabitants of planet earth, and also by looking *outward* to acquire greater understanding of the cosmos.[22] In point of fact, since all three areas are closely interrelated, it is sometimes difficult to distinguish the different types of security represented by space activity, particularly in the case of satellites, most of which can be used for multiple purposes and can serve as a means of advancing all three types. However, during the early post-World War II period, the initial development of space transportation systems in the U.S. was viewed by policy makers strictly in terms of military security as opposed to a broader outlook that would encompass all three aspects of security.[23]

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[21]Reference here is made to the extended meaning of national security as security that encompasses the social, economic, and political well-being of the individual. See the discussion of the multidimensional meaning of national security in Chapter Seven, esp. pp.202ff.

[22]The Report of the Advisory Committee on the Future of the U.S. Space Program, (the "Augustine Report," named after the Committee Chairman Norman R. Augustine) calls these two aspects of space activity the "Mission to Planet Earth" and the "Mission From Planet Earth." (Washington, DC: GPO, 1990).

[23]The Report of the Advisory Committee on the Future of the U.S. Space Program (the Augustine Report), for example, emphasizes that "our original national space effort was to a considerable extent founded on the need to assure national security. The revelation of the advanced state of Soviet

(continued...)

Space and International Politics: The U.S. Reaction to Sputnik

In terms of the importance of space as a political and economic variable, the fact that it has a significant impact on the national and international arena clearly emerged at the onset of the U.S. space program with the Soviet Union's launch of Sputnik I into space on October 4, 1957.[24] The startled, alarmed reaction to the launch in the United States and the magnitude of its subsequent impact on superpower relations is extraordinary if one considers that at the time it was no secret that the Soviet Union was working on the development of satellites and intercontinental ballistic missiles (which can also double as satellite launchers). While for the U.S. leadership and for the general public the launch of Sputnik seemed to be an unexpected, unsettling, and extremely dangerous event, in 1955 and 1956 the Soviet Union had published reports on its intention to build a satellite

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[23](...continued) technology, reflected in Sputnik, and the development of intercontinental ballistic missiles propelled America's space and advanced military technology efforts for many years." p.23.

[24]To make matters even worse from the U.S. point of view, this first launch was closely followed by the launch of a "biological" satellite carrying the dog Laika on November 4, 1957 which was designed, together with others that followed later, to furnish information for the first Soviet manned flight was to take place in 1961. In their desire to capitalize on their lead, however, the Soviets made the launch before they had worked out the technical aspects of reentry. The dog, therefore, had to be put to sleep after a week in orbit.

for scientific research and to put it into orbit in connection with the International Geophysical Year.[25]

The stunned U.S. reaction to the early Soviet launch reflected a policy making process that was limited in both breadth and scope. The shock engendered at the executive and legislative levels and among the general public evidenced a policy community that was not attuned to associating a variety of disparate elements in reaching policy decisions. Analysts had failed to focus on nonlinear or seemingly remote variables in their deliberations, such as the significance of the advances in Soviet satellite research or of background cultural factors. This in turn led to an incomplete understanding of the dynamic relationship of events. The reaction to Sputnik as something "unexpected" showed a lack of correlation of the diverse factors pertinent to the shaping of an overall U.S. space policy. Had such a multidimensional

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[25]Nicholas L. Johnson, an expert on Soviet space, quotes a translation from Vechernaya Moskva, 16 April 1955, p.1, published in a Rand Corporation Report, RM-1760 21 June 1956, A Casebook on Soviet Astronautics, by F.J. Krieger, which announced the creation within the Soviet Academy of Sciences of a "Commission of Interplanetary Communications" which would "organise work concerned with building an automatic laboratory (i.e., satellite) for scientific research in space."
Nicholas L. Johnson, Soviet Military Strategy in Space (London: Jane's Publishing Company Limited, 1987), p.17.
See also: Phillip Clark, The Soviet Manned Space Program (New York: Orion Books, 1988), p.9.
Sputnik I remained aloft until 4 January 1958 when its orbit decayed.

linkage of scientific, cultural, and security variables taken place, it is likely that the United States would not have been caught off guard by the Soviet launch and would have been better able to meet the Soviet "challenge" without the *angst* engendered by Sputnik. What for most was the "sudden" fall of the Shah of Iran and of the Berlin wall, also evidenced a similar lack of analytical linkage.

Subsequently, while most of the world grappled with the significance of the satellite *per se*, in retrospect, most observers would agree that a matter of equal if not greater interest in view of later arms race developments was the utilization of a new Soviet SS-6 Intercontinental Ballistic Missile (ICBM) for the mission. This missile, in addition to its use in the launching of satellites, could also be armed with nuclear warheads, an intimation of future technological developments in armaments.[26]

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[26]An intercontinental ballistic missile (ICBM) is a rocket-propelled guided missile with a range of over 3,000 nautical miles. After the initial boost phase, the rocket thrusters are turned off at an established point, one or more reentry vehicles are released, and these complete their trajectory on a free fall basis affected by gravity and atmospheric conditions. ICBM missiles have three trajectory stages: an initial boost stage when the rocket's thrusters are propelling it into space, a mid-course state in space during which at some point the thrusters are turned off, and a reentry stage for final free-fall approach to its target. Different defenses are targeted according to the particular intercept stage. ICBM defenses can be directed from space to target the exhaust heat of the missile's boost phase, or a mix of ground and space interceptors can target a missile (continued...)

While prior to Sputnik I, the realm of space was considered to be principally the domain of scientists interested in investigating the universe, Sputnik brought space squarely into the middle of domestic and international politics. As a result, both U.S. and Soviet scientists increasingly concentrated on the improvement of ballistic missile systems. Significant advances in this area were achieved in large part through utilization of the expertise of German rocket scientists who had been brought to both the U.S. and USSR after the end of World War II to continue their ballistic missile work.

Historian Walter A. McDougall in his study on the political history of the space age ascribes the U.S. reaction to Sputnik to a particular historical conjuncture that encompassed different psychological and international strategic factors. After World War II the United States had assumed the role of leader of the free world based both on its vision of democratic governance and way of life, a free-market economy, and on its technological lead which permitted it to extend security to those allied countries under its protective umbrella. With the launch of Sputnik, the Soviet Union was perceived to be on the verge of achieving strategic parity

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[26](...continued)
during its mid-course trajectory in space or during its reentry phase.

with the U.S. With its new ICBM capability, it could now strike at the heart of the United States. American deterrent capability was put into question. For McDougall, Sputnik changed the very nature of the Cold War:

> What Sputnik did, in simultaneously presaging nuclear parity and suggesting Soviet scientific superiority, was to alter the nature of the Cold War. Where it had previously been a military and political struggle in which the United States need only lend aid and comfort to its allies in the front lines, the Cold War now became total, a competition for the loyalty and trust of all peoples fought out in all arenas of social achievement, in which science textbooks and racial harmony were as much tools of foreign policy as missiles and spies. The self-confident administrations of Kennedy and Johnson set out to prove what had previously been taken for granted-- the superiority of American institutions. And their chosen weapon was induced technological revolution...[27]

The New Technological Arms Race

It must be remembered that the 1950's was the age of what Lawrence Freedman has described as "a developing vision of a technological arms race."[28] Freedman also points out that Sputnik was a watershed occurrence:

> No event focused popular attention on America's vulnerabilities to attack more than the launching

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[27]Walter A. McDougall, The Heavens and the Earth: A Political History of the Space Age (New York: Basic Books, 1985), p.10.

[28]Lawrence Freedman, The Evolution of Nuclear Strategy (New York: St. Martin's Press, 1981), p.156.

> of the world's first artificial earth satellite, *Sputnik I*, by the Soviet Union on 4 October 1957. It brought home the fact that the United States no longer enjoyed invulnerability to the ravages of war.... The Russians had shown that they could match --indeed exceed-- the Americans in technological sophistication. Previously the cold war had been a competition between economic systems. In the West the capitalist system had been expected to triumph because of its superior performance both in developing wealth and encouraging innovation. The communist system was viewed as being so rigid that it would not be able to meet the challenges of the modern world. *Sputnik* demonstrated that the Soviet Union could operate as a modern industrial power in its ability to mobilize and exploit scientific and engineering talent...Finally, as a surprise in itself, *Sputnik* lent credibility to the notion that the Russians could, surreptitiously, steal an unexpected lead over the United States and put her at a terrible strategic disadvantage." (pp.139-140)

The decade witnessed the acquisition of nuclear fusion (hydrogen) bombs both by the United States (1952) and the Soviet Union (1953), the initial development of deterrence and the theories of pre-emptive strikes and massive retaliation, and the compilation of the Killian (1954-55) and Gaither (1957) Reports, prepared for presentation to the National Security Council, which both highlighted U.S. vulnerability. Influential analysts of the realist school of politics, such as Albert Wohlstetter, Herman Kahn, Bernard Brodie, Thomas Schelling, Henry Kissinger, George Kennan, and many others, through their writings and assessments of superpower relations and technological achievements, also increased the impression of U.S. vulnerability.

In briefings given to the Gaither Committee, later presented in his persuasive article, "The Delicate Balance of Terror," published by Foreign Affairs in 1959, Wohlstetter emphasized the fact that deterrence is "neither assured nor impossible but will be the product of sustained intelligent effort and hard choices, responsibly made."[29] Wohlstetter saw the stability of the nuclear balance as something "delicate" and essentially unstable. He was disturbed by what he felt was a "misconstruction of the technological race" by current thought [late 1950's] that viewed the maintenance of the balance in terms of matching striking forces. In the process of developing his argument, however, Wohlstetter highlighted the vulnerability of the U.S. nuclear forces. His analysis underscored the problem that surviving a first offensive attack and being capable to strike back is not automatically a function of numerical *equality*. In order to guard against a first strike, a defense had to have *redundant capability* in terms of surviving that strike and inflicting unacceptable damage in return. Wohlstetter's argument had great impact on the U.S. military. It led to a reevaluation of defense vulnerability and capability which resulted in the *unintended consequence* of a substantial increase in military build-up in the United States in the years that followed.

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[29]Albert Wohlstetter, "The Delicate Balance of Terror," in Foreign Affairs, Vol.37 (January 1959), pp.209-234.

Sputnik: The Divergence Between Perception and Reality

The disproportionate reaction to Sputnik I in the United States also evidenced mistaken perception and a deep-seated sense of failure in competitive technological achievement. While the Soviets were quick to capitalize on their space feats in the realm of international public relations, in reality their technology was not as advanced as the United States and the world supposed. As space expert Nicholas L. Johnson writes in Soviet Military Strategy in Space, the Soviets "had merely mastered the problem of scale, not technology."[30] The 184 pound Sputnik I orbited the Earth for 21 days emitting radio beeps, and the biological satellite carrying the dog Laika weighed 1,121 pounds. Displaying greater sophistication in miniaturized electronics and in scientific instrumentation, the first U.S. satellites like the Explorer I, launched on January 31, 1958 and weighing only 10.5 pounds, permitted the discovery of the Van Allen radiation belts and the small Vanguard I, launched March 17, 1958, functioned for over six years, returning important scientific information including data confirming scientific theories that the earth was not completely round but rather pear-shaped.

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[30]Nicholas L. Johnson, Soviet Military Strategy in Space (London: Jane's Publishing Company Limited, 1987), p.18.

The life span of Soviet satellites to date is still shorter than that of their American counterparts, basically due to technological reasons and a different launch philosophy that emphasized redundancy in line with the Soviet strategic objective of winning any space conflict that might arise. This also accounts in part for the much higher launch rates in the Soviet Union as opposed to the United States, even before the Challenger disaster grounded the American space shuttle program from January 26, 1986 to September 29, 1988. From 1981 to 1988 the Soviets were making between 90 and 100 launches a year. They only started reducing the numbers significantly in 1989 (74 launches in 1989, 79 attempts in 1990, down to 59 in 1991).[31] At least three-fourths and possibly more of these launches were either military in nature or had dual military/civilian applications. For purposes of comparison, from 1981 to 1988 the United States recorded between 6 and 22 launches per year, with the lower figure pertaining to 1986, the year of the Challenger disaster. In 1989, the number of U.S. launches began slowly rising to 17, then to 27 in 1990, and in 1992 it

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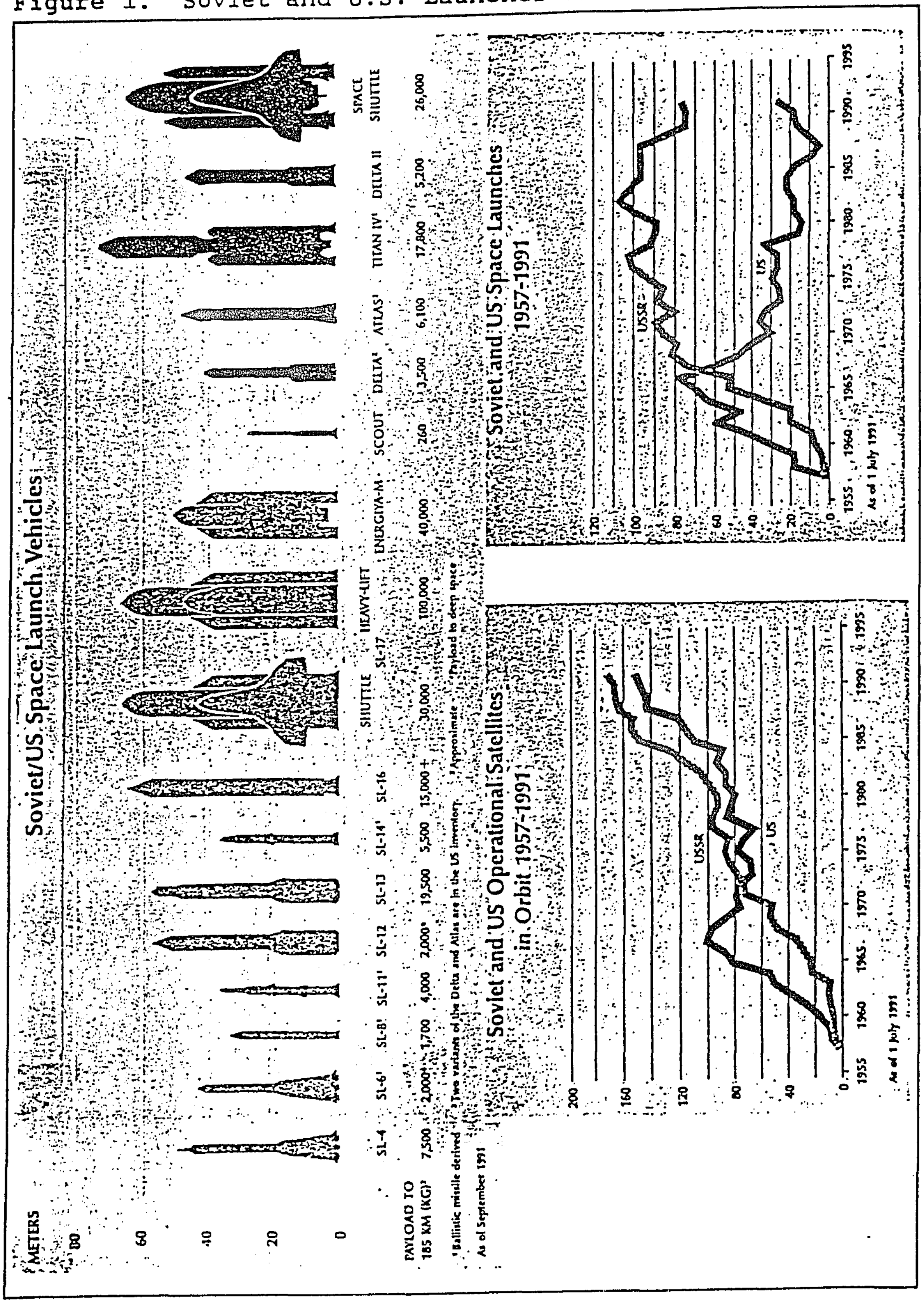
[31]See Appendix III: "World Record of Successful Space Launches," p.289.
To avoid confusion, it should be noted that numbers from different sources may vary slightly depending on whether they include only launches that were successful in placing their payloads into orbit or all launch attempts, including the ones that failed. One should also keep in mind that the number of launches is not equivalent to the number of payloads placed in orbit since one booster may carry several payloads.

is estimated that the launch rate will be in excess of 40 (47 launches and missile tests have been scheduled at Cape Canaveral alone).[32] In terms of total numbers of satellites, the Soviets/CIS currently maintain around 170 in orbit while the United States has over 150 in orbit (See Figure 6, p. 37).

[32]Edward H. Kolcum, "NASA, Pentagon Chart Ambitious Unmanned Launch Vehicle Program," Aviation Week and Space Technology, 16 March 1992, pp.131-133.

Figure 1. Soviet and U.S. Launches and Satellites



Source: Department of Defense, Military Forces in Transition 1991, pp.41-42.

Space and National Security: Technology and a New Concept of Power

Nevertheless, the Russian space feat, followed by others culminating in the first manned spaceflight with the launch of Major Yuri Gagarin on April 12, 1961, set the stage for the U.S. decision to go to the Moon and ushered in the beginning of the space age and space race. John F. Kennedy reflected a prevalent mood in the country when he asserted during his 1960 Presidential campaign: "We are in a strategic space race with the Russians, and we have been losing...Control of space will be decided in the next decade."[33] Kennedy, as John M. Logsdon points out in his perceptive study The Decision to Go to the Moon: Project Apollo and the National Interest, identified space with the American national interest. Logsdon indicates that in reversing President Eisenhower's decision not to go forward with a manned space program, President Kennedy resolved to "use the United States space program as an instrument of national strategy...as a national goal symbolic of American determination to remain the leading power in the world. He decided that the national interest required the first men on the moon to be Americans."[34]

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[33]Quoted in Nicholas L. Johnson, p.27.

[34]Logdson, p.100.

The advance of the new space technologies also heralded a subtle shift in the concept of power. National power and prestige were no longer merely viewed in terms of superior military might, but more as a corollary to technological competence, on which military might itself was seen to depend.[35] The very nature of national power was altered with the introduction of the space variable. Before, greater manpower and size, national unity, geography, alliances, proximity to oceans and trade routes were the defining elements of power. Now any nation that gains access to and/or control of space has effectively transformed and increased its power to the point where it can effectively threaten the security of a distant and much larger nation. Just as control of the seas and technical/industrial superiority enabled the relatively small British Isles to establish a world-wide empire, knowledgeable use and control of space can act as a force multiplier for any nation that acquires the appropriate technology and hardware. Space affords the ability to conduct observation of large expanses of earth. The lack of

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[35]Ralph Sanders in his study on the International Dynamics of Technology, has pointed out that technology has replaced land as the means of adjusting shifts in power: "Nations traditionally have used land as the medium for adjusting shifts in power. They fought most of their wars for land. As one nation increased its material assets by acquiring territory, others sought to redress the balance by like means. In the twentieth century, in many ways, technological competence has replaced land as the medium, sometimes leading to arms and space races." (Westport, CT: Greenwood Press, 1983), pp.115-116.

atmosphere and hence of friction allows objects in space to traverse great distances with relatively small dispersion of energy, thereby dramatically increasing the limited reach of any earth-bound nation. Nations with access to space that become unstable can escalate regional mischief or wars into far-reaching international conflict.

In the same way that we have witnessed the globalization of non-military threats to national security, such as dangers posed by destabilization of the ecosphere, or international economic instability, access to space has produced the globalization of military and nonmilitary threats for those nations that have obtained or developed the requisite technology to operate in this new domain. A nation that uses its satellites to gain natural resource and crop information on a competitor, for instance, might be tempted to use that information to gain economic or other advantages in the international marketplace. An intercontinental ballistic missile armed with a nuclear warhead launched from a Middle Eastern nation such as Iraq is potentially capable of reaching the U.S. or the republics of the former Soviet Union. While the former USSR has an antiballistic missile system in place, in the U.S. an advanced ABM system against ballistic missiles or against possible future space based offensive systems[36] is still in the research and development stage due to past policy decisions that viewed such defensive systems as destabilizing and therefore not worth pursuing. U.S. policy has since changed with the Reagan administration's endorsement of the Strategic Defense Initiative in 1983. At this time, nonetheless, although research and development work proceeds on exotic new defense systems, existing systems by and large would offer limited protection in case of a severe crisis. We will discuss this issue further below.

The impression one sometimes encounters that space has not undergone militarization or only limited militarization and that the Outer Space Treaty (1967) and other treaties have somehow prevented the use of space for military purposes is, unfortunately, not correct. The usage of space for military advantage dates back to the 1930's, to the German rocket scientists at Peenemunde and elsewhere in Germany who developed the first V-2 rocket which was used in battle against Great Britain in 1944. Intercontinental ballistic missiles, for example, traverse space to achieve their targets and therefore meet the definition of "military spacecraft." As one military space expert in referring to

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[36]Offensive systems are currently prohibited by treaties such as the Outer Space Treaty of 1967 and Salt II (see Appendix X, pp.339ff.)

the Soviet SS-18 intercontinental ballistic missile has pointed out,

> If you define a "spacecraft" as an object that enters space and transits it for some given interval of time or distance, then you must characterize the multiple independently targeted, 10-warhead platform of the Soviet SS-18 intercontinental ballistic missile as a "spacecraft." Not only do these platforms travel over 1,000 miles above the earth, they also travel between 3,000 and 4,000 miles *through* space while maneuvering. In fact, they travel above the orbits of over 40 percent of the satellites in low-earth orbits, including most of the Soviet Cosmos satellites, and above our own orbiting Transit naval navigation satellites and Metstar meteorological constellation.
>
> Because the orbital properties of space are ideally suited for spacecraft performing such functions as communications relay, aids to navigation, surveillance, warning, meteorological observation and geodesy, the military forces of both the United States and the Soviet Union have employed satellites in those roles for over two decades. If employment of a regime by military forces or the presence of military systems in a medium define "militarization," then space has been militarized for a long, long time."[37]

Agreements such as the Limited Test Ban Treaty (1963), Outer Space Treaty (1967), the ABM Treaty (1972), SALT I (1972) and SALT II (1979)[38] have nonetheless been instrumental in limiting the offensive potential of space systems to a

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[37]Gen. Robert T. Herres, USAF, "The Military Use of Space," in: Defense Issues, Vol. 1, No.79, pp.2-3. Remarks to the World Affairs Council of Northern California, San Francisco, on September 19, 1986. Gen. Herres at the time was commander in chief of the U.S. Space Command.

[38]Salt II was not ratified by the U.S. Senate in the aftermath of the Soviet invasion of Afghanistan in 1979. Both the U.S. and USSR, however, have adhered to its principles.

defensive function of support of terrestrial forces. When the Soviets in the 1960's developed the idea of an orbital bomb that could be launched into orbit and then returned to earth on command,[39] the existing arms control agreements were instrumental in helping to stop deployment of the system.[40]

The militarization of space has become particularly obvious with the conduct of the Persian Gulf War in which technological superiority both served as the basis of military power and also permitted political power to achieve its ends by enabling the conduct of a surgical operation with

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[39]1967 witnessed the testing of three new Soviet space programs that were primarily offensive in nature. In December of 1967 the Soviets introduced a radar ocean surveillance satellite whose main purpose was to assist their armed forces in targeting enemy naval units. Prior to the launch of this satellite, they had tested their anti-satellite system. And in January 1967 they first tested the Fractional Orbit Bombardment System (or FOBS). This system consists of a satellite launched into a very low orbit designed to evade, or at least render more difficult, radar tracking. In the case of ICBMs, their mid-course trajectory in space permits radar tracking that would give an enemy time for defensive maneuvering. Once the FOBS satellite is launched, however, it can release a nuclear charge upon command either before completing its orbit, or can continue its rotation around the earth for a number of orbits and then release its warhead. In this latter case it is called a Multiple Orbit Bombardment System (or MOBS). The Soviet FOBS tests from 1967 to 1971 were clearly in violation of the Outer Space Treaty signed in 1967 but the United States never forcefully took them to task for this. After 1971, the Soviets stopped testing this system which has remained dormant since then.
For a more extensive discussion of the FOBS and the MOBS, see Nicholas L. Johnson, Soviet Military Strategy in Space, pp.127-36.

[40]As Gen. Herres remarks, the treaties "put the genie of the Soviet fractional bomb back in the bottle." (p.5)

relatively few casualties on the Western allied side (at least if compared with other wars). The achievement of political aims would have been much more difficult had there been high civilian and other casualties documented in real time for a world-wide television viewership.

The Strategic Potential of Space

The significance of the space variable to political analysis rests to a large degree on the strategic value of space. This value continues to grow in importance not only for the two superpowers which have embarked on extensive space militarization programs but also for over two dozen other countries that either have satellites, ICBM missiles, or have acquired the requisite technology for space launches such as France, Italy, the EC, China, Japan, Brazil, India, Pakistan, Israel, Iraq before the Gulf war,[41] and possibly South Africa by the end of the century.

From the time of the launch of the first Sputnik and Explorer to date, satellites have become an increasingly essential element in the military capabilities of the U.S. and the former Soviet Union both in terms of verification and with regard to support of terrestrial communications,

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[41]Iraq launched a reconnaissance satellite in 1989, although its space capabilities have been effectively blocked for the time being by the outcome of Gulf War.

command, control and intelligence (C^3I). As space specialist Paul Stares has indicated in his study on the militarization of space:

> Military satellites not only play a crucial role in the maintenance of the armed peace between the superpowers but are also vital to the planning and prosecution of warfare at almost every level. This dependency derives in large part from the unique services that satellites provide. Where they are not strictly unique they are usually more efficient and economical. This relationship has been progressively reinforced as the variety of military satellites has widened and as the reliance on the equivalent terrestrial systems has diminished, often to the point of atrophy.[42]

The number and types of satellites with military applications has increased over the years, as has their sophistication. Stares lists an extensive array of military satellites, including:

- photographic reconnaissance satellites which can be used for intelligence gathering or the monitoring of arms control agreements;

- electronic intelligence (ELINT) satellites which can listen in on the communications or radar emissions of an adversary and help plot electronic countermeasures;

- ocean reconnaissance satellites which serve to trace shipping, may be improved to detect submarines and can be used for oceanographic surveillance (wave height, ocean currents and winds, sea temperatures) which may be important to naval and submarine operations;

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[42]Paul B. Stares, The Militarization of Space: U.S. Policy, 1945-1984 (Ithaca, NY: Cornell University Press, 1985), p.14.

- early warning satellites that are designed to provide advance information on the launch of intercontinental ballistic missiles, as opposed to reconnaissance satellites that can provide information on conventional force movements;

- nuclear explosion detection satellites;

- communications satellites, which serve as more efficient relays and control for military operations than the older cable systems and radio relays that often had to traverse other countries; in addition, these can act as force multipliers as advancing technology permits miniaturization of ground terminals and thus increases the number of users; these satellites can also double as guidance and tracking systems for ICBM's and conventional weapons;

- meteorological satellites which allow more accurate weather forecasting that can be of assistance for battlefield management, in improving targeting and efficiency of other photoreconnaissance satellites, missiles, etc.;

- geodetic satellites that afford data on shifting magnetic fields, or on the earth's surface, and that can be used to improve the accuracy of ICBM's. (pp.14-17)

Most observers agree that until recently space has played an essentially supportive role to earth-based military operations. As Soviet space observer Nicholas Johnson indicates, satellites are the "eyes and ears" of earthbound forces. However, they "constitute a major threat and become high-value targets primarily when they are viewed as extensions of a terrestrial conflict." (p.13) Strategic offensive weapons have not yet been permanently deployed in space and satellites can be regarded mainly as force multipliers, enhancing terrestrial activities and engagements, although this situation may not last indefinitely.[43]

A major lesson on the importance of military space systems was imparted to the world during the Persian Gulf War, one that has not been lost on military planners worldwide. Gen. Donald J. Kutyna, commander in chief of the U.S. Space Command, pointed out in testimony to the Senate Armed Services Committee in April 1991:

> Operations Desert Shield and Desert Storm displayed an unprecedented integration of military space systems in support of ground operations, amounting to a revolution in the conduct of warfare. These space support functions were provided to a broader range of forces, in a more direct and timely manner, and over a more extended period of time than in any previous conflict. The lessons learned will inform military planning for decades to come. Planners in the USSR, Europe and in other countries will increasingly have to take into account these developments.[44]

The use of high technology and of satellites for reconnaissance and surveillance, targeting, navigation, communication, meteorological and environmental purposes by the Allies

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[43]The distinction between "offensive" and "defensive" weapons is becoming less and less clear cut. The argument can be made that a satellite that is part of a "defensive system" but is designed to help ground forces direct missiles toward their objective and target enemy forces could be considered to have "offensive" capabilities.

[44]John Pike, "The Military Use of Outer Space," in <u>SIPRI Yearbook 1991: World Armaments and Disarmament</u> (New York: Oxford University Press, 1991), p.49.

against an Iraqi enemy that did not possess the same technologies enabled the Western forces to bring the war to a conclusion in record time. As Gen. Donald J. Kutyna underscored,

> ...Operation Desert Storm demonstrated most convincingly that space systems are vital and are an essential element of our force posture. While we did not war in space, Desert Storm was the first campaign-level combat operation where space was solidly integrated into combat operations and was vital to the degree of success achieved in the conflict. Communications, navigation, environmental monitoring and space-based surveillance systems were on-scene and available to our theater forces from the moment the crisis began until the last shot was fired.[45]

General Kutyna recounts that 90 percent of military communications occurred via satellite systems, the Navstar/Global Positioning System (GPS) navigation satellites provided vital accurate position information to troops in a desert environment that lacked points of reference, precise weather data was afforded by the Defense Meteorological Satellite Program permitting optimal assessment of weapons/aircraft load and usage and of movement of ground troops in changing weather circumstances, and LANDSAT multispectral imaging enabled the troops to quickly acquire reliable updated maps.

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[45]"The State of Space," p.4.

Conclusion

We have seen in this chapter how the U.S. space program was shaped by both unexpected events and the interrelationship of disparate factors which impacted policy: the cultural/philosophical and defense matrix of the Soviet preoccupation with space leading to early breakthroughs in rocketry by Konstantin Tsiolkovsky and others, the "unexpected" --at least in the case of a distracted West-- launch of Sputnik I and II that triggered a space race, the writings of academic experts, such as Albert Wohlstetter, that led to the unintended consequence of an unprecedented arms build-up in the United States, and the Gulf War which has promoted renewed interest in, and implementation of, military space systems. Now, so as to obtain a sense of the importance space has assumed in the area of national security, let us briefly highlight the military space programs of the two superpowers and consider current and prospective trends in their development.

CHAPTER 2. SUPERPOWER RIVALRY: THE SOVIET SPACE MENACE

> *Space is an enduring reality, which like mobility forces, provides support across the complete spectrum of conflict...[Effective space capability] is important enough, broad enough, and unique enough to stand alone as a critical element of our nation's military posture.*
>
> *Gen. Donald J. Kutyna, USAF*[46]

The Soviet/CIS Space Program

To increase our understanding of the militarization of space and its significance for the development of space policy, we will discuss both the Soviet and U.S. programs. So as to have a basis of correlation and contrast for U.S. space policy, let us first take a brief look at the Soviet space program. In order to gain a sense of its evolution, it is interesting to take note of a 1987 Pentagon study on space which, though outdated by more recent events, still gives an idea of the breadth and scope of the Soviet program and can serve as a point of comparison for later developments. A summary of the report published by Aviation Week and Space

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[46]"The State of Space," prepared statement of Gen. Donald J. Kutyna, USAF, commander in chief, U.S. Space Command, to the Senate Armed Services Committee, April 23, 1991, printed in Defense Issues, 6, 14:3.

Technology and based on an unclassified fact sheet (the original report is classified) indicated that the number of active satellites the Soviets maintained in orbit had increased from around 120 in 1982 to 150 in 1987 and that at least 90% of satellites launched could support both defensive and offensive military operations. The study forecast that by the mid-1990's the Soviets would probably have 200 operational satellites in orbit, of which 150 would have military applications and another 40 would have joint military and civilian uses, covering communications, navigation, and weather functions. In addition, the eight Soviet booster systems active at the time, would have permitted the reconstitution of the entire Soviet satellite fleet in three months in case of destruction.

The report indicated, moreover, that it was likely that military research was being performed on the MIR space station, and that many of the experiments being undertaken using cameras, radars, spectrometers and multispectral electro-optical sensors, could be directed toward supporting antisatellite and ballistic missile defense systems. Additionally, the report maintained that the MIR station could house up to 12 cosmonauts and that during the 1990's the Soviets, with their heavy lift Energia boosters and the new Soviet space shuttle which is under construction, would be able to build a large modular station that could house up to 100 cosmonauts.[47]

To what extent have the momentous events since 1989 modified this forecast? Have the breakup of the Soviet Union and subsequent economic and political difficulties dealt a fatal blow to a space program that in number of areas was ahead of the U.S. program?[48] Or are we merely witnessing a reorganization of a sector of former Soviet activity which will eventually reemerge, sphinx-like, as a strong contender on the world scene--perhaps within the context of a collaborative or individual effort of different republics of the Commonwealth of Independent States?

While it is true that the Soviets were diminishing their conventional force capability during President Gorbachev's tenure in office (1985-1991), a parallel movement toward restructuring and modernizing strategic forces was taking

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[47]Aviation Week and Space Technology, 12 October 1987, pp.28-29. Actual MIR 2 assembly in orbit is now scheduled to begin in 1996 with the launch of the base unit. Further elements of the station would be launched in 1997 and 1998. See: Craig Covault, "Russia Forges Ahead on MIR 2," Aviation Week and Space Technology, 15 March 1993, pp.26-27.

[48]While the U.S. generally leads in technological sophistication and systems, the former Soviet Union is ahead technical areas such as: biomedical experience for manned spaceflight (given the extended sojourns in orbit by their astronauts), materials research in space, particle beam technology, thruster technology, and in several other areas.

place.[49] Current economic difficulties might slow innovation, but it is unlikely that the Commonwealth of Independent States or eventual successor republics will stop this process of technological upgrading of force capability for a variety of external and internal security reasons.[50] While the current CIS outlook has discounted the United States as a threat, as we will see in the pages that follow, the armed forces are very much aware of new threats emerging in a multipolar world that is no longer held in check by former superpower rivalry. In 1992, even though functioning under severe economic constraints, the Russian/CIS program still launched 54 satellites (more than the United States). It is also noteworthy that even with the difficult economic conditions in 1991, as mentioned, the Soviet Union managed to launch 59 missions, most of which were military in nature.[51]

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[49]As Gen. Kutyna observed during his Senate testimony in April of 1991: "As a result of the rapid changes in the Soviet Union, there's a growing perception that the entire Soviet threat is diminishing. This interpretation is false--while President Gorbachev may be reducing his conventional capabilities, he is also restructuring and modeling his strategic forces--and we expect that to continue." (p.1)

[50]It should be kept in mind that effective maintenance of external and internal security is closely linked to continued support of a strong military-industrial complex.

[51]Craig Covault, "Russian/CIS Space Outlook Chaotic But Critical to Global Planning," Aviation Week and Space Technology, March 16, 1992, pp.125-127.

It is widely thought that the *involvement of* the military with the space program will continue to increase. Another Pentagon study points out that "An extensive ground infrastructure supports the [Soviet space] system. Despite the drop in launches in 1989, improvement, maintenance, or refurbishment of this infrastructure has remained active, indicating that Soviet military space capabilities likely will continue to improve in the future."[52] The decrease in satellites launched since 1989, while in part due to financial reasons, might also be correlated with the increased technical sophistication and life-span of the satellites themselves: the longer the useful life-span of a satellite, the less need there is for replacement launches. Despite the Soviet attempt to publicize the commercial and scientific aspects of their space program since 1985 with the advent of *glasnost* and *perestroika*, successive U.S. Defense Department studies have underscored the military character of the Soviet space program: "The Soviet space program is overwhelmingly military in character, although there is an increasing tendency to support civilian missions. Almost all satellites are dedicated either exclusively to military missions (such as ocean reconnaissance and targeting) or to dual-use,

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[52]Department of Defense, Soviet Military Power 1990 (Washington, DC: GPO, 1990), p.60.

As indicated (see p.35f.), throughout the early and mid-eighties, the Soviets launched an average of over 90 missions a year, *which declined to 74 in 1989 and further to 59 in* 1991.

military and civil, applications (such as communications and meteorology)."[53] What are the different elements of the Soviet Program and how might it change now with the birth of the Commonwealth of Independent States?

Soviet military space strategy, which is likely to be continued by the CIS or successor entities/republics, is based on the dual aims of supporting terrestrial forces and attaining the ability to deny access to other nations. The high number of satellite launches and the redundancy of their systems reflects the objective of being able to wage a successful war in space. As Nicholas Johnson comments,

> Soviet satellite philosophy closely parallels the philosophy evident in other areas of Soviet industry and military weaponry: the paramount design qualities are ruggedness, simplicity, relatively low cost of manufacture and operation, mission effectiveness and proliferation. These attributes are not only the trademark of the Soviet presence in space, but reflect a military space strategy designed, should the need arise, to fight and to win a war in outer space.[54]

The military space structure developed by the Soviet Union consists of the areas outlined below which for ease of reference have been subdivided, following the U.S. Defense Department format in the Soviet Military Power publications,

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[53]U.S. Department of Defense, Military Forces in Transition (Washington, DC: GPO, 1991), p.41.

[54]Soviet Military Strategy in Space, p.85.

into: Satellite Support of Ground Forces, Antisatellite System Support, and Launch Vehicles and Manned Flight.[55]

Soviet/CIS Satellite Support of Ground Forces

An integrated system of satellites and ground infrastructure is designed to support the military. It entails reconnaissance through radar, photographic, and electronic means; ocean surveillance and targeting through two systems that can be used together: The Electronic Ocean Reconnaissance Satellites (EORSATs) that intercept electronic signals, and the Radar Ocean Reconnaissance Satellites (RORSATs) which can track radar signals of ocean vessels;[56] command, control, and communications satellites (C3) at both low, medium,

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[55] The following overview of Soviet military space systems is based on material from several sources, including Military Forces in Transition (1991), Soviet Military Power 1990; John Pike, "Military Use of Outer Space" in Sipri Yearbook 1991: World Armaments and Disarmament; Gen. Donald J. Kutyna's testimony on the "State of Space" before the Senate Armed Services Committee on April 23, 1991, other DOD statements, articles on the evolution of the situation in the former Soviet Union in trade publications such as Aviation Week and Space Technology, and The New York Times.

[56] If a ship, for example, were to employ electronic measures against the RORSAT radar satellites, it would enable the EORSAT electronic satellites to discover its position and monitor or target its activity. Gen. Robert T. Herres of the U.S. space command has pointed out that "no other country in the world has a corresponding capability" and that these satellites could be seen as counterbalancing the large U.S. naval force: "...these systems were designed and would be employed in an attempt to diminish the naval advantage we have purchased by our large national investment in carrier battle groups." ("The Military Use of Space," p.3)

and geostationary orbits;[57] early warning satellites to detect missile launches; navigation (GLONASS) and weather satellites (Meteor); research and development satellites.

Antisatellite System Support

The Soviet Union had been the only nation up to now to have installed an active antiballistic missile defense system. The system is thought to have become operational in 1971. Different antisatellite (ASAT) capabilities were developed by the Soviets.[58] Although a moratorium on the launching of ASAT weapons was unilaterally declared by the USSR in August 1983, the Soviets have continued to test part of their system on the ground. The system included: (a) a co-orbital interceptor weapon[59] located at the Baikonur space-

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[57]Satellites are placed into orbit according to their specific mission. For example, reconnaissance and meteorological satellites are often placed into polar orbits because they can cover the entire surface of the earth as it turns below them. Communications and surveillance satellites, instead, are mostly placed into geosynchronous orbit at 22,300 miles above the equator since at that height they travel at approximately the same speed as the earth rotates on its axis. They therefore remain stationary with respect to earth and maintain the same rotational period of 24 hours.

[58]Speaking in 1986, Gen. Herres intimated that "The Soviet version of a multiple-layer 'Strategic Defense Initiative' has been quietly under development for two decades, and elements of it have already been fielded." "The Military Use of Space." p.4.

[59]The co-orbital interceptor ASAT consists of a killer satellite that is launched and maneuvered into an orbit coplanar with that of the target satellite. As the killer satellite passes near its target, it can eliminate it by a (continued...)

port in Tyuratam, Kazakhstan, which though not tested as a whole since 1982, is still operational;[60] (b) earth-based directed energy or laser weapons which could be effective against low and medium orbit spacecraft (one ground-based laser is located at the Sary Shagan test range in the center of the former Soviet Union); (c) exoatmospheric\ ABM missiles[61] and electronic warfare systems that could reach satellites in high geostationary orbits (22,300 miles).[62] Exoatmospheric ABM missiles ring Moscow and are also stationed at the Sary Shagan test range. There is ongoing research, as in the United States, on the development of future

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[59](...continued)
variety of means, including nuclear and non-nuclear charges, laser beams or other advanced technologies.

[60]Commenting on the Soviet interceptor system, Gen. Robert T. Herres observes: "The Soviets also developed and possess the world's only operational satellite interceptor system, a system emerging from their doctrinal requirement to be able to control the medium of space. Although some have described the Soviet satellite interceptor--deployed since 1971--as 'crude,' I do not share that appraisal. No system capable of engaging all of our satellites in low-earth orbit should be dismissed as 'crude.'"
"The Military Use of Space," p.3.

[61]Exoatmospheric missiles are those that travel outside the earth's atmosphere, generally above 100 kilometers, as opposed to endoatmospheric missiles that remain within the earth's atmosphere.

[62]Such systems involve rendering ineffective satellite communication links through jamming, disrupting sensors, and in general seeking to impede the functioning of enemy satellites through electronic means.

ASAT weapons such as work on kinetic energy, laser, radio frequency, and other technologies.[63]

Launch Vehicles and Manned Flight

As mentioned, it is probable that cosmonaut military activity has taken place on the Soviet Salyut and MIR space stations. The first Mir station, launched in February of 1986, was designed with significant expansion potential. In late 1989 the Soviets sent up an additional module called Kvant-2 which was suspected of carrying out military missions. The DOD publication Soviet Military Power 1990 points out that while the Soviets insisted that the sensors located on the external platform of the Kvant 2 were designed for studies of the earth, "military applications are highly likely. Cosmonaut military activity is another aspect of the Soviet space program which *glasnost* has yet to illuminate." (p.61) It is thought that another module destined for microgravity materials research called *Kristall* that the Soviets sent to the MIR station in 1990 might also have military, in addition to civilian, applications. The Soviets set space endurance records on both their Salyut and MIR

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[63]Kinetic energy weapons are designed to destroy a target through a high speed impact as opposed to an explosive charge; laser weapons use directed energy photons to burn, incinerate, or melt the target; radio frequency and other technologies are also being investigated for ASAT purposes.

space stations.[64] The time spent on the stations by their cosmonauts has given the USSR and its successor CIS a lead in research on the effects of space habitation on human beings. It also gives them a lead on materials research in space conducted by the cosmonauts.

In terms of launch vehicles, the Soviets had created an extensive series of launchers and ground support systems that would permit them to loft a significant number of satellites in a short period of time. This capability was designed to give them a decisive military edge in case of a problem.[65] Their diverse launch systems include Proton and Zenit boosters, the Energia heavy lift booster, and the Buran space shuttle which was successfully test flown on an automated (not manned) basis in 1988. Another flight is scheduled for 1993 although financial constraints might adversely affect this, as well as the Energia program. Both the Energia and Buran programs are in a holding pattern right now and dire forecasts of cancellation routinely appear in press reports.

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[64]A Salyut 7 crew set a space endurance record of 237 days and MIR crews have logged up to a year of time on the station.

[65]Gen. John L. Piotrowski, former commander in chief of the U.S. Space Command, in referring to the Falklands war observed that the Soviets "launched 28 times in 69 days--a capability only dreamed of in this country." "U.S. Military Space Strategy," Remarks to the International Security Studies Program, Fletcher School of Law and Diplomacy, Cambridge, MA, November 17, 1988. Reprinted in: Defense Issues, Vol.4, No.2, p.1.

Most observers would attribute this to the financial problems being experienced by the former Soviet Union. It should be kept in mind, however, that it is thought the two systems would not be used for heavy lift purposes until the mid-to-late 1990's when the Soviets expect to place a larger space station, the MIR 2, into orbit. If this is the case, financial difficulties and planning might simply signify a delay in implementation as opposed to a cancellation of the programs. It is also interesting to note that despite current economic constraints, the Russian parliament confirmed funding for the MIR 2 station for 1993, attesting to the importance given to space by Russia.

CIS Internal Political Turmoil and Future Directions in Space

The former Soviet space program, besides being affected by the troubled economic situation in the new republics might also fall victim to the political divergences between the republics. These signed an agreement on space in Minsk on December 30, 1991, governing the reorganization of the vast resources of the Soviet space program spread across the former Soviet Union. The Commonwealth of Independent States agreed to a format similar to that of the European Space Agency in terms of coordination, funding, and management of its space assets.[66] However, while the European Space

[66]The European Space Agency was formed in 1975 as a (continued...)

Agency programs were commercial and scientific in nature and the agency therefore did not have to cope with complex military questions, the Soviet/CIS space program is primarily

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[66](...continued) result of the merger of two institutions: The European Space Research Organization (ERSO) and the European Launcher Development Organization (ELDO). ELDO and ERSO had been created in the early 1960's to provide Western European nations with an independent space program. Separation of the research and launch aspects of the program, however, led to difficulties and paved the way for the consolidation of the two activities under the ESA umbrella. Of the thirteen states that are affiliated with ESA, eleven are members (Belgium, Denmark, Germany, France, Ireland, Italy, The Netherlands, Spain, Sweden, Switzerland, and the United Kingdom), Austria is an associate member, Norway is an "observer," and Canada is affiliated through a memorandum of association. The Agency's policy is determined by a Council governed by representatives from its member states. The Council coordinates the national space programs of its members and also undertakes cooperative programs with the United States and other nations. The ESA allocation of contracts for programs underwritten is based on the principle of "juste retour," that is, distribution is done geographically according to each member nation's contribution to the Agency. This has not always been positive in terms of cost effectiveness and quality since the choice of firms is largely under the control of the individual member states.
ESA conducts the research and development on the Ariane rockets for Arianespace which was created in 1980 for the purpose of promoting a commercial launch business for the benefit of its members. The consortium that established Arianespace includes: the French Space Agency (Centre Nationale d'Etudes Spatiales, or CNES) which holds about 34% of the company, 36 European firms and 13 banks. Since approximately 24.5% of Arianespace is owned by French companies, of which some are state-controlled, the French percentage of ownership is in excess of 58.5%. German control totals 19.6%, leaving 21% control to other interests. Since its founding, Arianespace has captured roughly fifty percent of the international launch market.
International Cooperation and Competition in Civilian Space Activities (Washington, DC: US Congress, Office of Technology Assessment,OTA-ISC-239, July 1985), pp.43-44, 70-73. Also: Space Commerce: An Industry Assessment (Washington, DC: U.S. Department of Commerce, 1988), p.10.

military in nature. Reorganization therefore requires dealing with the coordination of military space operations spread across eleven time zones, twelve republics and the three armed services: army, air force, and navy. In addition, it entails management and funding of the commercial and scientific programs. The initial agreement in Minsk placed the military part of the space program under the jurisdiction of a centralized body called the "Joint Strategic Armed Forces," following a formula similar to the one used for the control of strategic nuclear weapons. The republics, with the exception of Ukraine which did not sign the agreement, also approved creating a new Interstate Space Council to administer the Commonwealth program.

In March 1992, President Boris N. Yeltsin also created a Russian Space Agency, modeled on the U.S. National Aeronautics and Space Administration, to manage civilian space activities across the former Soviet Union. The former deputy director of the Ministry of Machine Building, Yuri Koptev, was nominated as the new Agency's first director. The Agency will reorganize the civilian part of space activity, including its research centers, determine programs, establish directives for inter-agency/program billing and interfacing, resolve financing problems, and contract for hardware and services.[67]

Problems of reorganizing such a large, military controlled program remain immense and include questions of (a) who will control specific military and civilian assets; (b) problems of access to resources ranging from who will be able to utilize military reconnaissance or communications satellites to questions concerning the critical need for continued cooperation between an industrial space base that is spread out across several republics. This problem is particularly serious in the case of republics or nationalities that do not get along well; (c) problems connected with military force reductions that also affect the space area; (d) problems with financing a hugh space operation that before the demise of the Soviet Union had absorbed from 15 to 33 percent of GNP (depending on the source of the estimates).[68] Even with the force reductions now contemplated, support of the far-reaching former Soviet military space structure will still require extensive financing.

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[67]Craig Covault, "Russia Seeks Joint Space Test to Build Military Cooperation," Aviation Week and Space Technology, March 9, 1992, pp.18-19.

[68]U.S. Department of Defense, Military Forces in Transition, p.5.

The main launch sites, research and design bureaus, and hardware production facilities are located in Russia, Kazakhstan, and Ukraine with greater part of the space program located on Russian soil. The primary launch site for manned and unmanned geosynchronous missions, however, is the Baikonur cosmodrome located in Tyuratam, Kazakhstan.[69] One example of unfortunate outcomes that can result from a combination of financial constraints and the disagreement between republics can be seen in the divergence between Russia and Kazakhstan on the use of the Baikonur cosmodrome. This resulted in an unexpected prolonged sojourn in space by a Soviet astronaut, Sergei Krikalev, who was launched to the MIR space station in May 1991 before the demise of the Soviet Union and had to extend his stay in space five months beyond his scheduled return as various problems between the two republics were resolved after the dissolution of the Union.[70] He is the first man to have witnessed the disappear-

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[69]There are two other former Soviet launch sites. The Kapustin Yar cosmodrome to the south, is located near the town of Kapustin Yar. It is used for military missions, although on a less frequent basis than the other two cosmodromes. Then there is the Plesetsk Cosmodrome near the Arctic Circle which has launched the largest number of military space flights (over 1,300 flights) and was the primary polar orbit launch site and military ICBM test area for the Soviet Union.
See: Craig Covault, "Plesetsk Cosmodrome Gearing for New Heavy Booster Role," <u>Aviation Week and Space Technology</u>, September 16, 1991, pp.46-51. Also, Nicholas L. Johnson, <u>Soviet Military Strategy in Space</u>, pp.79-82.

[70]Flight engineer Sergei Krikalev, launched into orbit (continued...)

ance of his country from space, as well as the aborted August coup against Gorbachev, and the collapse and disintegration of the Communist Party. There is also the case of the Ukraine which is the site, for example, of the Yuzhnoye Design Bureau that builds both the SL16 Zenit heavy lift booster, created primarily to launch electronic intelligence satellites, and the Energia heavy lift booster. With the intent to commercialize these boosters, questions have arisen as to which republic will benefit from future sales and in what proportion.[71]

Conclusion

The Ukraine's and the other republics' disputes with Russia, if not resolved, might lead to difficulties in coordinating smooth program implementation from the design stage to the production of hardware, launch, and support of orbiting spacecraft. Given the high costs involved, it is not probable that any one republic--even the Russian--might want or be able to develop a completely independent program. The

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[70](...continued)
on May 11, 1991 returned to earth on March 26, 1992 after spending 313 days in space, several months beyond his scheduled return in October, due to disputes between Russia and Kazakhstan concerning the Baikonur cosmodrome, problems with Kazakh nationalism, and financial questions. See: Serge Schmemann, "After 313 Days in Space, It's A Trip to a New World," The New York Times, March 26, 1991, p.A12.

[71]See: Craig Covault, "Russian/CIS Space Outlook Chaotic But Critical to Global Planning," Aviation Week and Space Technology, March 16, 1992, p.127.

trend in space has been toward greater, not lesser cooperation, due to cost, the necessity for redundant systems, and other strategic factors. However, while current financial and political difficulties deeply affect the military-industrial complex of the Commonwealth of Independent States, it is likely that the space sector as a whole will survive the current crisis given its strategic and, as we will see below, potential money generating-commercial value. It is *indicative of the importance given to the space program,* for example, that the reordering of space was one of the first problems addressed by the new Commonwealth of Independent States.

CHAPTER 3. THE U.S. MILITARY SPACE PROGRAM

We have entered an era when the use of space exerts such a profound influence on human affairs that no nation will be fully able to control its own destiny without significant space capabilities. From a strictly military perspective, the use of space is now necessary, even mandatory, for the success of global military operations.

Adm. William J. Crowe, Jr.[72]

Let us now briefly examine the U.S. military space program. U.S. military security is based on the principle of deterrence and flexible response to aggression. Seventy percent of U.S. space systems are designed to support conventional forces though communications, reconnaissance, and other surveillance. Space systems provided critical support in several recent U.S. military operations in the 1980's such as the air strike on Libya, the Panama operation, and most recently during the Gulf War in 1990-91. In view of current plans to reduce military forces both in the United States and the former Soviet Union, greater reliance will be placed on space systems in the future to compensate for

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[72]Quoted in the address by the Hon. Martin C. Faga, Assistant Secretary of the Air Force (Space) to the National Space Club in Washington D.C., November 29, 1989, p.5.

smaller naval, air, and ground forces. As indicated by Gen. Donald J. Kutyna,

> To support a declining force structure, the nation must pursue a strategy that ensures our country's access to, and ability to operate in, space during wartime. Enhancing terrestrial force operations and degrading those of an adversary are keys to concluding conflicts on favorable terms. It's not enough just to provide satellites for our use; one must acquire and maintain control of the space environment. This involves defending friendly satellites from hostile attack, providing assured access to space and, when necessary, denying an adversary the use of his space assets. With space control established, we can then provide essential force enhancement support to our terrestrial forces. Unless we have a sound space-control capability, we may find ourselves in a conflict with a nation with space forces while we have no means to prevent space-supported attacks on ourselves or our allies.[73]

During the course of the Defence and Space Talks, conducted parallel to the START (Strategic Arms Reduction Talks), and aimed at ensuring a balanced transition to greater reliance on strategic defense systems, the U.S. position substantially differed from that of the Soviets. In line with the Reagan administration's stance, also the Bush administration was in favor of leaving open options for the testing of space-based anti-ballistic missile components. The Soviets, instead, insisted on a stricter interpretation of the ABM Treaty which would prohibit such testing, although they had themselves conducted tests in space, as had the

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[73]"The State of Space," pp.5-6.

United States. The former Soviet opposition to space tests and defensive systems, however, has now changed with the CIS. In response on the one hand to President Bush's strategic arms reduction initiative on September 27, 1991 which included proposals on non-nuclear ABM systems and, on the other, to the U.S. Congress' proposal to renegotiate the 1972 ABM Treaty, in a marked turn around from only a few months earlier, senior Soviet officials demonstrated a willingness to proceed with discussions concerning the construction of a new and possibly cooperative ABM system with the United States, one that would include ground *and* space components. A member of the Russian Federation's State Committee on Defense, Major General Viktor L. Samoilov remarked during a meeting in the United States that

> By the year 2000, about 15-20 more governments will have their own ballistic missiles and launchers...Half of them will have missiles with a range of more than 5,000 mi. This will be a very serious source of threat in the future. Therefore, integration of joint efforts toward an ABM agreement is full of promise and interest to us."[74]

In any case, it should be kept in mind that with the changes in the former Soviet Union and with increasing Third World arms proliferation, the space scenario is likely to be

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[74]John D. Morrocco, "Soviets Endorse U.S. Effort to Cooperate on ABM System," Aviation Week and Space Technology, October 14, 1992, p.20.

transformed at an accelerated pace. Turning now to the U.S. military space forces, let us briefly look at the current mix of space systems.[75]

U.S. Satellite Support of Ground Forces

Also the U.S. has a system of satellites and ground infrastructure parallel to that of the Soviet Union. It encompasses imaging intelligence satellites,[76] electronic intelligence satellites in both low, medium, and high orbits,[77] ocean surveillance satellites[78], military communications satellites,[79] early warning satellites (Satellite

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[75]Information on specific satellite systems is largely based on the SIPRI 1991 chapter on space by John Pike, "Military Use of Outer Space," pp.49-84.

[76]These include KH11, KH12, and Lacrosse low-altitude photographic reconnaissance satellites. These were instrumental, for example, in providing intelligence on Iraqi troop movements, violation of the embargo, and other information during the Persian Gulf crisis.

[77]These satellites entail the ELINT satellites in geostationary orbit (comprising Magnum and Chalet/Vortex satellites) and others.

[78]The NOSS (Naval Ocean Surveillance System), comprising White Cloud satellites, correspond to the Soviet EORSAT system.

[79]These satellites comprise The Defense Satellite Communications System (DSCS) in geostationary orbit used both by the U.S. armed forces and some government agencies, the Navy's Fleet Satellite Communications System (FLTSATCOM) and Leased Satellite System (LEASAT) and the new Ultra-High Frequency (UHF) Follow-On (UFO) program; and the Satellite Data System (SDS) which ensures that low altitude photographic reconnaissance satellites can communicate in close to real time with ground stations. Other satellite groups comprise

(continued...)

Early Warning System-SEWS), navigation satellites,[80] weather satellites,[81] and nuclear explosion detection satellites.

U.S. Antisatellite System Support

With the disintegration of the former Soviet Union and with a growing number of nations besides the U.S. and USSR acquiring advanced space technology, the "Strategic Defense Initiative" (SDI) announced by President Reagan in March 1983 has been refocused. Whereas initially the goal of SDI was to create one massive shield to protect the U.S. from a possible Soviet intercontinental ballistic missile attack, in 1987 the program was redirected toward the less ambitious aim of deterring a first strike. In 1991, the pressing new global proliferation requirements combined with doubts as to present technical feasibility of a larger system, led the Bush administration to endorse the strategic defense concept of Global Protection Against Limited Strikes (G-PALS). In the G-

[79](...continued)
the Tracking and Data Relay System (TDRSS) which is used for near real time transmission from the Lacrosse imaging satellites, and the Milstar satellites which will begin to be deployed in 1992 with the mission to assist conventional forces confronting Third World problems.

[80]These systems consist of the Transit satellites that are being turned over to civilian use, the new Navstar Global Positioning System satellites which will support both armed forces units and weapons.

[81]These include Defense Meteorological Support Program satellites.

PALS system, anti-ballistic missile protection would be achieved for up to 200 incoming missiles and the system would also afford protection against tactical[82] and theater missiles. The plan envisions deployment of multi-layered defenses on three levels: (a) a mobile program that could be transported by air to defend theater sites called "Transportable Protection Against Limited Strikes," or T-PALS, (b) a ground based system to protect fixed sites in the United States which would work in conjunction with Brilliant Eyes space sensors,[83] (c) a space-based system of interceptors called Brilliant Pebbles which would afford global coverage.[84]

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[82]Tactical nuclear weapons, as opposed to strategic ones, have a shorter range, generally lower yield, are normally placed close to their targets and are designed to support specific areas of military engagement. They would include weapons like nuclear artillery shells, surface to surface missiles, nuclear bombs on tactical aircraft, nuclear tipped anti-aircraft missiles, etc.

[83]Brilliant Eyes are a series sensor satellites (probably between 50-80) that would orbit at a higher altitude than Brilliant Pebbles and would track missiles in mid-course through outer space before they reenter the atmosphere in the final phase of their flight.

[84]The Brilliant Pebbles concept evolved from the idea of multiple defense layers beginning with Space Based Interceptor rockets (or SBI) that would target the hot exhaust of enemy missiles on their boost phase and destroy them before they could in turn deploy additional missiles. Endorsed by the Administration in 1989, Brilliant Pebbles would involve a large number of up to 1000 spacecraft.

In the Missile Defense Act of 1991, however, Congress endorsed the accelerated deployment of an antiballistic missile ground system in the U.S. by 1996. Amendment of the 1972 ABM Treaty through discussions with the Soviet Union was also proposed. To accomplish early deployment, the Strategic Defense Initiative Organization (SDIO) has to shift its priorities (and funds) away from space based systems to the creation of ground-based weapons.[85] The system envisioned by Congress would involve the immediate development of an initial single site ABM defense with 100 ground-based interceptors, satellite sensors, and radars that would be in compliance with the ABM Treaty, leaving work on creating multiple sites and on the deployment of more exotic space systems for the longer term.[86]

We saw earlier (p.70) that there is increased interest in abandoning the old 1972 ABM Treaty and arriving at a new agreement. Both the U.S. and the CIS now seem to favor an ABM defense that would entail on the one hand multiple ground-based sites so as to provide complete coverage over the U.S. and CIS territories (6-7 have been proposed for both the U.S.

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[85]See: James R. Asker and Craig Covault, "SDI Will Shift Funds to ABMS But Miss Deployment Deadline," Aviation Week and Space Technology, 23 March 1992, pp.20-22.

[86]In the early 1970's Congress had decided to build the Safeguard ABM system in compliance with the ABM Treaty but was not strongly committed to the idea of strategic defense and ended up dismantling the system.

and the CIS), and on the other, the deployment of space based systems. There has also been discussion of developing cooperative early warning systems against nuclear attack that would comprise both ground and space based systems. The new Soviet/CIS interest in abandoning the 1972 ABM Treaty may be attributed in part to a partial loss of air defense network coverage with the dissolution of the Warsaw Pact. While there is still disagreement in the U.S. on the mix of weapons, numbers and location (ground or space), sites (one or many),[87] technical feasibility, and therefore final form the strategic defense system will ultimately assume, there is growing support today, especially after the events in the Gulf War, for the concept of strategic defense.[88]

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[87]Congress in the Missile Defense Act of 1991 directed deployment of the new defense system at the old Safeguard site at Grand Forks, N.D. This location was already authorized in past agreements between the U.S. and USSR. SDIO would prefer a multi-site system (6 or 7 sites) as a better basis for incremental defense deployment as new technologies are acquired and implemented.
See: Patricia A. Gilmartin, "SDIO to Pursue New Sites for Limited Missile Defenses," Aviation Week and Space Technology, 24 February 1992, pp. 26-27.

[88]The sight of Patriot missiles defending Israel and Saudi Arabia during the Gulf War has led to the grouping of programs concerned with tactical defense under the umbrella of the Theater Missile Defense Initiative (TMDI). These comprise Hawk and Patriot anti-aircraft missile programs, the development of missile interceptors such as the Israeli Chetz or the Extended Range Interceptor (Erint), and the Theater High Altitude Area Defense (THAAD) system or the Corps Surface-to-Air Missile (Corps SAM) program.

Launch Vehicles and Manned Flight

Using a mixed fleet of Atlas, Delta, Titan and Pegasus rockets, in addition to the Space Shuttle, the Pentagon launch rate for satellites and ballistic missile tests has been increasing and a sustained launch rate of 30-40 is forecast for 1993 and during the next few years.[89]

This is in contrast to the much more constrained launch rate of prior years due to a short-sighted policy decision taken in the 1970's to use the space shuttle as the primary launch vehicle for both civilian and military payloads.[90] The danger of placing all of one's eggs in a single basket became amply evident when the Challenger disaster grounded the shuttle fleet together with both the civilian *and the military payloads* it was scheduled to deploy. There was a point in 1987 when the military reportedly was left with only one KH-11 advanced photoreconnaissance satellite in orbit which had just about exhausted its life span. With the subsequent explosion of a Titan IV heavy lift booster in the process of being launch tested, no viable alternative unmanned booster system was in a state of launch readiness for payloads designed to be orbited from the shuttle. A

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[89]Edward H. Kolcum, "NASA, Pentagon Chart Ambitious Unmanned Launch Vehicle Program," Aviation Week and Space Technology, 16 March 1992, pp.131-133.

[90]For further discussion of this policy decision, see Chapter 4, pp.93ff.

rather astonishing lack of foresight by policy makers therefore left the Pentagon with no means to launch replacement satellites for the ones that were fast approaching the end of their design life. Then Secretary of the Air Force, the Hon. Edward C. Aldridge, commented in testimony before the Senate in March 1988, that

> "We made a tragic policy error in the late 1970s by deciding that Shuttle would be the only means for launch of our space systems. We have paid dearly for that mistake in recovery costs and risks to our national security. It will cost the Department of Defense over $10 billion and six years to restore our on-orbit assets to a healthy constellation and obtain a balanced distribution of payloads on a mixed fleet of expendable vehicles and the Shuttle."[91]

Having seen the danger of relying basically on one means of deployment--the shuttle--Congress in 1987 mandated as U.S. government policy that all payloads that do not require a manned presence be placed into orbit on expendable launch

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[91]The Hon. Edward C. Aldridge, "Statement on Space Launch Recovery" to the Committee on Armed Services, Subcommittee on Strategic Forces and Nuclear Deterrence of the U.S. Senate, March 25, 1988, p.5.

vehicles (ELVs).[92] Thus a formidable U.S. defense liability is in the process of being eliminated.

The Changing Military Space Scene

It is not clear at this time how the Commonwealth of Independent States will evolve or even whether it will survive in its present form. Therefore it is not possible to predict how the U.S. military space program might ultimately be molded in response to changing global requirements. It is nevertheless clear that present trends (barring any coups that might reverse democratic changes in the former Soviet Empire) would intimate closer U.S.-CIS collaboration in space in both the military and civilian spheres.

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[92]The Hon. Edward C. Aldridge, in his report to the Committee on Armed Services, Subcommittee on Strategic Forces and Nuclear Deterrence of the U.S. Senate (1988), on progress made in reactivating U.S. expendable launch systems after the Shuttle disaster, underscored the danger through which the U.S. had just passed due to the grounding of all U.S. launch systems. He attributed avoidance of negative consequences to the quality of the spacecraft in orbit which managed to outlast their normal life expectancy and maintained operational capability: "Two years ago, the Nation was still in shock over the tragic loss of the Challenger and less than a month away from another Titan launch failure that would ground all U.S. large payload launch capability for over eighteen months. I want to state firmly today that we have just crossed through a period of great risk, and we have come through it successfully.

We were able to do this because of several factors. First, and most important, is that our on-orbit spacecraft have continued to provide mission data far beyond their design life..."
"Statement on Space Launch Recovery," March 25, 1988, p.1.

With the former Soviet republics hoping to raise cash through the sale of their space technology to the West, we are witnessing an extraordinary flow of information and high level contacts not only in the civilian sphere but also in the military area. The Strategic Defense Initiative Organization has proposed to acquire Soviet ABM technology in over 50 areas. Additionally it wishes to buy Soviet ballistic missiles, and to hire 1,000 Russian experts. The technologies of interest include (a) data on soviet ballistic missiles so as to be better able to countermand threats in Third World countries where many of these missiles were sold,[93] (b) liquid rocket engines that the SDIO believes might be of use in launching elements of the G-PALS system into space. As opposed to the United States which is working on one type of liquid rocket engine for the National Launch System, the CIS has developed several types. Co-production proposals with U.S. industry have been circulated in this regard; (c) electric thrusters which are superior both in their light weight and longer life expectancy than similar U.S. ones; (d) the Topaz 2 space nuclear power reactor which SDIO hopes to use to develop improved electrical generation for its spacecraft; (e) tacitrons, which are high speed switches filled with non-ionized gas, can withstand heat of over 1000°

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[93]During the Gulf war it was reported that the Soviet Union furnished data on weapons sold in the Middle East to the United States and its allies.

centigrade and might therefore be useful in the reactor cores of spacecraft as well as in jet engines; (f) neutral particle beam technology in which the Russians are ahead of the United States.

While the White House had quietly blocked the acquisition of these technologies in the past for fear of assisting the Russian military-industrial complex, the Administration finally relented and announced on March 27, 1992 that it would permit the acquisition of high technologies and materials in the amount of $14 million as part of a financial aid package to the CIS. The items included the Topaz reactor, the thruster engines, plutonium 238[94] to make batteries for electricity generation on deep space probes, and a series of other technologies.[95]

This new scientific and technological collaboration between the United States and the CIS, again barring any unforeseen coups in the CIS or reversals to its former state,

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[94]not to be confused with plutonium 239 which is used to make nuclear bombs.

[95]It is ironical that while the administration can now speak of the acquisition of former Soviet high technology in terms of "financial aid," not so long ago, as was pointed out, "Western intelligence agencies would have probably paid billions of dollars to get their hands on a Topaz 2, which is similar to ones used to power Soviet spy satellites." William J. Broad, "White House Drops Barrier to Buying Soviet Technology," The New York Times, March 28, 1992, pp.1-2.

will result in increased use of space for both military, scientific, and commercial purposes. By pooling technologies, equipment and personnel, enormous savings in research and development costs can be achieved. Scientific, military and other missions that in financially constrained times might not have been possible may become attainable through cooperative efforts. Although it is unlikely that the most advanced U.S. technologies will be shared with the CIS,[96] the intellectual scientific and technological cross-pollination that is occurring is bound to lead to advances that would not have been within the reach of any single country working by itself.

Dangers to Space Stability

As we have seen, with the increasing number of new space actors, the question of space stability is becoming of increasing global concern. Steps are being taken to avoid a possible "star wars" scenario in the 21st century. These include the construction of space based anti-satellite systems which both the U.S. and former Soviet/CIS are developing and might eventually evolve into a cooperative international venture. While it is perhaps premature, one

[96]The director of the SDIO, Henry Cooper, has reportedly ruled out any outright sharing of U.S. technology with the CIS. See: John D. Morrocco, "Soviets Endorse U.S. Effort to Cooperate on ABM System," Aviation Week and Space Technology, p.20.

might look ahead to an international security umbrella in space, possibly under collaborative or United Nations sponsorship, that might be used to prevent or contain ground-based conflicts and bring them to a rapid end, much as the Gulf War was brought to a quick end through the use of space systems.

With the current problems facing the former Soviet Union it does not seem probable that a new confrontational stance would develop, at least in the short term, with the United States (unless hardliners should gain control in one of the republics). However, the development of a confrontational international situation through the irrational action of a Third World country that has acquired space systems is not beyond the realm of possibility, as was amply evident on a conventional arms scale in the case of Iraq. International space launches during the period from the beginning of the space era in 1957 through September 30, 1991, have included: Japan with 43 successful launches into orbit, the People's Republic of China with 28, India with 4 (using their own launchers), Israel 2, The European Space Agency 41, France 10, Italy 8, Australia 1, the United Kingdom 1 (see Appendix III, p.289). During this same time frame the U.S. had completed 932 successful launches and the Soviet Union 2,301.

In a SIPRI publication on Space Weapons and International Security,[97] space weapons expert Bhupendra Jasani indicates that while Japan, India, China, and the European Space Agency are using independently developed launch capability, other nations have satellites launched and/or built by another country, thus increasing the number of space actors. He underscores the fact that space weapons systems are becoming "multipurpose," that is, the distinction between their defensive and offensive capabilities has become blurred. In view of the above, Jasani warns that "technological progress is rapid and the political implications are changing equally fast." (p.5) Paul Stares also comments that "the chances of space remaining a "sanctuary"...into the twenty-first century appear today to be remote," (The Militarization of Space, p.18) and Nicholas Johnson adds "Space is not some sacrosanct region which is immune to the plague of war that has ravaged the Earth since the dawn of man. Inevitably it will become an extension of the global battlefield." (p.13)

Conclusion

In the preceding pages we have inquired into the historical origins of the U.S. space program. We saw how the

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[97]Bhupendra Jasani, ed., Space Weapons and International Security (New York: SIPRI and Oxford University Press, 1987), p.5.

development of that program was rooted in national security concerns and shaped by competition with the Soviet Union. We discussed how a subtle shift in the concept of power accompanied the technological arms and space race. Power was no longer identified primarily with the numbers of military might, but itself came to depend on technological prowess. After highlighting the space defense programs of the two major space actors, the U.S. and the Soviet Union/CIS, we noted the transitional nature of both programs as a confrontational stance between the superpowers is beginning to evolve from competition and antagonism into the direction of collaboration in space, perhaps leading to a future alliance. We additionally observed the dangers to international stability posed by strategic satellite defense systems and the proliferation of space actors.

We will now examine the evolution of the civilian space program, and the scientific and commercial aspects of U.S. space activity. As we proceed, we will seek to highlight the complex interrelationships between science, technology, foreign affairs, defense, and the international marketplace as events in one area have cascading feedback effects across of broad spectrum of policy options and decisions.

PART II: CIVILIAN SPACE AND THE TRANSNATIONAL MARKETPLACE

CHAPTER 4. CREATION OF THE U.S. CIVILIAN SPACE PROGRAM: THE POLITICAL ECONOMY OF DECISION MAKING

Must great nations always ape their rivals? Whatever the USSR undertakes, must the United States fully share? Must France follow the United States? And Japan France? And China the USSR? and India China? Surely a nation may choose to ignore the barbarians and their clever ships and guns, but it must then become a helpless giant...Regimes need not give way to technological revolution, but then they risk political revolution. It is in the very structure of international politics in our age that states must, in their own ways, fashion national technocracies, the better to compete, adjusting inherited institutions and values as required...

Walter A. McDougall[98]

The Birth of the NACA and the National Aeronautics and Space Administration

In response to European advances in aviation, Congress in 1915 created the National Committee on Aeronautics (NACA) to direct the study of flight and related areas in the United States.[99] At the outset, the agency began with a budget of

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[98]The Heavens and Earth: A Political History of the Space Age, p.435.

[99]The legislation for the creation of NACA was passed as a rider to the Naval Appropriation Bill on March 3, 1915 so as to attract less attention during the time of war in Europe. According to NASA historian Roger E. Bilstein, this was due in part to President Wilson's desire to preserve a perception of American neutrality in the conflict which the creation of a new agency dedicated to aeronautical research (which had dual civilian/military applications) might have undermined.
See: Orders of Magnitude: A History of the NACA and NASA, 1915-1990 (Washington, DC: NASA, 1989), pp.3-4.

$5,000 and a distinguished unpaid committee of twelve: two representatives of the War Department, two from the Navy, one from the Smithsonian, Weather Bureau, and Bureau of Standards, and five experts in aeronautics. By 1958, NACA had become a highly respected aeronautical research, testing and development center with 8000 people, three research centers, and two test stations whose work benefitted both the civilian sector and the military (although after the mid-1930s the agency's research was more heavily directed toward work for the military sector). When President Eisenhower decided to form a national space agency in response to the Soviet challenge posed by Sputnik, he was faced with the problem of deciding what kind of a structure might administer the new effort and whether it should be primarily military or civilian in character. As historian Walter McDougall comments,

> Was space technology a military problem rightfully devolving on the DoD? If so, how could space science receive the attention it deserved? If space was awarded to a civilian agency, how could legitimate military functions be performed? Was space inevitably tied to Cold War competition, or could it spawn global cooperation? If competition prevailed, the space program must be national and secret; if cooperation, then international and open.[100]

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[100]Walter A. McDougall, The Heavens and the Earth: A Political History of the Space Age, p.165.

With the able assistance of James R. Killian, former President of the Massachusetts Institute of Technology and recently appointed to the newly created post of presidential advisor for science and technology, Eisenhower concluded that it would be better to establish the new agency around a proven civilian structure like the NACA. Among other things, it was felt that placing the space program under the aegis of the military might have contributed to increase Cold War tensions. Congressional leaders adhered to this view and the bill for the establishment of a civilian space agency introduced on April 22, 1958 was subsequently approved. President Eisenhower signed the National Aeronautics and Space Act into law on July 29, 1958. The Act provided authorization for the creation of a civilian space program and to this end the NACA was merged into the National Aeronautics and Space Administration (NASA), giving birth to a new aeronautics and space agency on October 1, 1958. However, the dual military/civilian national security nature of space activity was present from the very beginning of the space program and was mirrored in the close cooperation that was mandated between NASA and the military.

Early U.S. Manned Space Programs: Mercury, Gemini, and Apollo

The first Mercury, Gemini and Apollo manned programs, with their aim of placing a man on the Moon by the end of the

1960s, offered a tangible goal around which the nation and Congress could rally. In addition, the competitive factor of trying to beat the Russians in the race to the Moon spurred enthusiasm in both the public and Congress and guaranteed the kind of substantial long-term funding necessary to complete the project. The NASA budget rose from $964 million in 1961 to approximately $5 billion in fiscal year 1964 and maintained that level through 1967.[101] The number of NASA employees also increased to 35,860 during that time. Most of the NASA budget, however, was not spent on internal administration but with outside contractors and university researchers. As Roger Bilstein indicates in his history of the space program, "When the Apollo production line peaked in 1967, more than 400,000 people were working on some aspect of Apollo."[102]

The Nixon Era and the Fragmentation of Space Policy

After the landing of Apollo 11 astronauts Neil A. Armstrong and Edwin E. (Buzz) Aldrin on the Moon in July 1969, taking "one small step for man, one giant leap for mankind,"[103] the Apollo missions continued up to April

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[101]See Appendix I, "Historical U.S. Budget Summary for Space Activities," p.285.

[102]Orders of Magnitude: A History of the NACA and NASA, 1915-1990 (Washington, DC: NASA, 1989) pp.70-71.

[103]Neil Armstrong's words upon setting foot on the lunar surface of Tranquillity Base.

1972. President Nixon, however, did not have the same commitment to space as Presidents Kennedy and Johnson. Beset by balance of payments difficulties that ultimately led him to take the dollar off the gold standard (August 15, 1971) and by the problem of winding down the Vietnam War, he decided not to continue Apollo and permitted the dispersal of the scientific, academic, and industry teams that worked in the program. As McDougall comments, "it was already clear that the American hare had stopped again to take a nap."[104]

Looking forward beyond Apollo, in 1969 President Nixon charged a task force under Vice President Spiro Agnew to evaluate options for the future of the space program. The task force proposed three programs. The first comprised four objectives: (a) creation of a shuttle transportation system to reach (b) an earth orbiting space station capable of accommodating fifty people, (c) a second orbiting station around the Moon, and (d) a manned Mars mission in the 1980s. Estimates for the implementation of this first option ranged from $8 to $10 billion yearly. A second plan reduced spending to $8 billion a year by postponing the Mars mission until the second part of the 1980s. Nixon, however, opted for the least costly third plan, which called for the production of a space shuttle and an earth orbiting space station. The

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[104]The Heavens and the Earth, p.421.

cost of this latter program was forecast to run under $6 billion. At the same time, the powerful Congressional space committees of the earlier era were reorganized under the Senate Commerce Committee and under the House Science and Technology subcommittees and lost their prior visibility and power. While the first U.S. space station, Skylab, launched in 1973, was only used three times by astronauts before it was abandoned in 1974,[105] the Space Shuttle achieved a more permanent position in furthering U.S. space activity, as we shall see below.

McDougall attributes the decline in the 1970s of the earlier level of interest in the space program not only to diverse financial and political problems, but also to the fact that the country's aspirations in this and other Great Society areas had outreached its grasp:

> It is easy to attribute the collapse of interest in the space program to the growth of more pressing problems and to relaxation of Cold War tension. But it would be wrong to consider Vietnam, the Great Society, and other developments as

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[105]The Nixon administration did not promote continued use of the station and a $2.6 billion dollar investment was therefore lost. As its orbit began to decay, in 1979 Skylab reentered the atmosphere. NASA had succeeded in steering the dying spacecraft over the Indian ocean so as to avoid impacting inhabited areas but as it disintegrated upon reentry, parts of the station fell to earth in a remote section of Australia. By contrast, the Soviets lofted eight space stations since the mid-1970's which have been almost continuously inhabited by cosmonauts and by guests from other countries.

> isolated or in opposition to the space effort. They were all of a piece--a package that Americans purchased after Sputnik in the belief that the United States must adopt the technocratic model to get back on top. First out of the package was the space program, but Kennedy and Johnson encouraged the nation to believe not only that it could send men to the moon but that it could eradicate poverty, resist Communist expansion, and promote development abroad, to the point where the country's reach exceeded its technical and financial grasp. In time, the original model for civilian technocracy, the space program, became dispensable.[106]

McDougall points out that loss of interest was also related to the "American style of 'panic and response'" (p.422) based on a discontinuous mode of viewing reality and enacting policy. This mode of policy determination led another commentator to observe that the Nixon decision to cancel Apollo was "an incredible blunder of national leadership and an unnecessary dissipation of a unique national resource," including the over $23 billion investment in the program.[107] Apollo, nonetheless, had lasted eleven and one-half years, landed twelve men on the moon and brought them back safely, gave the United States invaluable scientific and technological data, and provided materials and knowledge for technological spinoffs for earthly applications.

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[106]The Heavens and the Earth, p.422.

[107]Robert B. Hotz, chief editor of Aviation Week and Space Technology, quoted in Paul Mann, "Fear Makes a Dream Come True: the Space Age," Aviation Week and Space Technology, August 12, 1991, p.152.

The Birth of Shuttle Policy: Political and Economic Factors

Feeling its future less than clear or secure, in the early 1970s NASA lobbied hard to have the space shuttle program (Space Transportation System, or STS) authorized. What ultimately saved the program, according to McDougall, and encouraged the Nixon administration to approve it, was not so much a well thought out policy decision concerning America's role in space. Approval was rather the result of political considerations concerning a severe slump in the aerospace industry that would have been made even worse by cancellation of all substantial space programs. The decline was particularly severe in states like California, Florida and Texas which, with the loss of further space business, would likely have developed significantly higher unemployment rates. This might have proved particularly damaging in the Presidential reelection campaign. As McDougall indicates, "the White House became sensitive to the electoral logic of aerospace depression." (p.423) In 1972 Nixon approved the new shuttle STS program.

In its effort to secure the future of a manned space program, NASA presented the shuttle as *the* low cost answer to placing payloads into orbit. In order to amortize the cost of the program, it convinced the Administration that the shuttle could be used for both military *and* civilian programs. In order to satisfy military requirements, however, it was forced to redesign the orbiter and configure it for low altitude orbits which were of particular interest to the military. This made the STS a less attractive option for placing commercial and scientific satellites into medium and high geosynchronous orbit since they required an additional boost to reach the higher orbital positions. McDougall comments that "The STS appeared to be a handy tool for lifting great weights into low earth orbit, but clumsy for anything else. It was this fact that European, especially French, competitors perceived when the American post-Apollo program took final form in 1972."(p.423)

The Unintended Consequences of One-Dimensional Decision Making

The decision to use the shuttle for both military and civilian purposes also resulted in the phasing out of most other military space transportation research, development, and expendable vehicle procurement programs. So as to help amortize the high cost of the new Space Transportation System (STS), the armed services, very much against their will, were forced to cancel their expendable vehicle unmanned launch programs and to procure space on the shuttle to launch their payloads. The shuttle decision, with its exclusive concern with manned missions, also led to less usage of unmanned rockets for scientific missions, despite the scientific community's strong opposition to the emphasis on the employment of the shuttle for experiments that did not require continuous human monitoring. The decision also hindered the development of a commercial launch industry which could not compete with government subsidized launch prices, as we shall discuss further below. Through the STS program, NASA thus became the sole supplier of military, civilian commercial, and scientific launch services.

With the birth of the European Space Agency's commercialization project for its Ariane boosters in 1975, NASA was also faced with the problem of rendering shuttle satellite launch services internationally competitive. Like Arianespace, also NASA decided to charge subsidized launch prices for satellites in order to maintain market share. This strategy was highly successful in market terms since NASA was able to develop a large "captive" U.S. government market. As one commentator, Edwin Deagle, pointed out, "Defense and NASA represent[ed] about 75% of the non-Communist launch market." However, "From the technology management and budget points of view, the NASA shuttle strategy was clearly a disaster... NASA's monopoly supplier strategy early and continuously conflicted with its Apollo driven traditions of technical conservatism and with contemporary budget realities."[108]

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[108]Edwin A. Deagle, Jr., "America's Return to Space: (continued...)

Yet, as Deagle indicates, the very budget austerity contributed to the success of NASA's market strategy, until the Challenger disaster grounded practically all U.S. launches and revealed the dangers inherent in that policy. Governmentally subsidized launch prices, moreover, while to a certain degree attractive to satellite builders and operators, ultimately undercut the ability of U.S. commercial companies to compete on the international market and thereby stymied the development of a viable private commercial sector launch service. A weakened U.S. launch market contributed to making low cost alternative foreign booster systems like the Long March and the Soviet Proton an attractive prospect.

Given the decision to downscale other launch options in favor of the manned shuttle, as mentioned in Chapter Three (see pp. 76f.), a series of launch failures beginning in 1985 with the loss of an Air Force Titan 34D rocket, culminating in the destruction of the space shuttle Challenger, and followed by more rocket failures, left the U.S. without a viable launch system for a while, with grave national security implications for timely replacement of military

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[108](...continued)
U.S. Space Transportation Policy," in: The U.S. in Space: Issues and Policy Choices for a New Era, Edmund S. Muskie, ed. (Washington, DC: Center for National Policy Press, 1988), p.30.

reconnaissance satellites.[109] While in the aftermath of the Challenger accident, a reevaluation of past U.S. policies by the Executive and Congress led to decisions to encourage diversification in launch options and to more aggressively foster growth of a private commercial launch industry, most experts agree that after Challenger an important policy crossroads for future U.S. competitiveness and access to space was reached. As Edmund S. Muskie points out in a volume he edited in 1988 on The U.S. in Space: Issues and Policy Choices for a New Era, "Major decisions, about scope, scale and direction, must be made again, much as they were in the late 1950's and early 1960's. This time, however, the decision-making landscape is vastly more complex than it was before, and we no longer have the convenience of addressing U.S. purposes and resources independently of the purposes and resources of other nations."[110]

Program Complexity and the Problem of Policy Analysis

An additional issue facing the political analyst and decision maker alike is the complexity of U.S. space activi-

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[109]It should be remembered that once production lines for expendable vehicles have been diminished or shut down, in high technology areas it takes time to reconstitute work teams and former production momentum.

[110]Edmund S. Muskie, ed., "Introduction," The U.S. in Space: Issues and Policy Choices for a New Era (Washington, DC: Center for National Policy Press, 1988), p.vii.

ty, which makes it difficult to reach an informed and integrated program overview and, most importantly, to convey this knowledge to the public. A quick glance at Figure 2 (p. 100) which affords a brief non-exhaustive summary of the U.S. space program and the administrative bodies involved, will give an idea of the breadth and scope of activities undertaken under the aegis of the fourteen agencies and institutions responsible for space-related research, development and policy implementation. An extended discussion of Figure 2 would require a book in itself and is therefore not possible within the limited confines of this study. We will, however, briefly comment on the administrative bodies and programs indicated which should afford a sense of the scope and type of activities involved.

The National Aeronautics and Space Administration

The National Aeronautics and Space Administration is the leading civilian space agency and receives the largest part of the civilian space budget, approximately $14 billion (see Appendix I,p.286). This budget covers *Space Science* projects to study the universe, the earth, and to engage in the basic research for further manned planetary exploration. The Space Science program undertakes a variety of disciplinary studies, in areas ranging from astrophysics to earth and life sciences applications, information systems and microgravity research.

Space Science activities include the construction of 4 great observatories: the Hubble Telescope, launched in 1990,[111] the Gamma Ray Observatory, the Advanced X-Ray Astrophysics

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[111]Despite problems with its main mirror, the telescope is sending valuable information back to earth. The mirror is scheduled to be fixed by a space shuttle mission in 1993.

Figure 2. U.S. Space Activity and Administration

National Aeronautics and Space Administration

Space Science and Applications, Space Flight, Space Station, Commercial Programs, Space Operations, Aeronautics Research and Technology, Space Research and Technology, Exploration

Department of Defense

Space and Aeronautical Activities, Other Technologies

Department of Commerce

NOAA Satellite Operations, NOAA Application of Satellite Observations, National Telecommunication and Information Administration, National Institute of Standards and Technology

Department of Energy

Space Nuclear Power Systems, Nuclear Detonation Detection

Department of the Interior

Remotely Sensed Data Acquisition and Processing, Remote Sensing Applications

Federal Communications Commission

Communications Satellites

Department of Transportation

Federal Aviation Administration, Aviation Safety, Air Navigation and Air Traffic Control, Commercial Space Transportation

Department of Agriculture, Environmental Protection Agency, Department of State, Arms Control and Disarmament Agency, United States Information Agency, National Science Foundation, Smithsonian Institution

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Source: NASA, Aeronautics and Space Report of the President: 1989-1990 (Washington, DC: NASA, 1991).

Observatory, and the Space Infrared Telescope Facility. In the area of scientific exploration of the solar system NASA has launched spacecraft such as the Pioneer Venus Orbiter dedicated to gathering data on Venus, Pioneer 10 and 11 and Voyager 2 and 1 that have provided important scientific data on the universe and planets. Other significant exploration activities comprise the Mars Observer, Magellan (to map the surface of Venus), Galileo (to explore Jupiter and its moons), and the joint NASA/European Space Agency Ulysses craft to study the sun.

The Earth Science Program

This program, designed to further understanding of how the biosphere works, includes the Upper Atmosphere Research Satellite System to provide chemical and further data on the earth's upper atmosphere, other atmospheric, geological, and oceanic studies, including work to assess the status of the earth's ozone depletion, geological land assessment through remote sensing data, and the furthering of the Earth Observing System (EOS), an international effort to better understand the dynamics of earth biosphere interactions, which comprises both the use of satellite data and earth-based research.

The Life Sciences Program

In terms of *Life Sciences*, NASA focuses both on understanding the evolution of life in the universe and on the development of support systems for the conduct of human life and enterprise in space. Astronauts conducted extensive work in space medicine and life science research in terms of problems of human adaptation to a gravity free space habitat during space shuttle mission SLS-1 launched in June 1991, which was dedicated to life science investigation. The Russians have a significant lead over the United States in this area since they have been able to undertake experiments on a more or less continuous basis in space, especially since the launching of the MIR space station in February 1986. Life science research is one of the major reasons for the orbiting of a space station, since work in this area cannot be done on earth.

Microgravity Research Program

Microgravity Research is another area sponsored by NASA. It includes the study of earth processes, and the investigation of the dynamics that can lead to the creation of new materials in a gravity free environment. NASA is also working to encourage the commercial exploitation of these procedures. Experiments have encompassed the growth of protein crystals in space, work on new and more effective drugs and medicines, and other investigations.

Space Flight Program

The area of *Space Flight* includes the management of the Shuttle fleet and creation of a mixed manned and expendable launch fleet after the Challenger disaster. In line with President Bush's National Space Policy directive in 1988, the Space Flight Division also undertook to help foster space commercialization. It is engaged in the development of new propulsion systems and has begun work on the National Space Plane with DOD. With regard to orbiting a U.S./ international space station, Space Station Freedom, as indicated, has encountered a series of design problems and funding cuts which may lead closer collaboration with the Russians on station design and deployment.[112]

In addition to the other commercialization programs mentioned, in 1985 NASA created a series of Centers for the Commercial Development of Space which include over 100 affiliates. These consist in joint university, industry, and government cooperative arrangements to develop new potential commercial space areas. NASA also sponsors a Small Business Innovation Research Program. Following the Reagan and Bush commercialization policies, it has sought to assist the growth of a commercial expendable launch vehicle (ELV) industry by moving commercial payloads off the Shuttle,

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[112]See p.143.

procuring commercial launch services, and encouraging private cooperative projects such as SpaceHab (which involved the creation of a pressurized space module for use on the shuttle). NASA is seeking, moreover, to facilitate the creation of a privately developed orbital facility for experiments that would be jointly used by government and the private sector.

Space Operations Program

The *Space Operations* sector includes the development and management of the worldwide communications facilities required for all flight systems. This includes the *Tracking and Data Relay Satellite System*, earth stations, the *Deep Space Network* for data capture and relay. The area of *Aeronautics Research and Technology* covers research and testing of various aircraft relating to civil transportation, aeronautical safety, defense, high technology hypersonic aircraft. In conducting research and testing in these various areas, NASA cooperates with DOD and the Federal Aviation Administration.

Space Research and Technology Program

This program undertakes research in advanced technologies ranging from materials science and space energy conversion to communications, space flight and propulsion. NASA supports university engineering research programs in related engineering and civil space areas. Once having determined which new technologies hold most promise, the program proceeds to the development stage. Activities initiated comprise the Civil Space Technology Initiative and Pathfinder program. The former aims to develop new technologies for access to earth orbit and for scientific missions, and the latter focuses on generating technologies that will insure American leadership in space, ranging from space operations to human habitation.

In addition to the National Aeronautics and Space Administration there are a number of other Government Agencies involved with the U.S. Space Program. The following brief listing will serve to give an idea of the scope of U.S. space policy.

Department of Defense

The Department of Defense is continuing to develop its own fleet of expendable launch vehicles for military payloads which prior to Challenger had been launched from the Shuttle. At the same time, it maintains a system of military communication and reconnaissance satellites in orbit. It is also cooperating with NASA on the *Advanced Launch System Program* which seeks to develop new booster technology. Research and testing also continues in the *Strategic Defense Initiative Program* as does the development and testing of advanced fighter aircraft and the development of the National Aerospace Plane.

Department of Commerce

The Department of Commerce is active in the space area through the National Oceanographic and Aerospace Administration (NOAA) management of satellites for weather and climate data, studies of earth vegetation and atmospheric ozone depletion, or the tracking of fish populations. NOAA also administered the government part of the Landsat remote sensing program, which was delegated to a private company, Earth Observation Satellite Company, in response to the Reagan government commercialization initiative. The National Telecommunications and Information Administration is also part of the Department of Commerce.

Departments of Energy and of the Interior

The Department of Energy participates in the space program by furnishing nuclear power sources for space missions such as Voyager or Pioneer probes, the Galileo and other planetary missions. The Department of the Interior conducts research on remote sensing and utilizes satellite and aircraft data to manage its land holdings, monitor wildlife, wildfire, reservoir parameters, ocean current circulation, movement of sea ice. Through spectral analysis it does research on identifying geologic mineral deposits, monitors surface coal mines. Additional activities include cartographic mapping, global change monitoring of coastal erosion, ice, regional vegetation.

Department of Agriculture

The Department of Agriculture participates in the space program through utilization of remote sensing data for resource monitoring and management, such as crop and irrigation assessment.

Federal Communications Commission

The Federal Communications Commission monitors the communications satellites in orbit and oversees satellite activity and access to geostationary orbit, including civil communications (PanAmSat, ComSat, IntelSat), and maritime communications (INMARSAT).

Department of Transportation

The Department of Transportation's Office of Commercial Space Transportation (OCST) oversees the nascent commercial space transportation sector, issues licenses, monitors insurance requirements. The Federal Aviation Administration, also part of DOT, focuses on the promotion of civil aviation safety.

Environmental Protection Agency

The Environmental Protection Agency uses satellite data to monitor the environment, support pollution research, interpret water quality, toxic waste and other environment related data.

Department of State and other Agencies and Institutions

The Department of State is involved in international space negotiations with foreign governments and international organizations and seeks to advance U.S. foreign policy interests in the space area. The U.S. Arms Control and Disarmament Agency focuses on arms control problems of space systems. The National Science Foundation supports academic research in atmospheric sciences. The Smithsonian supports an Astrophysical Laboratory in Cambridge, MA and the Center for Earth and Planetary Studies at the National Air and Space Museum.

The Dilemma of Complexity vs Efficiency

Given the large array of space activities and the number of government agencies involved in administering these activities, it is easy to understand the difficulty legislators and experts alike have in gaining a comprehensive picture of the whole program. In the case of the Long March booster licenses, for example, we will see how a large number of different government agencies were involved in making and implementing the decision. The sheer number of activities in which NASA itself is involved prompted the Augustine Commission which authored a Report on the Future of the U.S. Space Program (December 1990) to comment that NASA should try to reduce the number of programs it sponsors. Yet complex technological endeavors such as those concerned with space require investigation of many different related technologies and areas of endeavor. The dilemma is not an easy one to solve. Too much fragmentation of scientific research and technological implementation can be as negative as too many projects run under one roof.

Conclusion

In this chapter we have noted the fragmentation that exists in the field of space policy which mirrors the fragmentation that characterized the field of political science in general. The complexity of the space program itself, with its many activities divided among several government agencies, does not make it easy for the interested observer to achieve an in-depth grasp of the overall program and specific U.S. policies governing the area. The dichotomy between the short-term vision of congressional policy making and the often long-term funding requirements of science and technology programs such as those in the space arena leads to additional problems in formulating a coherent space policy.

Next, however, in order to achieve a better understanding of the development of space policy within the context of a longer time frame, we will briefly look at the historical origins and development of the U.S. space program. While it is not the intent of this study to give an extended portrayal of the history of space activity, we will highlight the most important aspects of that history as they relate to the purpose of our inquiry. The three main aspects of space policy we will focus on are: defense, commercialization, and scientific. We will then examine how these aspects converged in the Chinese booster decision. Finally we will examine policy implications and relate them to our theoretical approach.

CHAPTER 5. RISING CRITICISM OF THE CIVILIAN SPACE PROGRAM AND A REEXAMINATION OF GOALS

> *Whereas in the past, the space program primarily looked outward, today's space programs looks inward as well in order to better understand our fragile planet. Whereas in the past, the space program was a symbol of the superpower race for technological dominance, today's space program represents common pursuits by all nations of the world to improve the quality of life for all humankind. And finally, whereas the space program of the past was the responsibility of governments, the space program of today and tomorrow represents the combined efforts of the government and private sector to fulfill the fundamental goals of the civil space program and to capture new markets and economic opportunities.*
>
> *Vision 21: The NASA Strategic Plan*[113]

Criticism of the evolution of the U.S. space program, which came to a head after the explosion of Challenger, led to a series of studies on the future of the U.S. space program. In 1987, two studies, one undertaken by NASA and the other by the CIA arrived at pessimistic conclusions when they sought to assess the political, economic, and strategic implications of space. According to the CIA study, while the U.S. still led in several technologies and space science areas, its progress was declining. European commercial space endeavors were found to exceed those of the United States in many areas. Another group, the NASA Advisory Council Task Force on International Relations in Space, headed by Prof.

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[113]National Aeronautics and Space Administration (Washington, D.C., 1992), p.1.

Herman Pollack of George Washington University and 15 non-NASA members, found the U.S. program to suffer from the following problems:

- difficulties in deciding on appropriate budget levels because of the lack of authoritative statements in this regard;
- management of details through budgetary controls by Congress and the Office of Management and Budget based on a short-term rather than a long-term perspective;
- interdepartmental confusion due to the lack of such authoritative statements on space station negotiations with prospective international partners;
- the erosion of U.S. leadership in civilian space activities with a consequent loss of international prestige;
- dissention between NASA and the Defense Department;
- damage to the U.S. national interest and foreign policy objectives;

Looking forward to the period 1995-2000, the report projected a significant loss for the United States both in market share and in international power and prestige in the space area. The decline signifies "obvious costs in terms of foreign policies and economic advantages foregone." The task force forecast that unless urgent modifications were made in current space policy, by the end of the century:

> Europe, the Soviet Union, Japan and China will each have mature or near mature capabilities in all or most aspects of space activity. Substan-

> tial national space independence will be a commonplace fact of life, and all will be competing aggressively for commercial market share.... However, U.S. leadership in specific areas and technologies will in many instances be shared or dispersed and in others will be lost. The U.S. will have to adapt its attitude, approach and policies on international cooperation and competition in space to a new set of realities...[114]

Also in 1987, a number of other studies were promoted both within NASA and outside the Agency, which were concerned with the problem of defining long-range goals for the civilian space program.[115] One of the most noteworthy of these, the 1987 report by former astronaut Sally K. Ride to NASA on Leadership and America's Future in Space, warned that "For two decades, the United States was the undisputed leader in nearly all civilian space endeavors. However, over the last decade the United States has relinquished, or is

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[114]Craig Covault, "Aggressive Foreign Space Programs Forcing U.S. Strategic Reassessment" In: Aviation Week and Space Technology, 12 October 1987, pp.28-30.

[115]These include The Next Giant Leap in Space: An Agenda for International Cooperation, sponsored by the United Nations Association of the U.S.A.; U.S. Civil Space Program: An AIAA Assessment, by the American Institute of Aeronautics and Astronautics; The Crisis in Space and Earth Science, by the Space and Earth Science Advisory Committee, NASA Advisory Council; Space Science in the Twenty-First Century: 1995-2015, by the Space Science Board, National Academy of Sciences; Task force on International Policy and Program Issues, sponsored by the NASA Advisory Council. For a more extensive listing of reports, see the Sally K. Ride report Leadership and America's Future in Space (Washington, DC: NASA, 1987) pp.60-61.

relinquishing, its leadership in certain critical areas..."[116] The Task Force marked four initiatives as a possible basis for the future development of a strong American space program: Mission to Planet Earth, Exploration of the Solar System, Outpost on the Moon, and Humans to Mars. These initiatives, as we shall see, have since been incorporated into U.S. space policy.

These pessimistic assessments of U.S. leadership in space reflected profound disenchantment with U.S. policy at the time. But is the United States still adrift in the space area today? One knowledgeable member of the government and space communities observed in a volume on space policy which appeared in 1989 that he believed the major deficiency of the civil space program to reside in too little policy direction from the Executive Branch and Congress: "Absent clear [government] policy guidance, NASA tries to generate programs and sell them in an increasingly difficult environment."[117] Have the dire forecasts served to spur action by the Adminis-

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[116](Washington, DC: NASA, 1987), p.11. The Task Force headed by Dr. Sally K. Ride was formed by NASA administrator Dr. James Fletcher to examine increasingly critical evaluations of the civilian space program in the aftermath of Challenger. The aim of the task force was "to define potential U.S. space initiatives, and to evaluate them in light of the current space program and the nation's desire to regain and retain space leadership." (p.7)

[117]Albert D. Wheelon, "Toward A New Space Policy," Space Policy Reconsidered, ed. Radford Byerly, Jr. (Boulder, CO: Westview Press, 1989), pp.68-69.

tration and Congress to obviate the danger of falling behind in space and if so in what way?

New Directions in Space Policy

With the advent of the Bush administration, and without the usual fanfare that normally tends to accompany pivotal change, U.S. space policy has undergone a major realignment and adjustment to a changing geopolitical international market landscape. Although within the constraints of this chapter we cannot examine all the multifaceted programs and areas affected by this realignment, we will seek to highlight the overall evolution of space policy toward a new phase of development. As we will see, contrary to the earlier comment on the lack of governmental guidance, the major catalysts promoting this new bearing have been the Executive Branch under the direction of President Bush and the U.S. Congress.

The new course endorsed by President Bush involves five main areas: (a) the establishment of long-term policy goals (which permits the determination of the best means of achieving them); (b) the reform of an over-bureaucratized NASA; (c) the establishment of cooperation between government agencies involved in space so as to avoid duplication of effort and pool dispersed expertise to improve efficiency and output; (d) the lowering of high technology trade barriers with the former Soviet Union so as to add to the U.S. technology base and reduce program lead times; (e) the fostering of the development of a commercial space industry in the United States and strengthening the bargaining position of U.S. companies operating on the global market.

The Reaffirmation of New Long-term Goals in Space

In Leadership and America's Future in Space, Sally Ride wrote that:

> We must ask ourselves: "Where do we want to be at the turn of the century?" and "What do we have to do now to get there?" Without an eye toward the future, we flounder in the present...A clear vision provides a framework for current and future programs: it enables us to know which technologies to pursue, which launch vehicles to develop, and which features to incorporate into our Space Station as it evolves. (p.6)

The problem of the U.S. future in space did not really lie in the *lack* of ideas for future space activity. The *lack of vision* in the U.S. space program decried from so many quarters was actually not one created by a dearth of goal oriented opinions. The situation might actually be more aptly described as one of "blurred" or confused vision as the sense of future direction was lost amidst the cacophony of present ideas and contrasting interests. The problem facing any policy planner in this area therefore was a rather basic one of conducting a thorough research of the market, identifying the suggestions with most merit, evaluating their feasibility, and forming a consensus so as to facilitate their implementation. This is precisely what President Bush set out to do by creating the National Space Council and commissioning two major studies by distinguished experts, the Augustine and Stafford reports, on the future of the U.S. space program.

The National Space Council

On April 20, 1989 President Bush signed Executive Order 12675 establishing the National Space Council. The Council is composed of the top government officials that have responsibilities connected with U.S. space policy. These include the Vice President, who acts as Chairman, the Secretaries of State, Treasury, Defense, Commerce, Transportation, the Director of the Office of Management and Budget, the President's Chief of Staff, the President's Assistants for National Security Affairs, and Science and Technology, the Director of Central Intelligence, and the Administrator of NASA. In addition, the Chairman of the Joint Chiefs of Staff, the heads of other government agencies and executive departments, and other senior government officials may be invited to participate in meetings by the Chairman of the National Space Council.

The Council's aims are to "advise and assist the President on national space policy and strategy, and perform such other duties as the President may from time to time prescribe." As part of its job, the Council is instructed to

> 1) review United States Government space policy, including long range goals, and develop a strategy for national space activities;
>
> 2) develop recommendations for the President on space policy and space-related issues;
>
> 3) monitor and coordinate implementation of the objectives of the President's national space policy by executive departments and agencies; and
>
> 4) foster close coordination, cooperation, and technology and information exchange among the civil, national security, and commercial space sectors, and facilitate resolution of differences concerning major space and space-related policy issues.[118]

The Council quickly moved to fulfill its mandate. In the brief time between its creation in April 1989 and November of that same year, it revised the 1988 National Space Policy. The revised version was then signed by President Bush in November 1989. The new policy, as indicated, gives clearer focus to diverse areas of activity, such as space transportation, remote sensing, commercial space activities, Space Station Freedom, space debris, in addition to defining a policy framework for future goals in space. The National Space Council drafted the Space Exploration Initiative for President Bush and prepared two enabling directives, regarding both the Initiative itself and the

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[118]For the full text of the Executive Order, see Appendix IV, p.309.

possibilities of international cooperation in this area, which the President signed in 1990. In March 1992, the Space Council issued a new Space Exploration Initiative Directive, approved by President Bush, that redefines NASA's role in the Moon-Mars mission. While NASA remains the lead agency in the undertaking, major roles are also delegated to the Departments of Defense and Energy.[119]

The Council, moreover, has established inter-agency working groups to monitor advances in the implementation of the President's goals, prepare guidelines for discussions and meetings, and apprise the Council itself on progress achieved on specific projects. In terms of clarifying policies or resolving conflicting issues, the Council's activities include: in February 1991, after a nine-month interagency review, it reformulated new U.S. Commercial Space Policy Guidelines that were aimed at fostering private sector expansion in the area of commercial space;[120] in July 1991, it released the directive for a new National Space Launch Strategy;[121] and in February 1992 it announced approval by

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[119]See Appendix IX, pp.334 ff.

[120]See Appendix VI, pp.314ff.

[121]The strategy, among other things, provided for the maintenance of the current systems based on older technologies, such as the shuttle fleet, and extending their lifetimes beyond the year 2000. However, it indicated that no new orbiters would be commissioned and that the nation's space (continued...)

President Bush of a policy governing the Landsat multispectral imaging (remote sensing) program.[122]

The Augustine and Stafford Reports

The two major policy reports commissioned by the Executive Branch were the Augustine and Stafford/Synthesis Group studies. The Report of the Advisory Committee On the Future of the U.S. Space Program, also known as the "Augustine Report" after the name of the task force's Chairman, Norman R. Augustine, was undertaken at the request of the National Space Council to reexamine the United States' civil space program and its chief agent, the National Aeronautics

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[121](...continued)
transportation needs would be met in the twenty-first century by a new fleet of medium to heavy-lift launch vehicles which would be developed jointly by NASA and the Department of Defense. To this end, it also directed the continued research and development of new technologies concerning "launch system components (e.g., engines, materials, structures, avionics, upper stages, improved launch processing concepts, advanced launch system concepts (e.g. single stage to orbit concepts including the National Aerospace Plane); and experimental flight vehicle programs." (see Appendix VII, pp.322 ff.)

[122]The directive acknowledges the importance of Landsat multispectral data acquisition, reaffirms government funding, and assigns agency responsibilities for the future development of the program. The Department of Commerce remains in charge of the continued operation of Landsat satellites 4 and 5, which are already in orbit, and of completing the production and launch of Landsat 6. The Department of Defense and NASA will instead design and launch Landsat 7, which will replace Landsat 6, and plan for future replacement satellites. The directive also provides for interagency cooperation and other matters. (see: Appendix VIII, pp.329 ff)

and Space Administration. The report was issued in December 1990. It represents a thoughtful and balanced evaluation of problems within NASA and offers suggestions for their solution, many of which have already been implemented. In line with its responsibility for making recommendations regarding goals and program content, the Augustine task force advises:

> 1) Establishing the science program as the highest priority element of the civil space program, to be maintained at or above the current fraction of the budget.
>
> 2) Obtaining exclusions for a portion of NASA's employees from existing civil service rules or, failing that, beginning a gradual conversion of selected centers to Federally Funded Research and Development Centers affiliated with universities, using as a model the Jet Propulsion Laboratory.
>
> 3) Redesigning Space Station Freedom to lessen complexity and reduce cost, taking whatever time may be required to do this thoroughly and innovatively.
>
> 4) Pursuing a Mission *from* Planet Earth as a complement to the Mission *to* Planet Earth, with the former having Mars as its very long-term goal--but relieved of schedule pressures and progressing according to the availability of funding.
>
> 5) Reducing our dependence on the Space Shuttle by phasing over to a new unmanned heavy lift launch vehicle for all but missions requiring human presence.[123]

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[123]Report of the Advisory Committee on the Future of the U.S. Space Program, p.48. As indicated earlier, Norman R. Augustine at the time was Chairman of the Martin Marietta Corporation.

The second major study, America at the Threshold, the Report of the Synthesis Group on America's Space Exploration Initiative also undertaken at the request of the National Space Council, was published in May 1991. The Synthesis Group was headed by former Gemini/Apollo astronaut General Thomas P. Stafford, USAF and represented a "synthesis" of viewpoints on space goals and programs from government agencies, scientists, industry, universities, organizations such as the American Institute of Aeronautics and Astronautics, and other experts and parties interested in the future of the U.S. space program. The Report redefines options for President Bush's Space Exploration Initiative (SEI) which will take the United States back to the Moon to establish a manned lunar base there and forward to Mars, to extend man's reach farther into the solar system. The study provides a detailed evaluation of technical choices on how to implement the SEI and offers four mission architectures which reflect emphasis on three areas: "human presence, exploration and science, and space resource development for the benefit of Earth." The four architectures put forward by the Synthesis Group are:

> 1. Mars Exploration: This architecture envisages development of a lunar base only to the extent necessary to attain experience for the future voyage to Mars;
>
> 2) Science Emphasis for the Moon and Mars: This entails equal emphasis on the Moon and Mars, with extensive scientific missions and lunar explora-

tion to obtain life sciences and other data necessary for the longer Mars mission;

3) The Moon to Stay and Mars Exploration: The main objective of this architecture is the creation of a permanent Moon base for humans, which can serve as preparation for a later Mars voyage. It involves extensive study of lunar surface conditions and the creation of human independent life support systems for breathing and food production;

4) Space Resource Utilization: The main goal of this architecture is the development of space resources both to support further exploration and "to develop a large class of available resources for a broader range of transportation, habitation, life sciences, energy production, construction and many other long-term activities."[124]

Among its recommendations, the Synthesis Group suggests that NASA establish a long range strategic plan for the civil space program within the agency which would revolve around the Space Exploration Initiative, that a new and aggressive acquisition strategy be implemented as opposed to slower methods of the past, that the SEI requirements be incorporated into the NASA-DOD heavy lift vehicle program, that a nuclear thermal rocket be developed for the Mars mission and also that space nuclear power technologies be developed to meet the SEI needs for electricity. (pp.7-9) Several of these suggestions have been incorporated in the National Space

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[124] America At The Threshold (Washington, DC: GPO, 1991), pp.4-6.

Council's March 1992 Space Exploration Initiative Strategy.[125]

Conclusion

We have seen in this chapter how enthusiasm for the space program reached a peak with the Apollo Moon landing and then lessened in the 1970s. We saw how the lack of a holistic vision of goals and the means of achieving them led to a poorly thought out policy decision concerning the development and utilization of a manned shuttle spacecraft. While the shuttle represents a high point in the achievement of an advanced space transportation system, to have made it the only means of access to space reflected a one-dimensional vision that proved to hold potential danger for the national security of the nation.

With the advent of the Reagan and Bush administrations and a changing geopolitical scene, we noted how the space program advanced from a situation of disenchantment and lack of clarity concerning America's goals in space, to a new feeling of purpose and direction in that area of future human activity and exploration. Through the creation of bodies such as the National Space Council, studies and reports from a broad cross-section of experts in the space sector, and the

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[125]See Appendix IX, pp.334 ff.

development of consensus regarding direction and goals, which serves as the basis for the attainment of sustainable funding from Congress, the Bush administration succeeded in channelling the nation's energy once more into the development of the research and technology necessary to move closer toward the centerpiece of the Space Exploration Initiative: the Moon-Mars mission. In the next chapter, we will look at the commercial aspect of space activity, the international space "market place," and the role this sector plays in the overall space policy of the United States.

CHAPTER 6. THE COMMERCIAL DIMENSION OF SPACE POLICY

> *the balance of probability strongly favors the view that the countries involved in space in the 21st century will be the technological leaders of the day and that benefits from space will spill over into other industrial activity...*
>
> *Committee on Science and Technology, Subcommittee on Space Policy, British House of Lords*[126]

Turning now to an equally important aspect of the significance of space for political analysis: the actual and potential socio/economic and scientific impact of space on the power relations within and between nations, it has been estimated that space and related activities will represent one of the largest industrial sectors in the twenty-first century.[127] Although still in its infancy, the economic dimension of space activity has not been overlooked by

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[126]Report of the Subcommittee on United Kingdom Space Policy chaired by Lord Shakleton, of the British House of Lords Select Committee on Science and Technology, quoted in David A. Brown, "British Science Committee Calls for Doubling National Space Budget," Aviation Week and Space Technology (February 8, 1988), pp.86-87.

[127]William J. Broad, "Space Drive's Tilt to Industry Gains Wide New Impetus," New York Times, January 24, 1988, Sec. 1, pp.1, 28. Estimate by Peter E. Glazer, of the consulting/ research firm Arthur D. Little in Cambridge, Massachusetts.

governments around the world. As a report issued by the British House of Lords' Select Committee on Science and Technology indicated, "The United Kingdom must take part in the development of space and must be seen to take part....This is not just another technological endeavor calling for funds in competition with information technology, medicine, nuclear power and the like...Space is a new domain."[128]

The International Space Market

If any lesson is to be learned from the course of human history, one might indeed agree with the conclusion arrived at by one space expert that "space is a place, just like Earth is a place, and all the laws of economics apply there."[129] While future commercial revenues from satellite communications, remote sensing, materials processing in space, launch services, on-orbit services, and income to contractors in major government projects such as Space Station Freedom are difficult to estimate, they nonetheless will increase as new technologies and launch systems currently under development lower the costs of access to space. Forecasts of demand and, therefore, of global revenues vary.

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[128]Quoted in David A. Brown, "British Science Committee Calls for Doubling National Space Budget," Aviation Week and Space Technology (February 8, 1988), pp.86-87.

[129]Peter E. Glazer, quoted in William J. Broad, "Space Drive's Tilt to Industry Gains Wide New Impetus," p.28.

In February 1991, the Congressional Budget Office estimated that the market for satellite launches into space will range through 1994 from 0.8 billion to 1.2 billion annually. Half of this market will be retained by the European Space Agency consortium Arianespace. The other 50% of the market will be divided between the three American launch vehicle manufacturers, Martin Marietta (Titan booster), General Dynamics (Atlas-Centaur booster), McDonnell Douglas (Delta booster) and the China Great Wall Industries Corporation (Long March booster). Market demand for launches is anticipated to vary between 15 and 20 satellites through 1995 and to decrease thereafter to between 12 and 17 until the turn of the century.[130] Different launch forecasts are listed in Figure 3 (p.130). The former Soviet Union has not been very successful in penetrating the Western launch market to date, but this situation is in the process of changing. Unless there is a halt to the democratization taking place in that area, the future is likely to witness a substantial increase in commercial competition in the global space arena as a changed international attitude relaxes barriers toward the new Commonwealth of Independent States.

Another recent study by the Office of Commercial Space Transportation (U.S. Department of Transportation), reports

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[130]Congressional Budget Office, Encouraging Private Investment in Space Activities (February 1991), p.xi.

higher demand estimates. While acknowledging significant elements of uncertainty relating to launch costs, infrastructure and vehicle development costs, technological advances in sensors, payload, or data processing, the study

Figure 3. Commercial Demand Forecasts

FORECASTS OF COMMERCIAL DEMAND FOR
SATELLITE LAUNCHES IN THE 1990s

Forecaster	Number of Launches
National Aeronautics and Space Administration, Office of Space Flight (June 1989)	11 to 21 annually in 1990 through 1994, 10 on average in 1995 through 2000
Center for Space Policy (November 1989)	17 to 25 annually through 1993, less than 10 in 1994 through 2000
Euroconsult (November 1989)	15 telecommunications satellites annually, 3 additional earth observation satellites annually in 1989 though the year 2000.
General Dynamics (November 1989)	13 payloads annually in 1990 through 1998
Arianespace (February 1990)	17 to 25 annually in 1992 through 1996, 15 to 19 annually in 1996 through 2001
United Technology Corporation (February 1990)	14 to 24 annually in 1993 through 1996, 13 to 16 annually in 1997 through 2000
U.S. Department of Transportation, Office of Commercial Space	17 to 20 annually through 1994, 12 to 17 annually in 1997 through 2000

Source: Congressional Budget Office, Encouraging Private Investment in Space Activities, p.32.

projected over 40 payloads per year for the period 1993-1999 and up to 55 payloads for the period 2000-2005 (see Figure 4, p.133).[131] Any launch failures could alter these estimates substantially since production and launches relating to the specific booster system would probably be suspended pending determination of the problem.[132]

Transnational Economic Interests and Space

If examined from the economic standpoint of global interdependence, the new domain of space offers some intriguing intimations of the impact of transnational economic interests in overcoming longstanding ideological and political barriers. In eyeing the lucrative market of the launch business and its potential to bring in much needed hard currency, both the Soviet Union, its successor Commonwealth of Independent States, and China have been actively marketing satellite launch services to countries around the world. In

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[131]U.S. Department of Transportation, Office of Commercial Space Transportation, The Future of the Commercial Space Launch Market: 1993-2005, prepared by Decision Science Consortium, Inc. and Berner, Lanphier, and Associates, Inc. (May 1991), p.iii.
The authors of the study attribute the higher launch figures they forecast to the methodology employed. As against studies that base their forecasts only on present scheduled or planned payload manifests and current market growth, they attempt to gauge "potential markets and to estimate the uncertainty associated with each." (p.iv)

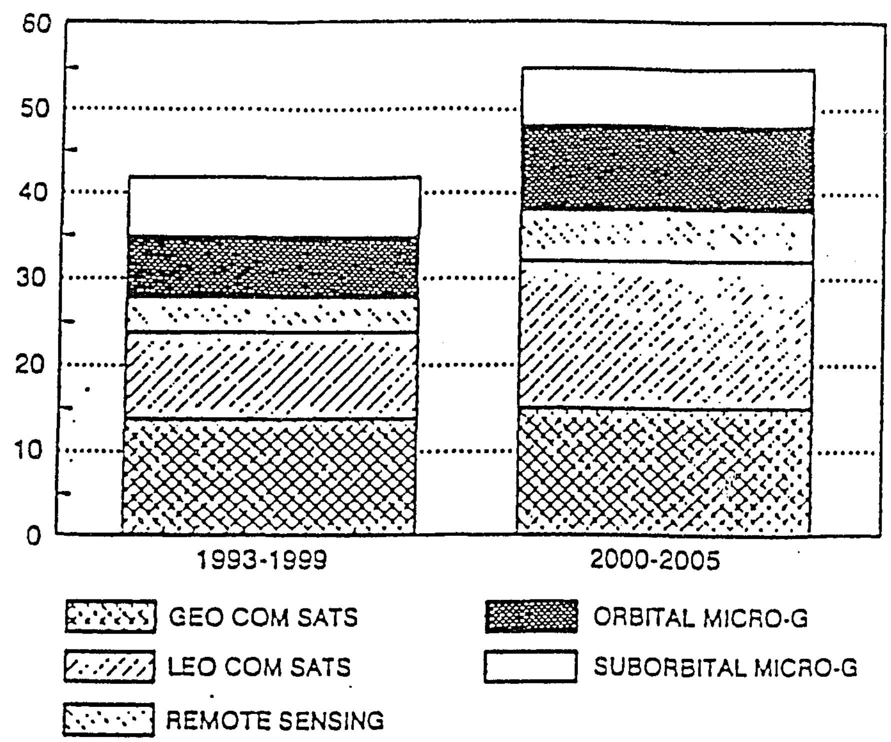
[132]Ariane launch failures in 1986 and 1990 led to a significant decrease in number of launches forecast while an investigation of the problem and search for a solution took place.

line with the new Gorbachev policies of *glasnost* and opening toward the West, the Soviet Union created Glavcosmos in 1985, a management/ marketing organization, which offered commercial launch services on its Proton boosters, for example, at $25-30 million per launch, a price significantly lower than that charged by NASA before the U.S. program was grounded in 1986 (for comparative pricing, see Figure 5, p.134). The price for launches of satellites on Soviet Vostok, Molniya and Soyuz vehicles was approximately $10-14 million. In addition, the price for the lease of a full relay capacity on a Gorizont telecommunications satellite (eight transponders, with the satellite prepositioned according to the customer's requirements) was also competitive with those set by the West.

The use of Soviet/CIS and Chinese boosters, despite recent trends in democratization in the former Soviet Union, still presents sensitive technology transfer problems for

Figure 4. Average Annual Number of Payloads Estimates

ESTIMATES OF AVERAGE ANNUAL NUMBER OF PAYLOADS
FOR PERIODS 1993-1999 AND 2000-2005



Source: U.S. Department of Transportation, The Future of the Commercial Space Launch Market: 1993-2005, p.iii.

Figure 5. Prices of Launch Vehicles

(In millions of 1989 dollars).

Vehicle	Launch Price
United States	
Delta 2	$ 40-50
Atlas 2	60-85
Titan 3	130-140
Europe	
Ariane 4	100-110
China	
Long March	30-60
Japan	
H-2	not available
Soviet Union	
Proton	30-65
Zenit	80

Source: Congressional Budget Office (from NASA), in Encouraging Private Investment in Space Activities, p. 28

Western nations. For this reason, both the Soviet Union/CIS and China have always insisted that any Western nation interested in utilizing their boosters can monitor the launch process on a continuous basis to make certain that no sensitive material gets into unauthorized hands. While U.S. launch policy toward the Chinese was modified with the Long March booster decision, the ban on the use of Soviet launchers only began to change with the State Department 1990 decision in favor of the Australian Cape York facility which will eventually lead to use of CIS boosters at that spaceport.[133] More recently, Lockheed Corporation has reached an accord with the Khrunichev Enterprise Bureau to market the Proton booster in the West and has tendered a bid to launch an Indonesian satellite. And the International Maritime Satellite Organization (INMARSAT) hopes to launch its INMARSAT-3 satellite on a Proton booster from the Baikonur Cosmodrome in 1995. In all of these prospective launches, technology transfer and other security and trade safeguards will have to be worked out.[134]

During Congressional hearings in relation to U.S. international launch practices, as we will see, major

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[133]On the Australian Cape York venture see also p.8.

[134]"Russian Proton to Launch INMARSAT-3 Satellite in 1995," Aviation Week and Space Technology, April 19, 1993, p.25.

satellite builders such as General Electric and Hughes Aircraft Company asked Congress to reconsider its policy of banning the use of both Soviet and Chinese launchers by U.S. companies. Even back in 1987, before the current accelerated democratization trends in the former Soviet Union, Eugene F. Murphy, Senior Vice President of General Electric, in a written statement to the House Space Science and Applications Subcommittee (on September 15th), urged the U.S. to "seriously investigate" the possibility of allowing U.S. firms to use *both* the Chinese Long March launchers and the Soviet Proton booster.[135]

The Soviet Union had also been marketing "getaway special" payloads, similar to those that were offered by NASA on the shuttle, for a variety of scientific experiments on manned and unmanned spacecraft. Agreements have already been signed and performed with several customers, including the United States with a first agreement concluded in 1988.[136]

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[135]Theresa M. Foley, "Satellite Builders Want Change in U.S. Anti-Proton Policy," in Aviation Week and Space Technology, 28 September 1987, p.138.

[136]The New York Times on February 21, 1988 carried the announcement that the first commercial contract was signed between an American company and the Soviet Union to undertake protein crystallization experiments on the MIR space station. This development heralded a new era of commercial cooperation in space between the Soviet Union and private U.S. companies. See: William J. Broad, "American Company and Soviet Agree on Space Venture: First Commercial Pact," The New York Times, February 21, 1988, pp.1,32.

The 1988 agreement was looked upon as a initial step in overcoming long-standing U.S. opposition to cooperation with the Soviet Union in areas where technology transfer might occur, although in the field of materials processing in space the Soviets/CIS are seen to have a significant lead over the U.S. because of their ongoing experiments on their space stations. Experiments and materials processing conducted in zero gravity are important for a series of commercial purposes. Protein crystallization in zero gravity, for example, is important to pharmaceutical companies for the development of new drugs. Gallium arsenide crystals, used in high speed computers and defense applications, when produced in zero gravity lack the imperfections of their counterparts manufactured on earth. And metals that do not mix well here on earth can be molded into new alloys in the absence of gravity, leading to the possible production of stronger and more resilient materials that may be better suited to long term space travel.

Growth Trends in U.S.-Soviet/CIS Cooperation in Space

Cooperation with the former Soviet Union seems likely to grow if the republics continue on their present democratic course. The U.S. at this time has no alternative means of conducting *long-term* materials processing or medical/biological experiments in space since the Shuttle is not configured for this purpose[137] and the U.S. Space Station, barring problems with funding or major technical glitches, will not be ready until the end of the 1990s. The Soviet Union-CIS, on the other hand, have been very active in promoting closer collaboration with the U.S. During the Moscow Summit at the end of July 1991, in addition to the Strategic Arms Reduction Treaty (START) and other important accords,[138] Presidents Bush and Gorbachev signed an agreement outlining future U.S.-Soviet cooperation in space.[139] The document includes a plan to exchange astronauts, with an American scheduled to be launched on the MIR space station for a prolonged stay in space to undertake medical experiments and a Soviet cosmonaut to be launched on a shuttle-Spacelab life sciences flight which would likely take place in 1993. It is hoped that this might lead to future joint missions, which have not occurred since the Apollo-Soyuz space rendez-vous in 1975.

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[137]A plan is presently being studied by NASA to convert one of the Shuttle orbiters to flight periods that could last up to nine months.

[138]The START Treaty marked the first time the two superpowers actually agreed to substantially reduce the number of armaments in their strategic arsenals. Other agreements signed included the areas of aviation security, medical aid, disaster assistance, and finance.

[139]See: Craig Covault, "U.S.-Soviet Pact Backs New Joint Manned Space Flights," Aviation Week and Space Technology (August 5, 1991), pp.18-19.

As part of the hope for future collaboration, the Summit agreement also set an agenda for the training of Russian cosmonauts at the Johnson space center and of American cosmonauts at the Star City Gagaran Cosmonaut Training Center near Moscow. It also provided for the formation of A Manned Flight Joint Working Group to coordinate training and other issues.[140]

In the area of earth observation and environmental studies, an invitation was extended to the Soviet Union to participate in the NASA Mission to Planet Earth program. This program will launch a number of satellites to undertake earth observation for environmental purposes, in addition to other means of monitoring the environment. As a sign of a new openness toward cooperation with the West, the Soviet Union permitted a U.S. team to go to the formerly highly secret Plesetsk military cosmodrome to prepare a NASA ozone mapper to monitor the ozone layer. The mapper was launched in August on Soviet Meteor-3 weather satellite. U.S. cosmic ray

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[140]Other collaborative working groups comprise: Earth sciences, space and terrestrial physics, biology and medicine, astronomy and astrophysics, exploration of the solar system.
See: Craig Covault, "U.S.-Soviet Pact Backs New Joint Manned Space Flights, Aviation Week and Space Technology (August 5, 1991), p.18.

detectors have also been placed on the outside of the MIR space station.[141]

Another important advance in collaboration was made with the creation of a high level space consultation group that would evaluate new areas and projects to be undertaken on a cooperative basis. The various proposals incorporated in the summit agreement represented a synthesis of the ideas of various groups undertaken by the National Space Council under the guidance of Vice President Quale and by the U.S. Inter-governmental Working Group on Soviet space cooperation.[142]

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[141]While the cosmic ray detector posed no significant technology transfer problems, the situation was different with the Goddard Total Ozone Mapping Spectrometer (TOMS) and its associated high technology Fairchild interface adapter which would connect the TOMS with a U.S. computer memory required on the satellite for the readings. In order to receive an export license for the hardware to be shipped to the Soviet Union, NASA, like Hughes Aircraft Company in the case of China, was forced to obtain a waiver from the State Department Office of Munitions Control. The State Department required agreements from the Soviet State Commission for Hydrometeorology concerning restricted access of Soviet personnel and U.S. personnel oversight of the devices. The ozone mapper was launched from the Plesetsk cosmodrome on August 15, 1991. This joint endeavor was important in assuring continued coverage of the ozone layer and continued data acquisition since the only other ultraviolet spectrometer aloft was launched by NASA in 1978 with a Nimbus 7 satellite which is now approaching the end of its useful lifetime. It is also the first major joint technical space project between the U.S. and the USSR since the joint Soyuz-Apollo mission in 1975.
See: Craig Covault, "Long Astronaut Flights on Mir Sought for U.S.-Soviet Summit," Aviation Week and Space Technology, (July 1, 1991) 134, 26, pp.18-19.

[142]See Covault, p.19.

They signal an important step toward future joint initiatives in the space area.

International Preeminence in Space and Foreign Policy Gains

In the past, the Soviets made extensive use of their space capabilities in furthering foreign policy objectives. Apart from the obvious gains in prestige they obtained through their space successes, such as orbiting the MIR space station in 1986, breaking their own manned spaceflight endurance record with a sojourn of 11 months in space by Col. Yuri V. Romanenko in 1987, and subsequently a year-long sojourn on the station by a different team, the Soviets actively used their space capabilities to promote cooperative ventures with countries around the world. They held a rendezvous in space with an American Apollo mission in 1975. and from the early 1980s, they have invited foreign nationals to join their own cosmonauts on certain missions, including French, Italian, German, Indian, Syrian, Japanese, British and other foreign crew members. The Soviets have also sought the collaboration of different nations on a variety of scientific unmanned space projects, such as the 1986 Vega missions to Halley's comet.

In October 1987, on the 30th anniversary of the launch of Sputnik I, the Soviets held an International Space Forum to outline their future space plans and encourage foreign participation and cooperation. Sponsored under the auspices of the Soviet Academy of Sciences' Space Research Institute, they invited to Moscow at Soviet expense over 400 space program managers and experts, researchers, scientists, businessmen, bankers and guests from 30 different countries to meet with an equivalent number of their Russian counterparts. In an interview with Aviation Week and Space Technology, Dr. Roald Sagdeev, former Director of the Academy Space Research Institute and presently in the U.S. undertaking research at the University of Maryland, summed up his goal in organizing the Space Forum as follows: "Cooperation [on peaceful space programs] becomes more important as the cost of missions goes up and up. We wanted to get this message across to the decision-makers -- both internationally and in the Soviet Union itself. This was my main goal for the forum, and I think I accomplished the task."[143]

Particularly in view of their long-standing intention to undertake a manned mission to Mars, the Soviets are hoping to encourage joint participation and sharing of costs. The question of a joint U.S./USSR/European/Japanese mission to Mars has received endorsement from several quarters, including a 1991 study by Stanford University and Soviet scientists, sponsored through a NASA Ames Research Center grant

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[143] 12 October 1987, p.25.

and other private contributions. The joint project envisaged would rely on the Soviet heavy lift Energia booster, which is the only heavy-lift launch vehicle presently available on the international market.[144] With the U.S. space station budget crisis and the Clinton administration's order to redesign the station and reduce its $31 billion estimated cost by about two thirds, the European Space Agency is seriously thinking of working more closely with the Russians. If forced to by U.S. redesign of the station, one German official intimated that they might favor adapting their Columbus module for use on the new Russian MIR 2 space station.[145] Even the Japanese, despite political differences, are interested in cooperating with the MIR 2 station. At the April 1993 summit between President Clinton and President Boris Yeltsin, collaboration between the two countries on the U.S. space station was advocated. NASA is now proposing an orbit of 51.6 degrees for the U.S. station which would make it more accessible to Russian spacecraft. Such collaboration, as has been pointed out, would represent "a watershed in East-West" relations.[146]

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[144] Aviation Week and Space Technology (July 1, 1991), 134, 26, p.20.

[145] Craig Covault, "Global Space Alliances Shift With Station Crisis, Aviation Week and Space Technology, March 29, 1993, p.22.

[146] William J. Broad, "Large Role for Russia Expected on Station," The New York Times, Science Times, 13 April 1993, pp.C1,C10.

There is, however, in the United States a deep-seated feeling of uneasiness in going forward with multi-year, and indeed multi-decade, high technology projects with the former Soviet Union while the country in engaged in a massive socio-political, economic, and cultural transformation. In addition to worries about technology transfer and national security issues such a joint mission would entail, there is also some apprehension as to whether the former Soviet Republics could be viable economic partners in a venture which requires substantial long-term funding commitments. The underlying concern, of course, revolves around the stability of the new Commonwealth of Independent States and whether the new republics will succeed in continuing along their path toward democracy and a free economy.[147] This feeling of unease could change, however, if the CIS or successor entities succeed in integrating themselves more rapidly into Western political and economic structures.

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[147]In an article in The New York Times on the attempts by Dr. Boris I. Gubanov to convince the West to use the heavy-lift Energia hydrogen powered rocket he designed, William J. Broad cites doubts by NASA and other officials as to whether the Soviet Union would retain sufficient long-term stability to permit the completion of a multi-decade joint Mars mission project.
See: William J. Broad, "Russian Seeks U.S. Buyer for World's Biggest Rocket, The New York Times, Science Times section, July 9, 1991, pp.C1,5.

Conclusion

In this and the preceding chapter on civilian space activity, we have seen how the evolution of U.S. space policy was marked by a fragmented reaction-crisis approach. While the enthusiasm for space, based on the challenge of Sputnik, led to the spectacular achievement of placing men on the moon within a ten-year time frame, the lack of clearly thought out goals left the nation adrift in the 1970s once the original moon mission was accomplished.

The 1980s saw renewed interest in space. At the beginning, this interest focused on military space and was spurred on by the Reagan administration's Cold War concerns. The Star Wars Defense Initiative was announced to protect the U.S. from the "Evil Empire" of the East. This period also marks the point where military space budgets start to outdistance NASA civilian space budgets. In 1981, for example, the NASA space budget was $4.9 billion, slightly higher than the military space budget of $4.8 billion. By 1983, a marked inversion in the numbers occurred with the NASA space budget now at $6.3 billion and military space outdistancing it at $9.0 billion. The difference between the two budgets continued growing with figures in 1990 standing at $12.1 billion for NASA and $15.6 for DOD, although the gap has started closing. The NASA space budget for 1991 was $13 billion and the military space budget was reported at $14.1 billion.[148]

The Challenger tragedy, in addition to highlighting problems in program implementation, was also a catalyst in refocusing attention on overall space policy goals. A series of reports and studies, from the National Commission on Space and Sally K. Ride Reports to the Augustine and Stafford Reports were all directed toward defining new goals for the U.S. civilian presence in space. Through what might be called a "market research" approach, the Bush administration arrived at a determination of future goals in space and the present problems to be overcome in achieving them. President Bush's establishment of the National Space Council, promotion of new commercialization policies, the reorganization of NASA with the appointment of a bottom line, achievement oriented industry executive to head the agency,[149] all lay the groundwork for the realization of the Moon-Mars objectives within the context of international cooperation.

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[148]See Appendix I, p.285 .

[149]President Bush nominated Daniel S. Goldin, an executive of TRW Inc., an aerospace government contractor, as the new head of NASA in March 1992. Mr. Goldin worked in the civil spacecraft and spy satellite divisions of the company and his nomination has been widely interpreted to signal a new direction for the space agency.
See: William J. Broad, "Bush Names Aerospace Executive To Lead Nasa in New Direction," The New York Times, March 12, 1992, pp.1,B10.

We saw how both the military and the civilian programs evolved discontinuously in response to national security concerns, and how the U.S. space program, as opposed to the Soviet one, developed without true long-term goals and vision. We also noted how decision making in this area is global in nature, and how the boundaries between both domestic and international, military and civilian considerations, are completely porous. The evolution of policy, moreover, has shown that there is a continuous feedback loop in the space area between national security, science and technology, the space market place, and domestic and foreign affairs. After having undertaken this somewhat abbreviated overview of U.S. space policy, let us now focus on a micro view of decision making as exemplified in the Chinese booster decision.

CHAPTER 7. THE LONG MARCH BOOSTER DECISION: THE FIRM, THE TRANSNATIONAL MARKETPLACE AND FOREIGN POLICY

Time and distance have shrunk too much for centralizing and decentralizing tendencies not to cascade in patterned ways across the foundations of cooperation and the fault lines of conflict that underlie the global system....

James N. Rosenau[150]

The Long March booster decision[151] is an interesting example of the multidimensional nature of today's policy making. It brings together in a concrete example the complex feedback processes and bifurcation of issues which connect business and trade, foreign policy and national security, science and technology, and a host of other complementary and divergent interests on a global level. As indicated earlier, the decision illustrates the working of corporate alliances

[150] Turbulence in World Politics: A Theory of Change and Continuity (Princeton: Princeton University Press, 1990), pp.458-9.

[151] I am grateful to Professor John M. Logsdon, Director of the Space Policy Institute at George Washington University, who first mentioned the Long March booster decision to me and indicated that it might afford an interesting case study. I also wish to especially thank John E. Koehler from Hughes Aircraft Company who lent a sympathetic ear and generously gave of his time to help answer questions concerning my research on the Long March decision. Any errors of interpretation or fact are, of course, my own.

and firm-government relations. It also represents the first time a U.S. company obtained licenses to launch satellites on a non-Western booster system.

Background: The Aftermath of Challenger

With regard to space launches, a backlog of payloads for launch into orbit had developed after 1986 due both to the Reagan administration's commercialization policy which, as indicated, mandated the transferral of commercial payloads from the shuttle to commercial launch vehicles and also to a number of launch failures culminating in the Challenger disaster which brought to a halt the launch of commercial payloads still scheduled to fly on the Shuttle. Companies were therefore forced to seek other means of placing payloads into orbit. Since the Arianespace[152] rocket program suffered a major launch failure and consequent suspension of flights shortly after the Challenger disaster, this created a situation in which only the Soviets and the Chinese were able to offer viable launch alternatives. Both nations were eager to enter the international launch market in view of the

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[152]The Arianespace organization is a quasipublic joint venture, one-third of which is owned by the French National Space Agency while the other two-thirds are owned by a group of European aerospace companies and banks. The European Space Agency, itself a consortium of several European nations--Belgium, Denmark, France, Germany, Ireland, Italy, the Netherlands, Spain, Sweden, Switzerland, the United Kingdom--undertakes research and development work for Arianespace.

substantial amounts of hard currency involved and the national prestige to be obtained. Yet the prospect of using either one of these two launch systems immediately raised a series of foreign policy, national security, trade, and technology transfer issues for the United States and other Western nations. It also led to the formation of international issue networks, as indicated at the beginning of our study, with converging interests uniting the American satellite builder, Hughes Aircraft Company, with its foreign customers, AsiaSat and Aussat, owners of the satellites, and with the Chinese Long March launch industry. Conversely, the prospect of admitting a new competitor into the international launch marketplace created a meeting of minds between certain U.S. launch industry representatives such as General Dynamics and Martin Marietta and the European Arianespace organization as they strived to oppose the Long March licenses.[153]

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[153]During Congressional hearings, the Arianespace representative pointed out that when Aussat asked whether the launch companies connected to the tenders (General Dynamics, Martin Marietta, and Arianespace) would consider furnishing a backup option should problems arise with the new Long March booster that was to be used, they all declined: "...we didn't see any business advantage to us to helping somebody else get into the business, and I believe that my U.S. competitive colleagues said much the same thing. And the reasoning was very simple: That we have all, through a torturous and painful and sometimes failure-ridden process, gotten ourselves to varying degrees of availability and reliability and dependability, all those things being very important to the end user, and we felt that was worth something, and we didn't want to give that up as a back-up to a new entrant." Douglas A. Heydon. Hearings: The Administration's Decision to License the Chinese Long March Launch Vehicle, U.S. Congress, (continued...)

In our attempt to illuminate the multiplicity of issues connected with the decision, we will look at the launch problem from three different perspectives. We will first look at the business dimension of the problem from the point of view of the companies directly involved: AsiaSat, Aussat and Hughes Aircraft Company, which were seeking to pursue their own immediate business interests. We will then examine the arguments advanced by the nascent U.S. launch industry, which on the whole opposed the decision based on the fear of losing market share due to subsidized foreign competition or "predatory pricing" by command economies such as the Chinese or the Soviets. Finally we will probe the position of the U.S. government on the licensing issue as it sought to achieve foreign policy and national security interests through the decision.[154]

A few comments are in order concerning the framework for the decision. The full complexity of the Long March decision was brought on by the fact that U.S. built satellites had

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[153](...continued) Committee on Science, Space, and Technology, House of Representatives, 23 and 27 September, 1988, 100th Congress, 2nd Sess., Doc. 145, p. 189.

[154]The reconstruction of the various factors leading to the Long March decision and the illumination of the complex issues involved is based on information derived from Congressional hearings, trade journal commentaries, newspaper articles, and a series of interviews, mostly off-the-record, with corporate and governmental actors involved.

been classified under the category of "munitions" since 1963 and are therefore subject to regulation under Section 36 (c) of the Arms Export Control Act administered by the State Department's Office of Munitions Control. In order to obtain export licenses, Hughes Aircraft Company first had to satisfy State Department requirements. The Act also directs that Congress be notified in cases that involve more than $50 million and that the legislative branch has thirty days to review the matter and either confirm or veto the licenses.

Once it received the export applications From Hughes on July 12 and July 15, 1988, the State Department convened a series of Senior Interagency Groups under the auspices of the National Security Council and the Economic Policy Council to evaluate the situation. Given the wide variety of issues raised by the request, a large number of different government agencies were involved, ranging from the State and Defense Departments, National Security Agency, CIA, DTSA (Defense Technology Security Agency) to the Departments of Transportation, Commerce, Justice, and the Office of the U.S. Trade Representative. The Senior Interagency groups were briefed by Hughes and others connected with the license request and provided reports and a decision memorandum that was forwarded to the Cabinet. The Economic Policy Council convened on September 7, 1988 and sent its report on pertinent economic and trade issues to the President. On the basis of these expert evaluations of the issues, President Reagan decided to grant the license requests subject to three government to government agreements to be signed by the People's Republic of China (PRC) and the U.S. designed to safeguard U.S. interests. The agreements were to cover the areas of technology transfer, insurance liability, and pricing and trade issues. The State Department issued a Notice of Approval on September 9, 1988 and its intent to notify Congress, which it formally did on September 12th, 1988, in compliance with Section 36 (c) of the Arms Control Export Act.

As mentioned, the Administration is only obliged to notify Congress regarding items on the U.S. munitions list valued at over $50 million. The sale of the two Aussat satellites was for $260 million and therefore entailed notification but the AsiaSat satellite launch was only valued at $40 million.[155] The State Department, nonetheless, given controversial aspects and the precedent setting nature of the decision, decided to inform Congress of both export license requests. The timing of the notification, coming right before the recess of the 100th Congress, was not particularly appreciated by Congressional representatives, who would have preferred a longer period of time to consider

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[155]The AsiaSat launch comprised a reconditioned Western Union satellite and did not require on orbit delivery, resulting in lower overall costs for Hughes Aircraft Company.

the issues. As Rep. Dante B. Fascell, Chairman of one of the Congressional committees reviewing the decision pointed out: "Normally, controversial sales of this nature receive a twenty day informal period of notice prior to the formal thirty day review period which is granted to Congress under the provisions of the Arms Control Act."[156] Complaints were also registered by several Congressional representatives that Congress had not received copies of the proposed agreements between the PRC and the U.S. They felt they were therefore being asked to review an important matter on the basis of incomplete information. The State Department on the other hand defended itself by pointing out that complex negotiations by the business parties involved determined the date it received the export license requests, completed its own investigation of the problem, and subsequently notified Congress.[157] The State Department indicated that it had

[156]Dante B. Fascell, Chairman, Subcommittees on Arms Control, International Security and Science, on Asian and Pacific Affairs, and on International Economic Policy and Trade of the Committee on Foreign Affairs, House of Representatives, 28 September 1988, Hearing: Proposed Sale and Launch of United States Satellites on Chinese Missiles. 100th Congress, 2nd Sess., p. 94.

[157]The Hughes agreement with Aussat necessitated the selection of the launch vehicle by September 30th, 1988 and a firm contract by October 1988. The lead time involved in building and launching the satellites is approximately 33 months and Aussat needed firm commitments in order to guarantee service to its customers. In the case of the AsiaSat satellite, the British-Chinese consortium also required quick license approval so that it could proceed to

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been in the process of concurrently completing drafts of the proposed agreements between the U.S. and the PRC and would brief Congress on the their contents in short order.

The Business Dimension

Initially, when companies such as AT&T needed to place new satellites in orbit, they would buy the satellite, make arrangements for launch with NASA and find insurance directly. The insurance industry, however, had not been pricing its premiums correctly,[158] and following a series of launch failures in the early 1980's culminating in the Challenger and Ariane disasters in 1986, premiums skyrocketed from 10% to 25% of launch costs. By the summer of 1986, insurance costs had reached over $40 million per launch, if insurance could be found at all.[159] As pointed out in congressional testimony, insurance groups were refusing to issue insurance

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[157](...continued) take ownership of the satellite and begin the necessary repairs. While some felt that the timing of the notifications to Congress right before recess was designed to improve chances for approval, it is also evident that a series of business requirements dictated a swift decision on the matter.

[158]The insurance industry was pricing launches at a loss of one out of twenty whereas the actual loss rate was one out of seven. From 1979 to 1986, it made $450 million in satellite launch revenues and lost $950 million.

[159]Insurance rates before the launch failures that plagued the industry in 1985-86 would have been around $16-17 million.

prior to six months before a flight. Companies seeking insurance thus were faced with difficulties in being able to estimate the cost of premiums and hence in being able to prepare an accurate (and therefore profitable) business plan.[160]

Given the dampening effect these problems had on business, in order to expedite satellite sales, Hughes Aircraft Company became the first to develop the concept of delivery on orbit: the satellite builder would deliver the satellite to the customer fully checked out and guaranteed on orbit. In this way risk would be shared: Hughes would assume the operational risks of launch and insurance while the customer would bear other business and financing risks. As this new practice for the launch of satellites evolved, the specific business arrangements between satellite builder and customer would vary according to the outcome of negotiations. While an earlier Hughes Aircraft Company agreement with British Satellite Broadcasting consisted of delivery in orbit of two satellites on a complete turnkey system basis, the Aussat agreement provided for the customer to make decisions

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[160]See, for example, testimony by John E. Koehler, Hughes Aircraft Company representative, Hearings: The Administration's Decision to License the Chinese Long March Launch Vehicle, U.S. Congress, Committee on Science, Space, and Technology, House of Representatives, 23 and 27 September, 1988, 100th Congress, 2nd Sess., Doc. 145, p. 138.

concerning the launch and the satellite builder (Hughes) to act as its agent. The AsiaSat launch, instead, did not contemplate on orbit delivery provisions.

AsiaSat

The Asia Satellite Telecommunications Company Ltd., or AsiaSat, is a joint venture partnership comprising companies in three countries: the United Kingdom, Hong Kong, and the People's Republic of China. Its goal was to offer communication satellite services in East Asia, including Hong Kong, China, Macau, Thailand, Burma, Pakistan, Nepal, Korea, and Bangladesh. The three partners are the Cable and Wireless Company, PLC., a British concern; Hutchinson Telecommunications Limited, a major trade and investment firm located in Hong Kong; CITIC Technology Corporation, a subsidiary of the China International Trust and Investment Corporation which oversees China's investment activities abroad and serves as a capitalist means of obtaining hard currency to further Chinese trade. In House testimony during the license review process, the AsiaSat representative, Steven A. Levy, Esq., defined the consortium's objectives both in commercial and strategic political terms. These included:

- An immediate need for improved links between Hong Kong and the PRC;
- The establishment of a base for continued UK involvement in Asian domestic telecommunica-

tions notwithstanding the change of Hong Kong's administrative status in 1997;

- The formation of a community of Asian countries through the shared use of a common, western-controlled space communication system. Through the use of Westar VI, the AsiaSat system has higher power and utility over the areas covered by the AsiaSat footprint than any other system presently available in the region, including INTELSAT. [The countries covered] are of obvious strategic importance for the UK and its allies, including the United States;

- Preemption of other competitive ventures, notably extensions of the Soviet and Japanese domestic systems, which are pursuing the same market...[161]

AsiaSat intended to initiate its strategy with the Westar VI communication satellite that had been recovered in 1984 by the space shuttle Challenger after an unsuccessful deployment into an incorrect orbit. AsiaSat had negotiated the purchase of the satellite from an insurance syndicate headed by Lloyds of London which had agreed with NASA to contribute toward the salvage costs in return for resale rights. It decided to have Hughes Aircraft Company, the original builder, refurbish the satellite for launch on Chinese Long March boosters. The decision to use the Long

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[161] Steven A. Levy, Hearing: Proposed Sale and Launch of United States Satellites on Chinese Missiles, Subcommittees on Arms Control, International Security and Science, on Asian and Pacific Affairs, and on International Economic Policy and Trade of the Committee on Foreign Affairs, House of Representatives, 28 September 1988, 100th Congress, 2nd Sess, pp.68-69. Mr. Levy was an attorney with the firm of Heron, Burchette, Ruckert & Rothwell.

March expendable launch vehicles (elv's) according to AsiaSat was based in part on the fact that China was a one-third investor in the project. The launch income would permit China to gain hard currency that would enable it to pay for the cost of its investment in the joint venture. In part, the decision was also founded on AsiaSat's belief that no other launch group would be able to guarantee a launch by late 1989 or early 1990, the time frame they had established for a successful conclusion of their business plan.[162] In subsequent Congressional testimony, however, both General Dynamics and Martin Marietta argued that they had not been given the opportunity to tender an offer on the launch, which they felt they could have completed within the specified time frame and at a competitive price.[163]

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[162]The AsiaSat satellite was launched on April 7, 1990.

[163]Alan M. Lovelace, President of General Dynamics Commercial Launch Services, points out that "[General Dynamics] would have been most happy to have provided an offer or a tender for launch services for AsiaSat but we were not asked." And Richard E. Brackeen, President of Martin Marietta Commercial Titan Inc., also indicates that "...like General Dynamics, Martin Marietta was not asked to bid on the launch of AsiaSat, although we have a launcher available in the time frame that they now are contemplating. I think it is clear that, as was testified, there were significant other factors involved with the decision to baseline that launch on a Long March, and I understand those, not the least of which is the participation of the Chinese government in the financing of the program, and we cannot, I think, respond to that."
See: Hearing: Proposed Sale and Launch of United States Satellites on Chinese Missiles, Subcommittees on Arms Control, International Security and Science, on Asian and Pacific Affairs, and on International Economic Policy and
(continued...)

The AsiaSat representative was careful to downplay the lower rates charged by the Chinese for the launch, in view of accusations of unfair price competition by a command economy. He indicated an Ariane promotional launch a few months earlier on its new Ariane 4 rocket was offered to PanAmSat, a U.S. group, for $8 million as opposed to the $30 million price of the Long March AsiaSat launch (with a $3 million additional charge for relaunch in case of failure).[164] A normally priced, shared Ariane launch would have cost $42 million, but the AsiaSat consortium did not want to be tied to the launch schedule of another group. It was argued that there are also equalizing price factors in the utilization of Long March. Due to a more northerly location of the launch, for example, it is necessary to expend more satellite fuel to attain proper geostationary orbit,[165] shortening satellite

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[163](...continued)
Trade of the Committee on Foreign Affairs, House of Representatives, 28 September 1988, 100th Congress, 2nd Sess., p.78.

[164]The President of Arianespace,Inc. took exception to the description of this inaugural flight of the Ariane 4 rocket as a "reduced cost" flight, implying the European group followed a policy of charging less on introductory flights (a point of contention in international trade talks between the U.S. and European launch industries). See p.171 below.

[165]A geostationary orbit for a satellite is located 23,000 miles (36,000 km.) above the equator. In that position, as the satellite travels from West to East at roughly the same speed as the Earth, it appears to be stationary at a set point. This is the preferred orbit for certain types of satellites, such as those dedicated to communications and
(continued...)

life by six to eight months. AsiaSat estimated that this shorter life span could translate into an additional $15 million in lost revenue.

Aussat

Aussat Proprietary Ltd. was owned 75% by the Australian government and 25% by the Australian Telecommunications Commission. It was incorporated in 1981 and required to function on a commercial profit-making basis for the purpose of furnishing telecommunication services to Australia and New Zealand. At the end of 1991, Aussat with its three satellite system was acquired by Optus Communications when the latter company was awarded an Australian government license to compete as a second carrier with the former government monopoly, the Australian Overseas Telecommunications Corporation (AOTC), in furnishing national and international communications and television (pay t.v.) services. Optus is owned 51% by a group of Australian companies and 49% by Britain's Cable and Wireless and the U.S. Bell South.[166] While Aussat was the party involved in the original license

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[165](...continued) navigation, since their high position gives them a large footprint and their relatively stable location enables them to be in constant communication with an Earth station.

[166]see: Sandy Plunkett, "Australia: Building Rome in a Day," Reuters Textline, Business Review Weekly, April 2, 1993.

request by Hughes to launch two satellites on the Long March boosters, since the actual launches occurred in 1992, Optus was the new owner and the name of the satellites changed from Aussat to Optus 1 and 2. Since the Long March booster decision antecedes the acquisition of Aussat by Optus, however, we will refer only to Aussat insofar as the our discussion pertains to the original procurement of the license.

The first generation of three Aussat-A satellites had been purchased from Hughes Aircraft Company. The first two had been launched on the Shuttle in 1985 and the third on Ariane in 1987. The company had decided to acquire and launch new satellites as replacements for two of the prior generation satellites whose life span was estimated to end in 1992 and 1993 due to fuel exhaustion. Having experienced rising insurance costs and launch delays with the placement of its initial three satellite system in orbit, Aussat specified that the new procurement process should include delivery in orbit arrangements. Four groups participated in the competition, three of which were American (Hughes Aircraft Company, Ford Aerospace, and GE Aerospace). The fourth group was the European consortium, British Aerospace/Matra.

Aussat had been aware that in light of problems affecting the U.S. and European launch industries, China Great Wall Industry Corporation had begun in 1987 to actively market its Long March boosters on the international market and had promised low introductory pricing. The Australian concern therefore indicated to those entering the competition for its business that it wished bids to include the Long March rocket as one of the proposed launch vehicles. In addition to Long March, individual tenders comprised offers for launch on one or more of the other vehicles on the market: the Ariane rocket, Martin Marietta's Titan, and General Dynamic's Atlas Centaur. Aussat, however, estimated that it could save $80 million for the two launches by using the Long March vehicle. When it selected Hughes, in its June 28, 1988 Letter of Intent, Aussat specified that the latter company should obtain all necessary approvals and proceed for a launch on the Long March booster. The same provisions were included in the contract signed between the two companies on August 28, 1988.

Aussat did not consider the lower Long March price to be predatory in nature because in their view it reflected common practice for the introduction of new products on the market followed both by NASA introductory pricing for Shuttle launches over the first three years of operation and also lower Ariane first launch prices. It did not foresee any dangers in terms of technology transfer because only minor quantities of data were to be provided to permit the mating of satellite and rocket, and there were to be sufficient safeguards in place concerning complete physical security for the spacecraft so that the Chinese would not be able to obtain advanced technical information.[167]

Hughes Aircraft Company

When Hughes Aircraft Company applied for the AsiaSat and Aussat licenses, they did not expect to encounter significant problems. In December 1987, before submitting bids for the launches, Hughes had requested a State Department advisory opinion regarding the possibility of obtaining licenses. The opinion indicated that in light of a earlier positive decision made in a Western Union case[168] and consistent with U.S. policy toward China,[169] the licensing procedure should not present significant problems.

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[167]See: Testimony by Richard C. Johnson, General Manager, Aussat Pty. Ltd. before the Committee on Science, Space, and Technology, U.S. House of Representatives, 100th Congress, 2nd. Sess., N.145, esp. pp. 88-95.

[168]Western Union had previously received a license for exchange of data for the launch of a U.S. satellite on a Long March booster, although due to the company's financial problems, it was forced to abandon the project.

[169]U.S. policy toward China concerning export licenses is much less restrictive than that toward the Soviet Union. (See p. 174).

The Hughes Aircraft Company is the largest builder of satellites and earth stations and also one of the major buyers of launch vehicles. Through Hughes Communications, which it owns, Hughes also operates satellite fleets that supply services to commercial companies in the United States and globally to the U.S. Navy. Its business activities thus encompass the commercial and military sectors. As both a satellite builder and a leading buyer of launch services from U.S. providers, its relationship with the U.S. launch industry is necessarily ambivalent, since it reflects interests which are at times divergent.[170] On the one hand, Hughes supports a healthy and competitive U.S. and international satellite launch industry. On the other, it has an interest in keeping the satellite building industry competitive, in part through contained launch costs. As Hughes representative John E. Koehler[171] indicated in House hearings, this means that "U.S. representatives need to have the same access to launch vehicles, or access to the same set

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[170]This prompted Congressman Solomon, a licensing opponent, to observe during one of the hearings, "it seems like everybody around here are friendly enemies." Hearing: Proposed Sale and Launch of United States Satellites on Chinese Missiles, Subcommittees on Arms Control, International Security and Science, on Asian and Pacific Affairs, and on International Economic Policy and Trade of the Committee on Foreign Affairs, House of Representatives, 28 September 1988, 100th Congress, 2nd Sess., p.81.

[171]John E. Koehler, Vice President, Hughes Aircraft Company, very effectively represented Hughes before the Senior Interagency Groups and in Congressional Hearings with regard to the licensing problem.

of launch vehicle alternatives, as our competitors."[172] If Hughes were not able to access sectors of the international launch market in the same way as companies from other countries, the latter would be able to outbid it by offering lower prices based on lower launch costs. Koehler makes the point by noting "the technical gap between what we offer and what the Europeans offer, is narrow. I believe in the recent competitions the determinants were not performance, but price/performance based on our ability to take advantage of economies of scale and our experience, but we have won by a whisker. The Europeans are very good. I believe the Japanese will be. The Chinese have built and launched their own communications satellites. The Indians build satellites. And now, of course, the Israelis."[173]

After having submitted the winning bids for the launches and convinced that licensing would be forthcoming in short order, Hughes suddenly found itself embroiled in controversy.

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[172]Hearing: Proposed Sale and Launch of United States Satellites on Chinese Missiles, Subcommittees on Arms Control, International Security and Science, on Asian and Pacific Affairs, and on International Economic Policy and Trade of the Committee on Foreign Affairs, House of Representatives, 28 September 1988, 100th Congress, 2nd Sess., p.56.

[173]Hearing: Proposed Sale and Launch of United States Satellites on Chinese Missiles, Subcommittees on Arms Control, International Security and Science, on Asian and Pacific Affairs, and on International Economic Policy and Trade of the Committee on Foreign Affairs, House of Representatives, 28 September 1988, 100th Congress, 2nd Sess., p.56.

The three main issues that were raised by the license request were: technology transfer, unfair trade competition in pricing by the Chinese that might damage the U.S. launch industry, and the question of liability insurance. However a series of other issues came to the fore that were of equal importance, such as foreign policy and national security considerations. In line with past policy, the President wished to maintain good political and trade relations with China so as to foster Chinese interaction with the free world. There was also some concern that other contracts with U.S. companies, such as the McDonnell Douglas contract for the construction of MD-82 aircraft with the Chinese (see below), might be subject to retaliatory measures should the Long March licenses not be approved. The Defense Department, moreover, was anxious to be able to use the Long March launch as an additional inducement to convince the Chinese to stop sending missiles to the Middle East. There also emerged the question of executive versus legislative authority as certain representatives in the Congress tried to gain legislative control over the issue.

U.S. and European Launch Industry Opposition

The three major U.S. commercial satellite launch companies, General Dynamics, Martin Marietta and McDonnell Douglas were not united in their opposition to the Long March decision due to dissimilar interests. While General Dynamics and Martin Marietta were strongly opposed to the issuance of licenses, McDonnell Douglas was not. In 1975, the company had undertaken a joint venture with the Shanghai Aviation Industry Corporation for the production of a series of MD-82 commercial aircraft and later had also underwritten a Technical Assistance Agreement with the PRC for the use of their PAM (payload assistance module) on the third stage of the Long March 2 vehicle.[174] The co-production arrangement on the MD-82 aircraft had produced revenues of $1 billion over a six year period. McDonnell Douglas therefore stressed the importance of international collaboration in the global marketplace. In congressional testimony, they supported the issuance of the licenses for launch on Long March vehicles with the proper agreements in place concerning safeguards for technology transfer, liability and pricing. As the McDonnell Douglas representative Robert H. Hood noted during congressional testimony, "Given this diverse set of relationships between McDonnell Douglas Corporation and the PRC, you can perhaps see why our Corporation is interested in an export license for launch of a U.S. satellite on the Chinese Long March. In general, we believe that we must continue to

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[174]The Agreement, however, was subject to a case by case review by the State Department and contained several restrictive technology control aspects, including the requirement that an export license be obtained for each feature of technical assistance offered.

vigorously participate in the world market. As a matter of fact, in 1987, 25 percent of McDonnell Douglas' revenues were from international sales."[175]

General Dynamics and Martin Marietta lacked McDonnell Douglas' compelling reasons to support the licensing issue and therefore criticized the Administration decision on several grounds. Richard E. Brackeen, President of Martin Marietta Commercial Titan Inc., suggested that the Administration decision was inconsistent with the commercialization policy mandated by the Commercial Space Launch Act of 1984 and amended in 1988. He argued that (1) the decision led to the risk of technology transfer, since working with the Chinese to mate satellite and launch vehicle would lead to transfer of knowledge and, more importantly, of experience; (2) the U.S. would be encouraging the Chinese to upgrade their vehicle to twice its lift capacity, leading to greater national security risks; (3) there were trade pricing issues that had to be resolved as otherwise predatory pricing by a non-market economy such as the Chinese would destroy the nascent U.S. commercial launch industry. He pointed to the

[175]Testimony by Robert H. Hood, Jr., Vice President, Aerospace Business Development, McDonnell Douglas Corporation, Hearings: The Administration's Decision to License the Chinese Long March Launch Vehicle, U.S. Congress, Committee on Science, Space, and Technology, House of Representatives, 23 and 27 September, 1988, 100th Congress, 2nd Sess., Doc. 145, p.164.

fact that as a result of the Commercial Space Launch Act, U.S. companies such as Martin Marietta had invested in vehicle and launch pad improvements. Due to a three year lead time for preparation for launches, the first Martin Marietta commercial payload would not be launched until August 1989. He noted that American companies are not able to compete against a non-market economy launch program, which instead of basing decisions on market factors such as return on investments focused more on foreign exchange and foreign policy criteria. He therefore suggested that Congress request resubmittal of licensing request after government to government agreements protecting U.S. interests were negotiated and in place. Had this advice been followed, Hughes in all likelihood would have lost the business since both AsiaSat and Aussat were working within stringent launch time frames.[176]

The European launch group, Arianespace, also came out against the Long March licenses. During the Congressional hearings on the matter, Douglas A. Heydon, President of Arianespace Inc., indicated that the Long March problem should be viewed as a trade issue. He stressed that approval

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[176]Testimony by Richard E. Brackeen, President, Martin Marietta Commercial Titan, Inc., Hearings: The Administration's Decision to License the Long March Launch Vehicle, U.S. Congress, Committee on Science, Space, and Technology, House of Representatives, 23rd and 27 September, 1988, 100th Congress, 2nd Sess., Doc. 145, pp.149-162 (esp. p.150).

should not be forthcoming until rules could be codified leading to a level playing field between the Chinese command economy and free world commercial launch companies. Since 1984, there had been ongoing discussions between the European Space Agency and the United States Trade Representative (USTR) concerning the definition of rules that might provide a level playing field which had not led to hoped for results. In terms of determining fair costs, the Arianespace representative acknowledged that it would not be an easy matter to establish reasonable market prices in the case of a command economy.

The Arianespace representative also sought to refute two other questions that had emerged during the hearings. The first was the contention that if Hughes lost the possibility of launching on Long March due to a denial of the licenses, Aussat might shift to the Europeans and that the latter might then proceed to launch on Long March. Hughes would therefore lose $300 million in revenues. This would in turn negatively affect the U.S. job market and balance of payments. Heydon argued that the European allies would not allow this to happen and that this argument should not be used as a reason to issue the licenses. The second issue concerned the fair trade problem of low priced promotional launches by Arianespace that had come up time and again during congressional testimony. Heydon insisted that the $8 million cost of the first Ariane 4 launch, which had been utilized by PanAmSat, was not a "promotional" price. The launch had been marked as an initial demonstration flight which would have flown with or without a satellite and, it was avowed, this was the reason for the low price quoted to the American firm.[177]

The U.S. Governmental Position

As mentioned previously, through the deliberations of the Interagency Groups, the National Security Council, the Economic Policy Council and the Administration, the President had decided that the licenses could be granted subject to the completion of three government to government agreements that would protect the United States from the major dangers that had been identified by the experts: technology transfer, predatory pricing practices, and liability. The first agreement would establish a regime to protect the satellites from intentional or inadvertent technology transfer. The second agreement was designed to shield the United States against any accident liability under international law. The third agreement established price and number of launch parameters: a limit of 9 launches over a three year period

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[177]Testimony by Douglas A. Heydon, President, Arianespace, Inc., Hearings: The Administration's Decision to License the Long March Launch Vehicle, U.S. Congress, Committee on Science, Space, and Technology, House of Representatives, 23rd and 27 September, 1988, 100th Congress, 2nd Sess., Doc. 145, pp.175-189.

that China would have to adhere to and certain pricing standards that it was felt would not damage the U.S. and international launch market.

The State Department representative, Eugene J. McAllister,[178] argued on behalf of the Administration that by approving the licenses the U.S. finds itself in a better position to set the standards of international competition in this developing international business area. He also pointed out that U.S. and COCOM[179] export control policy differentiates between China and the Soviet Union. China was consid-

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[178]The Hon. Eugene J. McAllister, Assistant Secretary, Bureau of Economic and Business Affairs, Department of State, represented the State Department and the Administration's point of view during the Congressional hearings. See: Hearings: The Administration's Decision to License the Long March Launch Vehicle, U.S. Congress, Committee on Science, Space, and Technology, House of Representatives, 23rd and 27 September, 1988, 100th Congress, 2nd Sess., Doc. 145, pp.18-32 (esp. p.20).

[179]This situation has changed considerably with the advent of the CIS. The Paris-based COCOM or Coordinating Committee, composed of the nations of the Atlantic Alliance minus Iceland and including Japan, was set up in 1949 under U.S. pressure, as part of the Cold War effort to control the export of sensitive technology (both military and dual-use civilian technology) to Communist regimes. It was hoped that members would voluntarily refrain from making available to targeted nations the list of strategic embargoed items compiled by the organization. To assure compliance, the U.S. subsequently passed the Mutual Defense Assistance Control Act in 1951, through which it could reject requests for economic or military aid to those countries that violated the COCOM agreements. In addition to the United States, member nations of COCOM include: Canada, Belgium, Denmark, France, Greece, Italy, Luxembourg, the Netherlands, Norway, Portugal, Turkey, United Kingdom, West Germany, and Japan.

ered to be a "friendly, non-aligned" nation and could therefore receive more advanced technology than the Soviet Union.

The State Department and the President were also sensitive to the impact of the licenses on U.S.-Chinese relations. The granting of the licenses was considered to be extremely important by the Chinese. It represented a prestigious entry into a high technology area and also, as noted earlier, a means of obtaining a fairly substantial amount of foreign currency.[180]

Additional support in favor of granting the licenses came from the Department of Defense.[181] On the occasion of Secretary of Defense Caspar Weinberger's trip to China in October 1986, the Chinese had requested his help in obtaining the license for the Western Union launch, which subsequently did not take place. And when the next Secretary of Defense, Frank C. Carlucci, visited China in August 1988, the Chinese also made it clear to him that the launches were very important to them. The U.S. Department of Defense had been

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[180]McAllister pointed out that the volume of trade between the U.S. and China went from $1 billion in 1979 to $10 billion in 1987.

[181]While the overall position of the Department of Defense concerning the licenses was favorable, not all branches of the services were equally supportive. The Air Force, for example, with its close ties to the U.S. launch industry, was less than enthusiastic over the prospect of granting the licenses to China.

concerned for some time with the problem of Chinese arms sales in the Middle East. They saw the granting of commercial licenses to China as a means of involving the country in Western enterprise, leading it away from dangerous arms proliferation activities in the third world. The Defense Department representative, Karl D. Jackson, stressed during the hearings that Secretary Carlucci personally supported the Defense Department's stand on the issue in the belief that it was in this country's "best interest."[182] He went on to affirm that:

> Concerning the relevance of this issue to the bilateral military and overall U.S.-China rela-

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[182]In an October 14, 1988 letter to Rep. Dante Fascell, Carlucci strongly urged Congressional approval of the licenses. He argued, among other things that "delaying the licensing of these U.S.-made satellites for launch on Chinese launch vehicles would most certainly imperil the important progress made in my talks with Chinese leaders in Beijing in August. These meetings touched on a number of bilateral issues, but most important were the successful discussions on China's arms sales policy. I said in Beijing that these talks on arms sales were the 'best discussions that we have ever had' with the Chinese, and I am now hopeful that we can put the issue of missile proliferation behind us.

The opening of China has been a major bipartisan foreign policy success. To continue this process we must show that we are prepared to deal constructively with China. Your support for this important national security issue can make a difference."

See: Hearing: Proposed Sale and Launch of United States Satellites on Chinese Missiles, U.S. Congress. Subcommittees on Arms Control, International Security and Science, on Asian and Pacific Affairs, and on International Economic Policy and Trade of the Committee on Foreign Affairs, House of Representatives, 28 September 1988, 100th Congress, 2nd Sess., Appendix 7, pp.122-23.

> tionships, approval of these licenses and China's entry into the foreign commercial space launch market is consistent with fundamental U.S. goals and objective for China. Our objective remains to encourage greater participation by China in Western economic endeavors. Such participation increases the stake China has in pursuing and coordinating policies that support rather than disrupt global and regional stability. Entry into the commercial space field will also foster efforts to direct China's missile and space activities into areas more compatible with our own non-proliferation concerns and objectives.[183]

The Chinese Long March decision survived Congressional review, a Senate amendment to the Conference Report of the Foreign Operations Appropriations Act of 1989 that was defeated on September 30, 1988 by the House of Representatives, COCOM evaluation, the reaction to Tiananmen Square in June 1989, and sundry attempts by those with divergent interests to block the licenses. The AsiaSat launch took place, as indicated, on April 7, 1990. The first Aussat/-Optus B1 satellite was successfully launched in August 1992 and entered full commercial service in December.[184] The second B2 satellite was launched December 22, 1992 on Long March 2E boosters and failed to reach orbit due to what

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[183]Dr. Karl D. Jackson, Deputy Assistant Secretary of Defense (East Asia and Pacific Affairs), Hearings: The Administration's Decision to License the Chinese Long March Launch Vehicle, U.S. Congress, Committee on Science, Space, and Technology, House of Representatives, 23 and 27 September, 1988, 100th Congress, 2nd Sess., Doc. 145, p. 36.

[184]The launch had originally been scheduled for March 1992 but was postponed due to booster ignition problems.

appears to be booster failure. Since the Aussat/Optus contract was for in-orbit delivery, Hughes is responsible for replacing the satellite. It is estimated that a replacement launch will take place in about 18 months. The ongoing investigation into the failure triggered U.S. technology transfer safeguards and U.S. government officials joined Hughes and Chinese officials in searching for parts of the satellite. It was reported in early February 1993 that approximately 65% of the satellite had been recovered and assembled at the Hughes El Segundo facility in California.[185]

Conclusion

In this chapter we have descended from the macro view of space policy decision making undertaken in prior chapters to the observation of forces that impact policy making at the micro level of a single policy determination: the Chinese booster decision. Also in the case of this single decision, we have attempted to illuminate the multidimensional aspects of policy making within the context of discontinuous or turbulent policy reality.

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[185]see: Aviation Week & Space Technology, February 8, 1993, p.25; Paul Proctor, Aviation Week and Space Technology, January 11, 1993, pp.60, 63.

With regard to longer time frames, we saw that in the course of the historical evolution of the U.S. space program, fragmented vision led to policy failures such as that involved in concentrating all launch systems in the Shuttle. The Challenger disaster thus resulted in the grounding of all U.S. launches, a contingency apparently not taken into serious consideration by decision makers who based their policy on short term pressures and funding requirements. This set into motion a set of cascading consequences ranging from the reestablishment of independent military launch systems to market forces that led to the acceptance of non-Western launchers as a means of orbiting backlogged payloads. One might say that a series of factors aggregated and combined at a global level to create a threshold whereby for the first time it became possible to contemplate the use of a Communist country's boosters.

Within the context of a shorter time frame, we examined the various immediate interests involved in the debate on the Long March issue. We highlighted the interests of the satellite builders who favored launching on the Long March, and, had it been possible at the time, on the Soviet Proton boosters. At the other end of the spectrum, we indicated the arguments of the satellite launch industry which was on the whole against the use of the Chinese boosters because of fear of losing market share. We noted the creation of international "issue networks" with satellite builders such as Hughes allied with the Chinese launch interests, while the U.S. launch industry for the most part found itself on the same side as their European competitor, Arianespace, in opposing the decision. In addition, we witnessed the interplay of foreign affairs considerations as the U.S. administration sought to use the decision to encourage China to remain within the orbit of the Western economy and sphere of influence. At the same time, the decision had broad national security implications: by offering the Chinese the possibility of acquiring hard currency through the launch of commercial payloads into space for the industrialized West, the Reagan and Bush administrations hoped to discourage China from continuing its arms sale policy in the Middle East

At a different level of analysis, the decision attests to the increased integration of the world economy which has unleashed forces of its own that overcome barriers to international trade and cooperation and function according to a new transnational logic that defies the older logic of nations. The Long March decision might be seen as a major affirmation of global market integration. This integration, as discussed earlier, has become strikingly more apparent with the new relaxation of trade barriers in the area of high technology in the case of both China and the former Soviet Union. This also evidences how the interrelated nature of variables in one area, in this case that of U.S. space policy with regard to the shuttle in the early 1970's, had cascading domestic and international ramifications several years later in 1986 with the Challenger disaster. The shuttle decision set the stage in which the aggregation of a series of unforeseen factors led to a severe security crisis and impacted different spheres, ranging from foreign affairs and defense to business/trade and technology transfer.

Finally, perhaps one of the more interesting aspects of the decision may be seen in the expanding role of the transnational firm in helping to mold national policy. The needs of Hughes Aircraft Company and of its Australian and British and Chinese clients to meet certain market deadlines and requirements led them to negotiate a dramatic shift in U.S. trade policy in a high technology area. It illustrates vividly what certain international political economists, such as Susan Strange, have referred to as the new "foreign relations" of firms:

> Besides the familiar interstate negotiating--some of it played in multilateral organizations like the International Monetary Fund (IMF) or the United Nations, but most of it still played on a one-to-one basis of bilateral bargaining--there are now two equally important kinds of transnational diplomacy. One is the diplomacy between governments and firms; the other is the diplomacy conducted between firms.[186]

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[186]Susan Strange, "An Eclectic Approach," p.43.

Let us now turn to the theoretical dimension of our inquiry and investigate how old state-centered paradigms have withered and new multidimensional ones are emerging to deal with the rapidly changing, technology-driven, nonlinear reality of the approaching twenty-first century.

PART III: THE THEORETICAL DIMENSION

CHAPTER 8. TENSIONS BETWEEN OLD PARADIGMS AND A CHANGED ECONOMIC AND POLITICAL REALITY

> *The Industrial Revolution changed the source of wealth, transforming once useless piles of rock and ore into riches of steel and steam. Even as it gave value to once neglected natural resources, industrialization dramatically increased the power of the nation–state not only by enhancing its revenues but also by expanding its regulatory power and the armaments needed to control those resources and the territory that embraced them. In the last few decades the information revolution is again changing the source of wealth... The new source of wealth is not material, it is information, knowledge applied to work to create value. The pursuit of wealth is now largely the pursuit of information and the application of intellectual capital to the means of production. This shift in perception of what constitutes an asset poses hugh problems in expanding or even maintaining the power of government. Information resources are not bound to a particular geography or easily taxed and controlled by governments.*
>
> *Walter Wriston*[187]

> *The overwhelmingly military approach to national security is based on the assumption that the principal threat to national security comes from other nations. But the threats to security may now arise less from the relationship of nation to nation and more from the relationship of man to nature.*
>
> *Lester Brown*[188]

Political Analysis and Space

In our analysis of U.S. space policy in general and of the Long March booster decision in particular, we noted how the making and implementation of policy was not the result of

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[187]Walter Wriston, The Twilight of Sovereignty: How the Information Revolution is Transforming Our World (New York: Charles Scribner's Sons, 1992), p.19.

[188]Lester Brown, "An Untraditional View of National Security," in American Defense Policy, John F. Reichart and Steven R. Sturm, eds. (Baltimore, MD: Johns Hopkins University Press, 1982), p.22.

a linear progression of causes and their effects. Decision making emerged rather from a series of different, often not directly related factors that aggregated and combined to mold final policy outcomes. Sputnik I led to the development of a highly militarized U.S. space program that in turn fueled the Soviet military program. The two programs thus became linked through an inexorable feedback process which developed its own policy logic. In the 1970's, a short-sighted policy decision concerning the focus on the shuttle as the exclusive mode of space transportation resulted in the grounding of both the U.S. civilian and military space programs after the Challenger explosion in 1986. This in turn led to the reshaping of U.S. space transportation policy. Global apurposive events, over which no one nation can have significant control, molded the policy making processes at every turn. Considered from a theoretical perspective, this ultimately unpredictable sequence of events raises the question of which theoretical approach may be most useful in helping us to illuminate policy making in a world in which decision making is increasingly the result of nonlinear elements that aggregate and combine on a global scale as a result of a rapidly changing scientific and technological environment.

As can be surmised from the preceding chapters, the political, economic, scientific and social impact of man's access to space over the last thirty years has become increasingly significant. Yet, most political scientists have not focused on space to any great degree as a major new variable in political analysis. As has occurred in other fields, also in political science the attention paid to space has been mostly highly specialized, state-centered, with an emphasis in the literature on military defense. This has given rise to a *fragmentary* as opposed to *integrated* perspective of the space variable within the context of the theoretical literature, and especially the international relations literature. With few exceptions, the more subtle linkages or longer-term economic, socio-political or international correlations between space and other areas of human endeavor have not been scrutinized to any substantial degree from a global viewpoint in book-length format.[189] While there have been some excellent academic and expert studies on certain aspects of space activity, ranging from space law to decision making, or from the history of space programs to debates concerning the feasibility or non-feasibility of the Strategic Defense Initiative,[190] as we approach the twenty-

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[189] A notable exception is historian Walter A. McDougall's book The Heavens and the Earth: A Political History of the Space Age (New York: Basic Books, 1985).

[190] See: John M. Logsdon, The Decision to Go to the Moon: Project Apollo and the National Interest (Cambridge, MA: The MIT Press, 1970); Carl Christol, The Modern International Law of Outer Space, (New York: Pergamon Press, 1982); J.E.S. Fawcett, Outer Space: New Challenges to Law and Policy (continued...)

first century there is a growing need to adopt a multidimensional perspective and to integrate space within the overall analysis of the socio-political, economic and scientific activities of a nation and the study of international relations.

While space policy connects issues ranging from science and technology to foreign affairs, national security, and international trade, there has been very limited interfacing and correlation of the problems spanning these different areas. As one commentator has noted, "Although over the years scientists, technologists, and foreign affairs experts have improved their knowledge of one another, they still tend

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[190](...continued)
(London: Clarendon Press [Oxford], 1984); Thomas Karas, The New High Ground: Systems and Weapons of Space Age War (New York: Simon and Schuster, 1983); Union of Concerned Scientists, The Fallacy of Star Wars (New York: Vintage Books, 1984); Colin S. Gray, American Military Space Policy (Cambridge, MA: Abt Books, 1983); Bhupendra Jasani, Outer Space: Battlefield of the Future? (London: SIPRI, Taylor & Francis, 1982); David P. Gump, Space Enterprise: Beyond NASA (New York: Praeger Publishers, 1990); Nathan C. Goldman, Space Commerce: Free Enterprise on the High Frontier. (Cambridge, MA: Ballinger Publishing Company, 1985); Nicholas L. Johnson, Soviet Military Strategy in Space (London: Jane's Publishing Company Limited, 1987); Gerard O'Neill, The High Frontier (New York: Anchor Books/Doubleday., 1976, 1982).
More recent collections of essays on policy include: Radford Byerly, Jr., Space Policy Reconsidered (Boulder, CO: Westview Press, 1989); Muskie, Edmund S. ed., The U.S. in Space: Issues and Policy Choices for a New Era (Washington, D.C.: Center for National Policy Press, 1988).

to operate in their individual spheres, unmindful of the opportunities that each has to offer the other."[191] It is interesting to see that the practical area of policy analysis mirrors the fragmentation and limitations that characterize general theory. This fragmentation in approach occurs not only *between* major disciplines and their policy areas but also *within* disciplines and subdisciplines. In political science, it has prompted Gabriel Almond, among others, to comment on the "fragmented and faddish character" of the field.[192] This compartmentalized approach to political analysis, for the most part state-centered in outlook, is increasingly coming under scrutiny as analysts come to feel that it is ineffective in illuminating the large-scale political, social, and economic transformations that characterize the end of the twentieth century. This has led practitioners to comment on the "tragedy of political science,"[193] and on "the impairment of professional memory."[194] There seems to be a consensus among political

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[191]Ralph Sanders, The International Dynamics of Technology (Westport, CT: Greenwood Press, 1983), p.5.

[192]Gabriel Almond, "Corporatism, Pluralism, and Professional Memory," World Politics, 35, No.2 (January 1983), 252.

[193]David M. Ricci, The Tragedy of Political Science: Politics, Scholarship, and Democracy (New Haven: Yale University Press, 1984).

[194]Gabriel A. Almond, "Corporatism, Pluralism, and Professional Memory," in World Politics, 35 (1983), 245-60.
(continued...)

scientists that a general lack of focus and definition pervades the field. This is particularly true for the area of international relations which reveals a diffuse feeling of failure throughout the literature.[195] At the same time there is little agreement on how to solve the problem, with each practitioner in the discipline for the most part firmly clinging to an entrenched point of view. Nonetheless, since there is a growing consensus that the fragmentation in the field limits understanding and explanatory power, we seem to be involved in a "paradigm shift," to use Thomas Kuhn's term, in which researchers not only in political science but also in a variety of scientific and humanistic fields feel the need to seek a new synthesis or all-embracing paradigm.

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[194](...continued)
Almond laments the fact the political scientists tend to embark on new directions without attempting to build on the past. For this reason, they fail to form those all important linkages that permit a solid anchoring of present and future work.

[195]See, for example, K.J. Holsti: "International theory is in a state of disarray. In the past decade, the three-centuries-long intellectual consensus which organized philosophical speculation, guided empirical research, and provided at least hypothetical answers to the critical questions about international politics has broken down." The Dividing Discipline: Hegemony and Diversity in International Theory, (Boston: Allen & Unwin, 1985), p.1.

Paradigm Shifts and the Nature of Theory

Thomas Kuhn, in his work The Structure of Scientific Revolutions[196] attributes definitive changes in the paradigms guiding scientific research to the perception of anomalies or the inability of the paradigm to provide guidance for solving the problems addressed. Paradigm shifts entail actual shifts in vision, in how the interrelations between things are perceived, according to Kuhn. If this idea is applied to political science,[197] then given the disaffected debates on approach and methodology within the discipline, it would seem we are in the midst of a paradigm shift, in which the old rules are no longer perceived as valid and capable of giving direction to the field, while new ones are in the process of evolving and have not as yet been accepted by the majority of practitioners.

The aim of political theory, in the opinion of most practitioners, is to describe, explain and, if possible, achieve some understanding of the forces that govern our lives and lead to process and change. In the words of Kenneth N. Waltz, a theory is "a picture, mentally formed, of a bounded realm or domain of activity... a depiction of the

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[196]Second edition enlarged (Chicago: The University of Chicago Press, 1962, 1970), esp. pp. 52ff-111ff.

[197]I will for the time being sidestep the debate as to whether the word "science" may be appropriately applied to the political arena.

organization of a domain and of connections among its parts...A theory indicates some factors are more important than others and specifies relations among them .... A theory arranges phenomena so that they are seen as mutually dependent; it connects otherwise disparate facts; it shows how changes in some of the phenomena necessarily entail changes in others."[198] While researchers might agree on this generic statement of the goals of theory,[199] substantial differences emerge with respect to underlying assumptions and expectations of outcome. On the one hand, adherents to the realist, state-centered, and linear outlook or "classical paradigm," which we shall discuss further below, such as Waltz, consider the usefulness of a theory to depend on its explanatory and *predictive* powers.[200] Other schools of

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[198]Kenneth N. Waltz, Theory of International Politics (New York: Random House and Newbery Award Records, Inc., 1979), pp.8-10.

[199]Another definition advanced by Dougherty and Pfaltzgraff, views a theory as an "intellectual tool that helps us to orient and organize our knowledge, to ask significant questions and to guide the formulation of priorities in and the design of research; it enables us to apply methods of scientific inquiry in an orderly way; as it becomes more comprehensive, it enables us to relate knowledge in our own field to that of other fields; and thus it enhances our ability to understand and explain reality in a satisfying way."
James E. Dougherty and Robert L. Pfaltzgraff, Jr., Contending Theories of International Relations, 2nd Edition (New York: Harper and Roe, 1981), pp.11-12.

[200]Many would argue that the type of predictability which characterizes a certain part of science governed by linear cause and effect is not achievable with regard to the
(continued...)

thought, however, would argue that prediction is not possible. Susan Strange, for example, in referring to the political economy subfield writes:

> What we should *not* try to look for, because it does not exist and therefore cannot be found, is an all-embracing theory that pretends to enable us, even partially, to predict what will happen in the world economy tomorrow. The ambition of the social sciences to imitate the natural sciences and to discover and elaborate 'laws' of the international system, patterns so regular they govern social, political and economic behaviour, is and always has been a wild goose chase. Much valuable time and strenuous effort has gone into it and most of both the time and the effort could have been better spent on re-learning some of the basic axioms about human vice and human folly, about the perversity of policies and arbitrariness of coincidences....
> What we have to do, in short, is to find a method of analysis of the world economy that opens the door of student or reader choice and allows more pragmatism in prescription; and, secondly, a method of analysis that breaks down the dividing walls between the ideologues and makes possible some communication and even debate between them.[201]

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[200](...continued)
highly nonlinear course of politics and of human history. Human beings are subject to too many unforeseeable contingencies in terms of both internal psychological or other pressures and the influence of external phenomena. This makes it difficult to be able to accurately predict outcomes in human affairs with any degree of accuracy. However, one could further distinguish between linear and nonlinear predictability and the partial generic predictability associated with the perception of recurring patterns, which may indeed emerge through close analytical examination of a certain kind.

[201]Susan Strange, States and Markets (London: Pinter Publishers Limited, 1988), pp.16-17).

A Multiplicity of Theoretical Approaches: The Problem of Change

The fact that we seem to have reached a point of paradigm shift, to use Kuhn's term, and that past theoretical endeavors have not succeeded in developing a satisfactory all-embracing paradigm for the discipline does not mean that these efforts should be discarded. Any growth in knowledge involves both a building on past experiences (whether positive or negative) often combined with a flash of intuition concerning possible new directions. In the field of political science, innumerable orientations of research and experimentation have been pursued by the many schools of thought, ranging, to name only a few, from those based on realist/classical assumptions, such as early decision making models proposed by (among others) Snyder, Bruck, and Sapin;[202] bureaucratic models such as those utilized by Graham Allison[203] or Joseph LaPalombara;[204] work on game theories, such as Schelling's;[205] system theory models such

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[202]Richard C. Snyder, H.W. Bruck, and Burton Sapin, eds., Foreign Policy Decision-Making: An Approach to the Study of International Politics (New York: The Free Press, 1962).

[203]Graham T. Allison, Essence of Decision: Explaining the Cuban Missile Crisis, (Boston: Little, Brown and Company, 1971).

[204]Joseph LaPalombara, Bureaucracy and Political Development (Princeton: Princeton University Press, 1963).

[205]Thomas C. Schelling, The Strategy of Conflict (Cambridge, MA: Harvard University Press, 1960, 1980).

as those put forth by Easton[206] or Waltz;[207] interest group theory in its various formulations from "iron triangles"[208] to "issue networks;"[209] or more recent decision making "implementation" models;[210] psychological approaches to decision making such as those exemplified in the work of Alexander George, Fred I. Greenstein, Robert Jervis, or Stanley Renshon;[211] approaches centering on interdependence, such as those advanced by Robert O. Keohane and Joseph

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206 David Easton, A Systems Analysis of Political Life (Chicago: The University of Chicago Press, 1965, 1979).

207 Theory of International Politics, 1979.

208 "Iron triangles" refers to the relationships between federal bureaucracy, congressional committee and special interest group actors that form a generally closed and independent subsystem in the making of policy. See, for example, J. Leiper Freeman, The Political Process: Executive Bureau-Legislative Committee Relations (New York: Random House, Inc., 1965); Kenneth J. Meier, Regulation: Politics, Bureaucracy and Economics (New York: St. Martin's Press, 1985).

209 see: Hugh Heclo, "Issue Networks and the Executive Establishment," in The New American Political System, ed. Anthony King (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1978), pp.87-124.

210 see: Steve Smith and Michael Clarke, Foreign Policy Implementation (London: George Allen & Unwin, 1985).

211 see: Alexander George and Juliette L. George, Woodrow Wilson and Colonel House: A Personality Study (New York: Dover, 1956, 1964); Fred I. Greenstein, Personality and Politics: Problems of Evidence, Inference, and Conceptualization (Princeton: Princeton University Press., 1969, 1987); Robert Jervis, Perception and Misperception in International Politics (Princeton: Princeton University Press, 1976); Stanley Renshon, Psychological Needs and Political Behavior (New York: Free Press, 1974).

S. Nye.[212] Those efforts based on the classical paradigm that have viewed reality in basically linear terms, have considered the state and/or its various sub-components (groups, sectoral analysis of Congress, the Presidency, etc.) to be the primary units of analysis and *prediction* to be the ultimate goal of analytical endeavor have in the main experienced a sense of failure in being able to adequately illuminate complex reality. On the other hand, there is the Marxist and *dependencia* literature, and that in the vein of Immanuel Wallerstein or Fernand Braudel which never embraced the state as primary unit of analysis, as well as the literature of technology studies, interdependence, and the new international political economy, among others, which are trying to free themselves from a state-centric perspective and to develop new and more effective theoretical models.[213]

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[212]see: Robert O. Keohane and Joseph S. Nye, Power and Interdependence: World Politics in Transition (Boston: Little Brown, 1977); Andrew M. Scott, The Dynamics of Interdependence (Chapel Hill, NC: The University of North Carolina Press, 1982).

[213]see: Robert Gilpin, The Political Economy of International Relations, with the assistance of Jean M. Gilpin (Princeton: Princeton University Press, 1987); Robert W. Cox, Production Power, and World Order: Social Forces in the Making of History, Vol.1. (New York: Columbia University Press, 1987); Susan Strange, States and Markets (London: Pinter Publishers, 1988).

What of course lies at the basis of the confusion and multiplicity of "approaches" is the difficulty of understanding and coming to terms with process and change. This is the old problem defined by philosophers as that of the "One and the Many," or the tension between the universal or transcendent (the domain which is not subject to becoming) and the ephemeral (that which is subject to change). To cope and survive, the human mind needs to see some underlying order in the world of events, which would otherwise appear to be a meaningless stream of random occurrences. This requires attempting to perceive some form of enduring pattern in the process of becoming to which all life is subject. At the same time, however, imposing fixed categories on the ebb and flow of human events can also severely limit and distort explanatory possibilities. The basic problem today is in a sense the same as that of past millennia, but vastly accentuated by global economic integration and rapid technological advances, especially in communications. That is, the fundamental concern is with devising an explanatory model that takes into account process and change without simultaneously falsifying the conclusions reached by imposing analytic parameters that are too rigid.

Since it can be argued that space policy may be most fruitfully understood in international or global terms, let us turn now to the literature of international relations and seek to understand how the classical, realist, state-centered model embraced by most practitioners evolved. Subsequently, we will look at the paradigm shift that has taken place and some of the new approaches that are being advanced to deal with the growing complexities and flux of a turbulent world system. We will sketch the broad outline of theoretical development in the field, the reasons for the sense of failure that pervades current research, and paradigm shifts that are taking form in relation to the changing reality of the last decade of the twentieth century.

K.J. Holsti has described the boundaries of the field of international theory as consisting of "descriptive and explanatory statements about the structure, units, and processes of international politics that transcend time, location, and personality."[214] The socio-political reality of the West from the sixteenth through the twentieth centuries was largely determined by problems connected with the limited geographic units of the evolving system of *nation-states*. It reflected an international situation in which there was no overarching authority such as that provided in the past by the Empire of Alexander, the Roman Empire or that of Catholic Church in the Middle Ages. International theory during this period reflected concern with a world seen as an

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[214]K.J. [Kalevi Jaakko] Holsti, The Dividing Discipline: Hegemony and Diversity in International Theory, (Boston: Allen & Unwin, 1985), p.3.

anarchy of competing states, and came to focus primarily on problems of war and peace, order and security, the interaction of nations and blocs in their quest for, and organization of, power. The main actors or units of analysis were the nation-states. This view of the world gave rise to a tradition of philosophical and empirical inquiry often called the "classical paradigm," which has inspired writers ranging from Nicolò Machiavelli, Thomas Hobbes, Hugo Grotius, and Jean Jacques Rousseau to contemporary writers such as Hans Morgenthau, Hedley Bull, Kenneth N. Waltz and others.

Since in an anarchic world system the individual is at high risk, one of the most important roles of the nation-state, considered to be the *primary actor* on the world stage, becomes that of protecting and guaranteeing the security of its citizens and the boundaries of the territory of which they are a part. That responsibility lies at the very foundation of government, whatever concept of national legitimacy it adheres to, whether democratic or totalitarian, capitalist or Marxist. National security thus became an issue of fundamental importance in the classical paradigm.

A central problem facing governments has always been that of correctly identifying the nature and component aspects of national security, obtaining the necessary domestic support for specific policies, and implementing decisions so that outputs and outcomes converge in a coherent foreign policy. In the classical paradigm, security was primarily viewed as protection from the ill intents of other states. Yet, as we shall see below, a highly integrated global environment is rapidly transforming the older, territorial concept of national security.

The Changing Concept of National Security

How can one define national security? One authoritative definition advanced by Charles F. Hermann considers national security to be "the expectation of retaining and enhancing the ability to partake of highly regarded value outcomes free of obstruction." In his view national security consists of "security with respect to 'value outcomes' desired by those who comprise the effective political base of a nation."[215] This idea follows in the classical tradition of seeing the *state* as the place where men may fulfill their human potential and live a happy and rewarding life. For Plato and Aristotle, as well as for modern thinkers of the traditional school, human beings may achieve life, liberty and the pursuit of happiness, however defined, in and through the

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[215]Charles F. Hermann, "Defining National Security," in American Defense Policy, John F. Reichart and Steven R. Sturm, eds. 5th Ed. (Baltimore, MD: John Hopkins University Press, 1982), p.19. Reprinted from "Are the Dimensions and Implications of National Security Changing?" in Mershon Center Quarterly Report, 3, No.1 (Autumn 1977), 5-7.

"security" offered by the *state*.[216] Hermann identifies five broad aspects of the national security environment that have been, and will, in his opinion, continue to change: preferred value outcomes, international environment, domestic environment, nature of threats, and strategies for threat aversion.

The problem of dealing with change is a major one for a government concerned with protecting the security of its citizens. The responsibility for defending national security has never been an easy one to fulfill in the past. In today's world, however, the task of assessing current international threats has been further complicated by rapidly evolving technology which is often poorly understood by both layman citizen and legislator. In the light of accelerating feedback due to advances in communications and transporta-

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[216]It should be noted, nevertheless, that for the Greeks, as opposed to modern thinkers, there was no antithesis between individual and state since the end of the state is to promote the moral perfection of the individual. As Sir Ernest Barker has indicated, "The 'limit of state interference' never suggested itself to the Greek philosophers as a problem for their consideration... Their state, we have always to remind ourselves, was a church as well as a state; and most churches believe in moral guidance and stimulus." In the era of the nation-state in which the idea of direct participatory democracy has given way to the necessity of representative democracy, the emphasis has shifted in Barker's terms from the concept of 'administration of stimulus' to that of 'removal of hindrances.'
Ernest Barker, "Introduction," The Politics of Aristotle (New York: Oxford University Press, 1958), pp. li-lii.

tion, the effect of technology on a given situation, moreover, may be so far-ranging as to *modify the very parameters* of the discussion before the decision makers have had time to realize what has occurred. What would it mean for the social, political and economic life of the nation, for example, if its satellites suddenly ceased to function? Space security seems remote and not of immediate concern to the average person and even to the private sector and government officials who do not directly deal with the area. Yet, any massive satellite failure would probably have a highly destabilizing effect --both nationally and internationally-- on communications, on the flow of data in the banking system and financial markets around the world, on military command, control and verification. In other words, it would affect the overall security of a nation and of the international system.

Moreover, while national security may be viewed, as Hermann does, in terms of protecting the value outcomes desired by the citizens of the *nation-state*, there are those who would argue that "national" security itself is an outmoded concept tied to 19th century nationalistic constructs which are no longer relevant to our highly interdependent late 20th century society. Before World War II, an "external threat" to national security was primarily viewed in terms of military defense, and armed force was considered to be the appropriate means to settle international disputes. After World War II, with the increased pace of technological advance, the multiplication of the number of independent nation-states, and with the emergence of the "global village," the concept of national security acquired an extended meaning. The actual use of force in solving major international disputes gave way to the threat of its use in what Thomas C. Schelling has referred to as the "diplomacy of violence."[217] In our present-day international system, characterized by nation-states at various stages of development, social and economic well-being, cultural traditions, and power, there is no doubt that force, or the threat of its use, is still a primary tool of foreign policy. At the same time, notwithstanding the older force-based mindsets, the question is increasingly being asked whether, given the new

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[217]Schelling describes the "diplomacy of violence" as follows: "Military force can sometimes be used to achieve an objective forcibly, without persuasion or intimidation; usually, though -- throughout history but particularly now -- military potential is used to influence other countries, their government or their people, by the harm it could do to them. It may be used skillfully or clumsily, and it can be used for evil or in self protection, even in the pursuit of peace; but used as bargaining power it is part of diplomacy --the uglier, more negative, less civilized part of diplomacy-- nevertheless diplomacy.
There is no traditional name for this kind of diplomacy...For the last two decades, though, this part of diplomacy has been central and continuous; in the United States there has been a revolution in the relation of military to foreign policy at the same time as the revolution in explosive power." Though written in 1966, Schelling's words are still relevant in today's multipolar world.
Thomas C. Schelling, Arms and Influence (New Haven: Yale University Press, 1966), Preface, vi.

interdependent high tech international environment, the use of force in the traditional sense still retains its past importance as a way of solving international problems, some of which may no longer be appropriately dealt with by such means.

The New Non-Military Threats

Threats to national security in the global village may not come from the traditional dangers to territorial integrity but from perils affecting the well-being of nations that originate in other non-military areas such as satellite failure, energy resource shortage, population growth, uncontrolled population dislocation and mass migration, ecological damage, illegal drugs, international financial and economic manipulation and speculation, stock market or bank crashes, international terrorism, computer viruses, or large-scale epidemics such as AIDS. Since the impact of sudden major shifts in these new areas can quickly and geometrically affect nations around the world on a long-term or short-term basis, these non-military threats have become an integral, if less understood part, of the concept of "national security."

A reduction or manipulation of the oil supply in the Middle East has an immediate and potentially destabilizing effect on the industrial and civilian economies of oil-importing nations such as the United States, Europe or Japan.

In the Persian Gulf War, for example, both military and non-military threats formed part of the decision to go to war with Iraq. It might be argued that the primary cause of war was the military violation by Iraq of international law through territorial aggression. An equally important corollary cause for going to war might be seen in the non-military *perceived* threat that the annexation of Kuwait by a power-hungry and ruthless leader like Saddam Hussein could result in the manipulation of the international oil market, thus creating global market and financial chaos and instability.[218] An additional economic-military threat to international security -- and thereby to the national security of the United States, -- might be seen in the increased flow of income to Iraq from the sale of annexed Kuwaiti oil. Given the Iraqi dictator's past track record, it could be justifiably assumed that a major portion of the new funds would have gone to expanding and technologically upgrading his military machine, with the possibility of his coming to pose a more direct and dangerous military threat to the United States and its Gulf allies and interests. A variety of non-military

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[218]For a comprehensive discussion of theories of perception and misperception in foreign policy decision making, see: Robert R. Jervis, Perception and Misperception in International Politics (Princeton, NJ: Princeton University Press, 1976); Stanley Renshon ed., The Political Psychology of the Gulf War: Leaders, Publics, and the Process of Conflict (Pittsburgh: University of Pittsburgh Press, forthcoming 1993).

threats are therefore significant components of the changing concept of national security in our times.

In terms of ecological threats to national security, acts by one country that affect the world ecological balance could have devastating implications for the national security of other countries. Deforestation, uncontrolled population growth leading to food shortages and increased environmental pollution, the international repercussions of another accident like Chernobyl in 1986 or of the Kuwaiti oil well fires in 1991, the spilling of large quantities of oil into the seas whether intentionally as in the case of Iraq in the Persian Gulf or unintentionally, as in the case of oil tanker disasters such as the Exxon Valdez, Amoco Cadiz, or more recently in tanker accidents off the coast of Scotland and Indonesia,[219] all reinforce the case for an extended concept of national security.

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[219]The Exxon Valdez ran aground off Prince Williams Sound in Alaska in 1989, while the Amoco Cadiz accident occurred off the coast of France in 1979. A major spill occurred off the coast of Spain in December 1992. The tanker Braer lost 26 million gallons of oil off the Shetland Islands and the Danish supertanker Maersk Navigator crashed into an empty Japanese tanker at the entrance of the Strait of Malacca with a loss of over 30,000 tons of crude oil in January 1993, prompting the Indian government to ask for international help to clean up the spill. Oil spills seem to be increasing through a combination of aging fleets, human error and lack of properly trained crews. It has been pointed out that five of the 15 major oil spills of the century have occurred in the 1990's.
See: Joel Havemann, "Why Oil Spills Are Increasing," Los Angeles Times,(Home Edition), March 26, 1993, Part A, p.1.

Unanticipated Consequences

With technology-propelled innovations, we are also witnessing the emergence of new and unforeseen threats. A possibly very dangerous threat to the world food supply and therefore a potential threat to socio-political stability has emerged recently in the area of the genetic manipulation of seeds to increase crop yields (and profits). Scientists are warning that homogenization and loss of wild strains that accompanies such manipulation can lead to global catastrophic crop failure, since the new hybrids are generally not as resistant to viruses and sickness as the older strains and the natural barriers posed by changing varieties of seeds from one country to another no longer exist.[220]

A similar threat to stability may be posed by the unregulated use of chemical crop fertilization much in the same way the use of chlorofluorocarbons in refrigeration

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[220]See, for example, Robert E. Rhoades, "The World's Food Supply at Risk," National Geographic, 179, No.4 (April 1991), 74-105. Rhoades points out that: "Modern farmers prefer the modern varieties [of seeds], the plants redesigned by genetic scientists who borrow the best attributes from various seeds and blend them into new ones to increase productivity, to meet the taste of consumers, and to provide maximum protein, among other reasons.
But there is a trade-off. By relying on a few crop strains instead of many, farmers open themselves to disaster. In the U.S., for instance, billions of rows of essentially identical corn are planted each year, making the entire crop vulnerable to a single pest or disease....Such disasters are nothing new. Throughout history the sowing of uniform crops has led to a harvest of tragedy." (p.84)

equipment, aerosol sprays, and other commercial endeavors has led to problems with the ozone layer. Scientists do not know the *danger thresholds* for the use of chemicals on crops and foods, beyond which the benign effects of the chemical could become negative. A case in point is the use of the DuPont chemical Benlate in Florida to control mold and enhance the appearance of fruits and vegetables. After approximately twenty years of use, the chemical's effect from positive unexpectedly turned deadly, reducing fields on which it was applied to barren wastelands.[221] Factors such as these are rarely taken into consideration by analysts and yet have the potential of becoming powerful destabilizing forces should their effects become widespread. As indicated previously, large-scale crop failures can aggregate with other factors and lead to a series of socio-economic and political problems

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[221]Over 1000 growers in Florida and other Southeastern states, including Texas, California, and Puerto Rico, attributed large scale crop failure to the use of Benlate applied to vegetable, tree, and flower crops to control fungal diseases. The New York Times reported that research seemed to indicate Benlate broke down into other chemicals when exposed to sunlight and heat and that these new chemicals had a deadly effect on the crops. Benlate was withdrawn from the market by E.I. DuPont de Nemours & Co. in March 1991 and the company paid more than $500 million in damage claims before changing its position at the end of 1992 and rejecting blame for both crop failures and health related problems alleged by farm workers.
See: "One Time Charges Cause Du Pont to lose $240 Million," The New York Times, January 30, 1992, Sect. D, p.4; and also: Keith Schneider, "After Millions Paid, Du Pont Now Denies Blame Over Fungicide," The Houston Chronicle, December 5, 1992, 2 Star Edition, Sect. A, p.24.

ranging from higher food prices to extreme socio-political reaction if the food chain should suddenly fail.

Ecological, economic, and national security factors are inextricably intertwined. As one expert has indicated:

> ... the deterioration of the earth's biological systems now threatens the security of nations everywhere.... The deterioration of the earth's biological systems is not a peripheral issue of concern only to environmentalists. The global economy depends on these biological systems. Anything that threatens their viability threatens the global economy. Any deterioration in these systems represents a deterioration in the human prospect.[222]

A measure of the magnitude of the problem may be obtained if one considers that a 3 percent increase in the annual population growth rate of a developing nation leads to a nineteenfold increase in the course of a century and can, as has been pointed out, "destroy a country's ecological system and social structure more effectively than a foreign adversary ever could."[223] Unfortunately, as mentioned, the exact point at which environmental thresholds are crossed is still not well understood by scientists since the critical

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[222]Lester Brown, "An Untraditional View of National Security," in American Defense Policy, John F. Reichart and Steven R. Sturm, eds. (Baltimore, MD: Johns Hopkins University Press, 1982), p.22. [Excerpted from Redefining National Security, Worldwatch Paper 14, Washington, DC: Worldwatch Institute, October 1977].

[223]Brown, p.23.

demarcation area is created by complex interactions between human demands, and the ability of the earth's biological systems to support them.[224] Ecology and development have also become intertwined and are having an increasing impact on international relations and security. As indicated by Jim MacNeill et al. in Beyond Interdependence: The Meshing of the World's Economy and the Earth's Ecology,

> The issues of development and environment are beginning to reshape national and international affairs and they could well become even more critical during the next two decades.If human numbers do double again, a five- to tenfold increase in economic activity would be required to enable them to meet their basic needs and minimal aspirations. Aspirations are just as important as needs. A five- to tenfold increase translates into a colossal new burden on the ecosphere and raises the question of sustainability...Can growth of these orders be managed on a basis that is sustainable. The question of sustainability has been forced front and center by

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[224]For example, forest damage in West Germany in 1982 had been assessed at 8 percent, in 1983 at 34 percent, and in 1984 it had climbed to 50 percent. It reached a peak of 54 percent in 1986 and in 1988 showed a small decline to 52 percent. The spread of damage to the forests in central and Northern Europe is still poorly understood by scientists. While the feeling is that it is due to pollutants from the burning of fossil fuels, it came at a time when the use of fossil fuels was levelling off. This is an indication that some threshold of natural equilibrium may have been breached through the cumulative stresses on the ecosystem from the introduction of man made chemicals which weaken the forest's resistance to disease and environmental stresses such as severe temperature fluctuations.
See: Lester R. Brown and Sandra Postel, "Thresholds of Change," in State of the World: 1987, A Worldwatch Institute Report on Progress Toward a Sustainable Society (New York: W.W. Norton & Company, 1987), pp.3-19; and Hilary F. French, "Cleaning the Air," in State of the World 1990, pp.98-118, esp.p.106.

> the acceleration of events. It will preoccupy governments, industry, and our institutions of higher learning well into the next century.[225]

The Nation-State: A Powerful Anachronism?

It is easy to see that non-military threats to national security have become an increasingly important part of any definition of national security in an interdependent world. On this basis, some would say that the concept of the nation and national sovereignty have become obsolete, and that an interconnected world requires new forms of governance to solve its many problems. The point has been cogently made by Barbara Ward and others that the justification of the nation-state in terms of its securing the well-being of its citizens is absurd in view of the global limits to survival and that "undiluted sovereignty" is no longer in the best interest of the citizen: "The present organization of mankind in a lawless assembly of competing sovereignties deprives every state of security, great and small alike. If the justification of sovereignty claimed for the state is that it secures safety and well-being for the ordinary citizen--and what other justification can there be?--then our objective

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[225] Jim MacNeill, Pieter Winsemius, Taizo Yakushi, Beyond Interdependence: The Meshing of the World's Economy and the Earth's Ecology (New York: Oxford University Press, 1991), p.5.

judgment must be clear. Undiluted sovereignty is no longer an efficient or sufficient instrument of government."[226]

As problems assume planetary proportions and require global solutions, the concept of *national sovereignty* as a basic principle of international law is increasingly undermined. A dramatic case in point is the plight of the Kurdish and Shiite populations in Iraq when they fled from the repressive regime of Saddam Hussein. Through the powerful impact of the news media, and particularly television, images of their suffering were brought on a daily basis before the conscience of the world. The growing consensus that such suffering could not be condoned in the name of national sovereignty and the realization that population movements of that magnitude would further regional destabilization and endanger international security led to the unprecedented intervention by the United States and allied forces directly on Iraqi territory to save, feed, and protect the fleeing minorities from their own government.

The European Community, the United States and the United Nations are urged by world opinion to intervene militarily to stop "ethnic cleansing" and the slaughter of innocent civilians in Yugoslavia. During 1991, Italy and Greece faced

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[226]Barbara Ward, Spaceship Earth (New York: Columbia University Press, 1966), p.29.

massive problems with the sudden illegal entry of thousands of Albanians fleeing economic and political hardships. A more recent example of humanitarian assistance may be seen in the U.S. led United Nations intervention in Somalia. These and other developments are in turn providing new momentum for a reevaluation of the principle of nonintervention in the internal affairs of nations which has been adhered to by the United Nations since it was founded. Serious consideration is also being given to the idea of creating a rapid deployment force to deal with the multiplication of world crises that had previously been managed within the context of superpower rivalry.[227]

While nonmilitary threats to security have become increasingly important, they should not be seen as replacing military threats but rather as *additional* dangers to the existence and self-realization of the individual in the

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[227]Article 2, paragraph 7 of the United Nations Charter upholds the *principle of sovereignty and nonintervention* in the internal affairs of states: "Nothing contained in the present Charter shall authorize the United Nations to intervene in matters which are essentially within the domestic jurisdiction of any state or shall require the Members to submit such matters to settlement under the present Charter." In a world in which the information media bring us real time information on the suffering and indignity human beings are subjected to because of internal civil wars or government persecutions, the UN position on sovereignty is becoming progressively untenable. Countries that have internal problems, moreover, are turning to the UN for assistance in solving them, as in the case of Afghanistan or Cambodia.

social context. It is true that global problems will require increasing international cooperation for their solution, but one should not jump to the conclusion that the nation-state is therefore defunct and reasonable men will work toward the creation of a world government that is better equipped to handle these problems. This is amply demonstrated by the reluctance of nations to delegate sufficient powers to the United Nations to handle worldwide security problems. Even in the case of the Persian Gulf war, in which, following strong U.S. and Security Council leadership, consensus on joint international action was reached within a relatively brief time span in the United Nations, it was clear that the use and control over military force and the humanitarian relief effort itself was still under the aegis of individual nations participating in the campaign against Iraq. Despite the increasing globalization of problems, the concept of national sovereignty is still very much alive in today's world. In a thoughtful article on technological change and the world economy, Michael Blumenthal comments that technology has "created a world no longer effectively composed of individual national economic entities." However, despite this fact of life, he indicates that:

> Regardless of where the technology moves, nation-states will continue to exist for a long time to come, and more important, will behave as if they can continue to control key economic events a great deal more effectively than may actually be the case.

> There are several reasons for this. The practice has been deeply ingrained over the centuries and will not easily give way; as yet there is no ready, practical alternative to continuing national action much as in the past; even if national measures on key issues can no longer work, they can still appear to do so, and thus influence the behavior of markets and managers.[228]

A quick look at the world scene will show that the nation-state system still has a long way to go --barring any world cataclysm-- before national and regional barriers are overcome. *The meaning of security in today's world is both* national and global, military and non-military, domestic and foreign in its scope. While the distinction between the national and international realms has quietly disappeared, countries still have to accept this fact in their national psyches. The old divisions exist not only at the level of the nation-state, but also at the social and cultural levels, where knowledge and human activity is conceived of in terms of narrowly defined disciplines or fields. A new holistic consciousness of the dynamical interaction of life systems and knowledge within the continuum of reality is just beginning to emerge and achieve acceptance. This holistic tendency and vision may be found in much of the more recent interdependence, international political economy and technology studies literature. It is also a characterizing feature

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[228] W. Michael Blumenthal, "The World Economy and Technological Change," Foreign Affairs: America and the World, Vol. 66, No.3, 1987/1988, p.545.

of chaos theory, a new multidimensional and nonlinear theoretical approach which is evolving across diverse disciplinary areas.[229]

Conclusion

In this chapter we examined the tensions between the old classical paradigm of the realist school and a rapidly changing economic and political reality. We discussed the nature of theory and of paradigm shifts and investigated the literature of international relations and the multiplicity of theoretical approaches that evolved as different attempts were made to better illuminate socio-political reality. We noted the transformations occurring in the concept of national security as new non-military threats emerged shaped by accelerating technological advances and the globalization of human activities. The question was raised whether the nation-state in the context of a highly interactive global village has indeed become a powerful anachronism and whether the increasing incidence of unanticipated consequences required new models and a revised definition of what constitutes a threat to "national" security. In the next chapter, we will look at some new approaches that have been developed to deal with the complex reality of the late twentieth century and explore whether these tentative models might

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[229]For a brief discussion of Chaos Theory see pp.234f.

offer better explanatory possibilities than the older realist state-centered models.

CHAPTER 9. NEW APPROACHES TO A DYNAMIC LATE TWENTIETH CENTURY REALITY

> *...just as nation–state rivalries are being overtaken by bigger issues, we may have to think about the future on a far broader scale than has characterized thinking about international politics in the past.*
>
> *Paul Kennedy*[230]

> *A body of knowledge, insight, and theory concerning international politics has developed over time but it has not kept pace with the profound transformations taking place in the international system... Reality has outrun theory. Humankind is trying to understand and manage a highly interactive and interdependent world while relying upon assumptions and concepts developed for a pre–interdependent world. Thucydides and Machiavelli may have had a better grip on the international scene in their respective times than contemporaries do today because the fit between ideas and reality may have been closer then.*
>
> *Andrew M. Scott*[231]

The reality of the latter part of the twentieth century is one of mixed trends which serve to augment the confusion of the observer. On the one hand it is still that of nation-states and their quest for power. The post-World War II era has seen a veritable proliferation of new nation-states and disputes based on pursuit of conflicting interests and domination. However, at the same time there are strong

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[230]Paul Kennedy, Preparing for the Twenty-First Century (New York: Random House, 1993), p.15.

[231]The Dynamics of Interdependence, pp.vii-viii.

forces of change at work which various observers have tried to define and which account for the high degree of fragmentation in the field of international theory. Most of these definitions have revolved around a concept of interdependence which has gone beyond the still state-centric one initially put forward by Keohane and Nye[232], the new international political economists' "eclectic" approach to reality, concepts of evolving capitalism or socialism, such as the various theories advanced by Wallerstein or the Marxist schools, or those that see reality being molded by advancing technology and its effects. While all succeed in capturing an aspect of the forces behind change in our contemporary world and seek to move from the particular level of analysis (war, alliances, decision making, interest groups, class, psychology) to a broader explanatory perspective reflecting the global nature of current reality and problems, it is evident that a greater overall synthesis has not been reached. This is especially true when technology is factored into the analysis. Two of the more interesting approaches that have emerged are Andrew Scott's vision of the "interac-

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[232]See Robert O. Keohane and Joseph S. Nye, Power and Interdependence: World Politics in Transition (Boston: Little, Brown and Company, 1977). Keohane and Nye, while criticizing the classical paradigm for its lack of attention to non-state actors and to transnational movements, essentially attempted to broaden its parameters by adding new actors. They did not, as others did after them, claim that the whole nation-state paradigm was basically flawed. We will discuss this transition further below (see p.227 ff.)

tion-technology continuum" and Susan Strange's "eclectic" approach to international political economy. We will first briefly look at Scott's work and examine how he views the impact of the technological variable on political analysis. Subsequently, we will discuss Susan Strange's work and see how she deals with the new complex reality of our late 20th century.

The Interaction-Technology Continuum

One of the more comprehensive views, which seeks to combine the reality of an increasingly interdependent global system with that of a world driven by intensifying technological change, is put forth by Andrew M. Scott in the Dynamics of Interdependence.[233] Scott's work falls within the tradition ranging from Vico to Popper which acknowledges the *apurposive* nature of the world processes. These processes encompass the whole area of human life-space, from economics to ecology. They have been set in motion by the geometrically accelerating interaction between human actions that take place in an ever more interdependent world and advancing technology that increases and facilitates the interaction, thus augmenting its scope and impact. Scott calls this process the *interaction-technology continuum*.

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[233]Andrew M. Scott, The Dynamics of Interdependence, (Chapel Hill, NC: The University of North Carolina Press, 1982).

In his analysis of the evolution of global problems, Scott argues that increasing world interaction combined with rapid technological innovation is leading to a situation in which dangers to human development are no longer only or even primarily posed by the security dilemma as viewed by the realist school of power politics. The true danger is instead created by the growing numbers of actors on the world scene, the increased level of their interaction and the increased impact of the technologies at their disposal which has combined to create apurposive processes that seem to be beyond man's capacity to manage them safely. He contends that what is needed is a clearer understanding of the *dynamics of interaction and interdependence*, for "unless humankind can come to understand what is happening to it and why, it will be powerless to shape events and will drift with the tide." (Introduction, ix) As he indicates, the microcosm in which the individual lives has become inextricably enmeshed with the macrocosm of global problems and processes:

> "Most individuals live in a microcosm--a village, a town, a neighborhood in a city. In the right kind of world, their lives would be smooth and undisturbed save for problems arising in that microcosm. Unfortunately, as the global system becomes more interactive and as technology moves forward, those little worlds become more vulnerable to happenings in the big world. With increasing frequency the big world fires thunderbolts at them--the consequences of inflation or recession, of trade and payments disturbances, of population and food problems, or resource problems, of new technologies, of disputes between developed and developing nations, and the conse-

> quences of assorted environmental problems. For a long time movement out along the interaction/ technology continuum seemed to matter little. With the passage of time, however, it has come to matter a great deal, for global processes are thrusting themselves forward. Increasingly the dangers that must be dealt with are produced not by traditional power politics or conflictive actions but by the working of potent, impersonal processes vast in their scope."[234]

We will discuss the implications of the interaction-technology continuum for political analysis at greater length in the Conclusion (see pp.262ff).

The Technological Variable

Technology has always been recognized as a significant variable in social organization and relations. New technological inventions have heralded civilizational change from the time man discovered fire, or stole it from the gods as myth would have it, to the creation of iron and bronze artifacts, or the invention of agriculture and agricultural tools, that signalled the beginnings of new ages. In addition to its peaceful uses, technological invention has always been associated with devices of war. Possession of new technology was a means of achieving power and of effecting changes in power relationships, whether one considers the role of the development of armaments from gunpowder to ballistic missiles and lasers, or the advance in communica-

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[234] Scott, p.11.

tions from the improved use of sailing vessels, to the evolution of space shuttles and satellites.

In the context of international theory, the military aspect of technology was emphasized in the classical paradigm, in line with the prevalent world view of an anarchical world system driven by war, territorial aggrandizement, and power. In the post-World War II era, greater attention has been paid to both the military and non-military aspects of technological inventions. The Sprouts in the 1960's wrote that the political implications of the surge in technological inventions both in the military and non-military areas warranted the consideration of technological factors as "master variables in any political analysis."[235] They pointed out that the world was catapulted into the nuclear age before it had the time to fully assimilate the political consequences of prenuclear technologies and argued that "This holds true not merely for military machines, but also for nonmilitary machines of many kinds as well. We have only commenced, for example, to explore and understand the international implications of printing, photography, radio, television, and other nonmilitary media for influencing the behavior of people." (p.215)

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[235]Harold Sprout and Margaret Sprout, Foundations of International Politics (New York: D. Van Nostrand Company, Inc., 1962), p.214.

The significance of this observation written over thirty years ago is particularly relevant today as we witness the role of the international communications media in the liberation of Eastern Europe and the sweeping changes in the former USSR or in the conduct of the Persian Gulf War. An interesting aspect of the Gulf War was the influence media coverage, especially television, had both on the political and military conduct of the war.[236] In line with this train of thought, the mathematician and scientist John Von Neumann, also writing over three decades ago, forecast that technological changes have the power to alter social and political relationships:

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[236]Television coverage of the Gulf war created a complex instant feedback process which affected both the political and military aspects of the war. On the one hand, coverage involved a worldwide public in the process of continuously monitoring the events of the war on a daily, and indeed minute by minute, basis. Extensive reporting by major networks around the world provided possibilities of immediate viewing and comparison of events from individual and multiple international perspectives, thereby creating sets of information feedback loops. By involving the worldwide public on a continuous instantaneous basis, it enabled that public to judge the events in question in real time and to exert pressure in a variety of ways on governments around the world in relation to the events witnessed. This led to both constraints on how the war was conducted (emphasis by the allied military on civilian damage control, perhaps restraint by Iraq on the use of biological or chemical weapons) and marshalling support for the war effort through information management on both sides of the conflict (e.g. the daily multiple international military briefings by the allied forces; or Saddam Hussein's use of CNN and other foreign and arab media to support, in his words, the "mother of all battles."

> It will, therefore, be necessary to develop suitable new political forms and procedures. All experience shows that even smaller technological changes than those now in the cards profoundly transform political and social relationships. Experience also shows that these transformations are not <u>a priori</u> predictable and that most contemporary "first guesses" concerning them are wrong...[237]

Science and Technology Studies

Based on the preceding discussion, therefore, one might wish to add the technological variable as a primary factor to be considered in political analysis, as well as the concept of the "interaction-technology continuum." The area of science and technology studies is one that is growing in importance as new adherents seek to define its parameters.[238] Those practitioners concerned with developing this area of political study argue that the trial and error methods of past decision making are no longer an adequate means of safeguarding the interests and even survival of human beings. Chernobyl and the effect of unrestrained production of chemical compounds such as fluorocarbons on the ozone layer forcefully brought that lesson to the attention of the inhabitants of the global village. The critical

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[237] John Von Neumann, quoted in Harold Sprout and Margaret Sprout, <u>Foundations of International Politics</u>, pp.248-249.

[238] See, for example: Jon Alexander, ed. <u>Science, Technology and Politics</u> (Ottawa, Canada: Odda Tala Press, 1990).

question they ask is: "how can intelligent decision making take place in a world governed by complex political and technological activity?"

This is the same question that Andrew Scott posed with regard to the interaction-technology continuum, or that Robert Dahl, Hugh Heclo or Alexander King raised with regard to technology's transformation of policy making, whereby non-elected "technology experts" are increasingly called upon by legislators for their advice and thus become influential in determining the direction of the decision making process.[239] Different answers to these questions have been given, ranging from the idea advanced by analysts such as Andrew Scott who suggest slowing down the momentum of

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[239]Robert Dahl raises the question of whether technology is transforming democratic societies into guardianships along the Platonic line, as governance and policy issues have become so technologically complex that only technocratic experts can understand them. Hugh Heclo points to the emergence of policy "technopols," policy professionals who are the only ones equipped to deal with the complex social, environmental, defense, international relations and other problems and who form "issue networks" or groups that defy traditional coalitions and patterns of influence. Based on the foregoing, Anthony King concludes that a "new American political system" has emerged.
See: Robert Dahl, Controlling Nuclear Weapons: Democracy Versus Guardianship (Syracuse, NY: Syracuse University Press, 1985); Hugh Heclo, "Issue Networks and the Executive Establishment," in: The New American Political System, ed. Anthony King (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1978), pp.87-124); Anthony King, "The American Polity in the late 1970s: Building Coalitions in the Sand," in: The New American Political System, ed. Anthony King (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1978), pp.371-95).

technological advance (an extremely difficult if not impossible task) even if this means abandoning certain technologies, to the notion supported by Aaron Wildavsky and others, of promoting technological advance as the ultimate safeguard against technologically induced disasters.[240] We will examine these contrasting views further in the Conclusion.[241]

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[240] See: Aaron Wildavsky, Searching for Safety (New Brunswick: Transaction Publishers, 1988), esp. pp.205-228.

[241] Another view is advanced by the proponents of science and technology studies such as David Collingridge and E.J. Woodhouse who would opt for a four part approach including: (a) thorough initial dissection of issues and analysis of goals, pitfalls and strategies; (b) retention of the possibility of altering or slowing organizational project momentum so as to be able to change or adjust policy implementation; (c) special safeguards in the initial stages in which new technologies are adopted to monitor unforeseen risks that might emerge; (d) continuous supervision of feedback as a learning and control mechanism. They call these strategies "sophisticated trial and error, intelligent trial and error, or low cost learning from experience," which should become part of an as yet undeveloped domain of decision theory. This focus on developing a theoretical approach to science and technology studies is important in helping to clarify the role of technology in socio-political affairs. One might argue, however, that technology itself is so pervasive in all aspects of social life that *it should considered part of any paradigm of political analysis*. In our closely wired, interconnected world, there are few places that can escape its daily influence.
Source: Letter addressed to technology studies colleagues dated March 22, 1991 summarizing their research approach.

The New International Political Economy and Susan Strange's "Eclectic Approach"

A different approach to illuminating the complex interactions in a global reality is advanced by international political economist Susan Strange. The roots of modern international political economy (IPE) reside in the field of international relations. As such, in its post-WWII evolution, early IPE was affected by the classical realist outlook which underpinned the idea of a liberal economic order directed toward maximizing the common wealth. This outlook was also based on the separation in the main of politics and economics, national and international politics. As long as the postwar U.S. economic system was at the basis of the international economy, these transparent divisions did not create major explanatory problems. However, when in the late 1960s and early 1970s under the pressures of rising oil prices and the Vietnam war, the U.S. was forced to retreat from the liberal system envisaged in Bretton Woods and withdrew its support of the gold standard in 1971, it became clear that the divisions between politics, economics, national and international could no longer be maintained. Analyses based on the separation of economics and politics proved to have insufficient explanatory power. Yet, breaking away from the old mindset proved difficult, and both practitioners of international relations and those of international political economy tended to gravitate back toward the old divisions. As Craig N. Murphy and Roger Tooze have pointed out,

> First, the new problems were defined as *international*, that is they were defined as problems located within the relationships of (nation) states and national economics. Second, they were defined as primarily *economic*, that is they were derived, ultimately, from the pursuit of wealth as distinct from the pursuit of power. The problems had only become "political" due to the breakdown of rules and norms. Thus, contemporary IPE began as the study of "the politics of international economic relations" (PIER), and its philosopher's stone became the identification of effective "regimes" that could *de*politicize international economic relations again.[242]

There have been approaches that never accepted these divisions such as those put forth by Marxist and *dependencia* writers, or the adherents to Wallerstein's systems analysis, and the analysts of the new political economy join them in rejecting artificial dichotomies. As they undertake new research agendas, they seek to "shed light on new questions raised by unforeseen changes in the world political economy."[243] The new political economists include writers such as Susan Strange, Robert Cox, Craig N. Murphy, Roger Tooze, Stephen Gill, Robert Gilpin, W. Ofuatey-Kodjoe, and others.

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[242]"Introduction," The New International Political Economy, p.4.

[243]Craig N. Murphy and Roger Tooze, p.6.

Turning now to briefly examine Susan Strange's work, we see that she is committed to developing an "eclectic approach." For her, the first step in this endeavor is to be open to "the concerns and insights of a variety of disciplines."[244] Next she seeks a synthesis which would better reflect the dynamics of change. As opposed to a strictly state-centered view of the exercise of power, she develops a *multilevel* view of the sources of change and how structural power is exercised. Economics does not merely deal with the maximization of wealth but also with the relationships of power. In her view, the determinants of change (i.e.: who gets what, when) in major structures are not only states, but also markets and technology "...although some states have power consciously or unconsciously to shape structures, so do technology and markets. The resulting structures can then create an environment within which states bargain with each other but also within which governments bargain internally with interest groups (social, political, economic), and within which political, and economic interest groups contest the arenas of policy." ("An Eclectic Approach," p.40) The four major structures in which power is exercised are the security, production, finance, and knowledge structures.

[244] Susan Strange, "An Eclectic Approach," in The New International Political Economy, p.33.

Power is exercised in four major structures shaped by states, markets, and technology: the security, production, finance, and knowledge structures. As she indicates, "These four major structures are the intervening variables affecting the range of options open to states, firms, labor unions, or others." (p.38). A focus on one structure be it the state or class is not sufficiently helpful in illuminating an international political economy that consists of multiple structures under the influence of multiple authorities working in accordance with different sets of values.

Strange is interested in differentiating between structural power and relational power and feels that structural power is increasingly more important than relational power. Relational power is what the realists refer to as the power of one party to get another party to do what they otherwise would not. Strange defines structural power as the "power to shape and determine the structures of the global political economy within which other states, their political institutions, their economic enterprises and (not least) their scientists and other professional people have to operate...[it] confers the power to decide how things shall be done, the power to shape frameworks within which states relate to each other, relate to people, and relate to corporate enterprises." (States and Markets, pp.24-25)

She also disagrees with the term interdependence which she considers a misnomer for the post WWII structural changes since these were not symmetrical and did not involve a loss of control by and between state actors. The loss of control that occurred was not between states but rather between states and the world economy: "What had really happened that was in the long run more significant was that the name of the game for most states and for an ever larger number of economic enterprises had changed. The name of the new game was competition for world market shares. Only by winning and holding on to a good share of world markets for high value-added goods and services could the governments of states --or the management of firms-- survive successfully." ("An Eclectic Approach." p.41) In this she takes issue with writers such as Stephen Krasner or Keohane and Nye as they focused on international regimes or "issue areas" mainly in relation to states as opposed to changes in economic power and structures. In her mind, the Keohane and Nye framework

> only takes structural power in at secondhand as it were, by looking at the rank ordering of states in international regimes or organizations. This will often mirror the relative importance of states in the world economy. But it only reflects the structural power of states, not of other entities; and it can often be a rather distorting mirror, as when some states are excluded from an organization for historical or political reasons

> or when voting systems reflect a power distribution of the past rather than the present.[245]

She considers the scholars most closely related to international political economy to be guilty of astigmatism, as the economists have not paid sufficient attention to political power, political scientists have focused principally on how power is exercised within the state, and the international relations writers have failed for the most part to go beyond the relation of power between states: "Too often, they have ignored or refused to contemplate structural power, or the power to define the structure, to choose the game as well as to set the rules under which it is to be played." (States and Markets, p.37)

A third step in expanding this eclectic approach would be to recognize "the role of firms in the evolution of structures...Firms are becoming important to states both in alliance with governments and in conflict and competition with them." ("An Eclectic Approach." p.40) Since the success

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[245] States and Markets, p.38. While recognizing the influential nature of the Keohane and Nye study Power and Interdependence, she feels that as the study discussed Canadian and U.S.-Australian relations in the issue areas of money and ocean management, "it listed the change in states' relative political power, or in other words the political structure, as a possible explanation for regime change, but omitted changes in economic power and in economic structures, paying attention only to economic processes, which was a much narrower factor altogether." (p.21)

and survival of states has become increasingly linked with the economic factor of gaining adequate or superior market share which is achieved through the activities of firms (as is evident in the case of the collapse of the former Soviet Union and Eastern Europe), Strange indicates that this has led to two new types of diplomacy: between governments and firms and, the secondly, between firms. As against past bargaining between governments and firms which were largely related to questions concerning natural resources, this new bargaining affects more aspects of the firm's activities and is conducted not only at the federal level, but also at the state and local levels. As she indicates, "For many states, industrial policy making is more critical than foreign policy making. A government must negotiate over the conditions by which it gives market access to the FOF [Foreign Owned Firm], and over the conditions by which the enterprise collaborates in supporting and furthering macroeconomic or macrosocial policies." ("An Eclectic Approach," p.43).

Since firms that operate on a global scale have more choices as to where to create new plants, governments must also be able to make the case that they can provide attractive locations for production, what Strange calls the "infrastructural efficiency of the host country. This *involves not just the efficiency of its transport and* communications system but equally the efficiency of its educational system and its administrative competence in processing requests for, for example, import licenses or profit remittances." ("An Eclectic Approach," p.45) The evolution of this new dimension of policy between states and firms has led to an increased influence of firms on government policy, as we saw in the case of Hughes Aircraft Company and the Long March booster decision which changed decades-old technology transfer and trade policy. Strange cites other significant examples such as the pressure of European firms for the creation of a unified European market, or the effect of the concerted divestiture of foreign firms in South Africa which helped contribute to the end of apartheid.

The third dimension of global diplomacy highlighted by Strange is that conducted between firms which has resulted in a series of international alliances. We saw this happen in the case of Hughes Aircraft which allied itself with Australian and British/Chinese interests and firms, or conversely in the case of the U.S. launch companies like Martin Marietta which found itself on the same side as the French company Arianespace in opposing the Long March decision. Strange points to the large number of corporate alliances that took place in the 1980s which included AT&T and Olivetti, Daimler-Benz and Mitsubishi and others. Though not always successful, alliances are still growing as companies detect new opportunities and markets that require multidimensional cooperative ventures.

As mentioned earlier, Strange indicates that not many have focused on the changing roles of firms and states on the global stage. In her opinion, political scientists, economists and business schools need to broaden their perspective so as to encompass this new reality of global "bargaining" and diplomacy in their analyses. As she writes,

> Firms, like states, play a role in markets and in technological development. Like states, they are affected by change in any of the four major structures, and can sometimes deliberately or unwittingly restrict, or enlarge, the range of options open to policymakers in government and in other firms. Or conversely, their own options may be enlarged or restricted. Analyzing which, and how, is the task of IPE. (p.48)

Chaos Theory

A final promising multidimensional approach to understanding turbulent reality is afforded by an evolving theory in the sciences called "chaos theory." Breakthroughs achieved in understanding the behavior of complex dynamical systems in the natural sciences are being applied in the social sciences and are affording new insights into the vital interplay of natural and social forces. The "chaos" in chaos theory denotes a *bounded irregularity* which is why it is sometimes referred to as "deterministic" chaos. Chaos theory seeks to deal with the nonlinear aspects of reality. One of the basic assumptions at the heart of the theory is that due to feedback and "sensitive dependence on initial conditions," long-term prediction is not possible.[246]

Research in this area is occurring under a broad theoretical umbrella encompassing a variety of disciplines and fields in both the natural sciences and the social sciences. Chaos theory has been called one of the three major paradigms of the twentieth century in the physical sciences, the other two being relativity and quantum mechanics. Since it directs its attention toward the complex aspects of existence, in so doing, it crosses and unites scientific disciplines. Practitioners of chaos research, which with new advances in computers began acquiring momentum in the 1970's, include medical doctors, physicists, chemists, biologists,

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[246]For a perceptive and illuminating treatment of chaos theory, see: James Gleick, Chaos: Making a New Science (New York: Viking Penguin, Inc., 1987); John Briggs and F. David Peat, Turbulent Mirror: An Illustrated Guide to Chaos Theory and the Science of Wholeness, illustrations by Cindy Tavernise (New York: Harper & Row, Publishers, 1989); Ilya Prigogine and Isabelle Stengers, Order Out of Chaos: Man's New Dialogue With Nature, forward by Alvin Toffler (Paris: Editions Gallimard, 1979); Saul Krasner, The Ubiquity of Chaos (Washington: American Association for the Advancement of Science, 1990); Ian Stewart, Does God Play Dice? The Mathematics of Chaos (Cambridge, MA: Basil Blackwell, 1989); Benoit B. Mandelbrot, The Fractal Geometry of Nature (New York: W.H. Freeman and Company, 1977, 1983).

psychologists, economists, political scientists, and philosophers.

In the area of politics, the progressive feedback between the physical and social sciences has led to the experimental application of concepts in chaos theory to new models designed to illuminate political decision making and events. Chaos models have been developed to analyze the outbreak of war, the arms race, and strategic decision making.[247]

In times of turbulence, such as the world is experiencing at present, the concern with order and change becomes more pressing. The current focus on order in social science research, however, is basically a holdover from the classical Newtonian "clockwork universe" world view, subsequently handed down to us through the Enlightenment.[248] In brief,

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[247]See, for example: Alvin Saperstein, 1988, "A Nonlinear Dynamical Model of the Impact of SDI on the Arms Race," Journal of Conflict Resolution, 32:636-670; ______, 1984, "Chaos--a Model for the Outbreak of War," Nature. (24 May) 309: 303-305; Diana Richards, 1990, "Is Strategic Decision Making Chaotic?. Behavioral Science. (July) 35: 219-32.

[248]The term "clockwork universe" refers to a model of reality based on predictable, time reversible laws that emerged during the Enlightenment. The classical concept of reality with its chained sequence of cause and effect combined with the ideas of Newtonian mechanics and led to the view of a universe that performed with clockwork periodicity. It embraced the notion that phenomena could be assembled and

(continued...)

one might say that this mechanistic world view rested on the assumption that (a) linear universal laws like those Newton discovered with respect to motion and change govern the universe; (b) time is reversible: past and future are linked in direct linear terms; (c) therefore, if we could collect enough information concerning initial conditions, the complete understanding of the laws governing the universe and the prediction of future events might be attained. This Laplacian[249] faith in the capacity of the human mind to understand and predict events through the accumulation and analysis of data was adopted by and became a main, and often unquestioned, assumption in social science research.

A certain kind of order is central to political life and indeed to all of life. The concept of order advanced by the Enlightenment, however, has evidenced severe limitations in explanatory power when applied to dynamical, complex systems (such as the ones we see in the natural world) which are

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[248](...continued)
disassembled into their component parts through the methods of scientific inquiry and is reductionist in maintaining the universe can be understood in terms of its basic components.

[249]The French scientist and mathematician Marquis Pierre Simon de Laplace (1749-1827) conducted work on celestial mechanics and probability studies. He endorsed the idea of the clockwork universe and maintained that should a demon exist who could know all of the initial conditions affecting the universe, this demon could in principle arrive at total knowledge of past and future. The concept of the possibility of prediction based on the accumulation of data concerning initial conditions was thus affirmed.

characterized by turbulence and change. In the second part of the twentieth century, however, a new (or rather ancient) concept of order has come to the fore. Scientists and researchers working in areas ranging from the natural and physical sciences to the social sciences, have increasingly turned their attention toward achieving an understanding of real world dynamical systems, in which disorder or turbulence are the central elements. Aided by the development of powerful new computer technologies in the second half of the twentieth century, they have focused on a holistic approach to understanding reality in which disorder is seen as the principal governing element in nature and not an aberration to be relegated to a less important plane or even factored out of the analysis. In their view, it is through a "deterministic" or "bounded" chaos that a new and different order arises. Disorder thus assumes the creative aspect it was endowed with in antiquity.[250]

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[250]The creative aspect of Chaos may be seen in different mythologies. In Hesiod's Theogony (8th century B.C. circa), Chaos was the primary entity out of which Heaven and Earth, gods and men were created, giving rise to new orders of being. In the ancient mythologies of Egypt and Mesopotamia, the primeval waters of Chaos were seen to give birth to the world. The fertilizing annual flood of the Nile is thought to have, among other things, given rise to the concept of the God Nun, who was considered to be a creative primeval ocean. As opposed to the positive idea of chaos in Egyptian mythology, Mesopotamian mythology views chaos from a more pessimistic and darker viewpoint. The Mesopotamian primeval ocean, conceived as the Great Mother Ti'amat, produced so many monsters and gods that it required the intervention of the Champion of the Gods, Marduk. The latter was able to overcome (continued...)

Could a focus on an order of a different nature, one that is shaped by disorder or turbulence, provide a more powerful theoretical model in dealing with the rapid, technology driven changes affecting our highly interdependent global village? Contrary to Laplacian optimism, in such a model long-term prediction is unattainable, given the discontinuous, nonlinear elements which compose a shifting reality shaped by feedback and turbulence. However, if prediction is for the most part unattainable, has the social scientist then lost his main *raison d'être*? How does this affect the kinds of questions (s)he might ask and therefore answers (s)he might receive? What kind of policy analysis will (s)he be able to undertake? We will examine these and other aspects of the theoretical dilemma posed by the turbulent reality of our times in our concluding chapter.

Conclusion

In the preceding pages, we looked at a number of different approaches that have evolved in response to our complex end-of-century reality. While differing in form and content, each approach maintained the need for a multidimensional analysis of reality. Each approach highlighted the highly integrated nature of life in the global village and

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[250](...continued)
the powers of chaos, kill Ti'amat, and create the universe out of her body.

proposed different ideas for dealing with the challenges posed by interaction of apurposive political, economic, and natural forces that are largely uncontrollable by any single nation. We saw how Andrew Scott highlighted the interaction-technology continuum, how the technological variable has acquired a fundamental place in socio-political analysis, and how Susan Strange proposed to deal with an unpredictable and rapidly changing global reality through an "eclectic" multidimensional approach. Finally, we briefly touched on chaos theory, a new theory that is being developed across a variety of disciplines, which addresses the problems of nonlinear reality that is highly sensitive to initial conditions and affords new explanatory possibilities. In our concluding remarks, we will further discuss space policy, civilizational transitions, and the new role of the social scientist faced with an ultimately unpredictable turbulent reality.

CONCLUSION. CHANGE AND THE ROLE OF THE SOCIAL SCIENTIST

> *... the world has now moved beyond economic interdependence to ecological interdependence--and even beyond that to an intermeshing of the two... This is the new reality of the century, with profound implications for the shape of our institutions of governance, national and international. It raises fundamental questions about how economic and political decisions are made, and their implications for sustainability.*
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> *J. MacNeill, P. Winsemius, T. Yakushiji*[251]

> *Existence has always been a fight and will forever be one. The goal of life is not and cannot be a continuous improvement of conditions because if conditions become better, the people become worse. The only sensible goal can be the increase of understanding and wisdom.*
>
> *Carl Gustav Jung*[252]

In the course of this study, we discussed the problems and future possibilities that characterize the U.S. space

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[251]Jim MacNeill, Pieter Winsemius, Taizo Yakushi, Beyond Interdependence: The Meshing of the World's Economy and the Earth's Ecology (New York: Oxford University Press, 1991), p.4.

[252]Excerpt from "The Myth of the Liberal Dictator," an unpublished letter written in 1939 to a young man in Kansas who asked Jung's opinion on whether a liberal dictatorship might provide a more viable form of government. As part of his answer, Jung warns that the Nazi and Fascist youth "within one generation ...will be thoroughly sick of the stuff that is preached to them and the political outlook with them will change considerably. Now of course they are all drunk with the noise of the day." With regard to the idea of a liberal dictator, he continues, "There is no such thing as a liberal dictatorship, because a dictator just can't afford to be liberal....It surely would be very nice to have an intelligent, benevolent and omniscient government, but most of the people are neither intelligent nor benevolent, nor sufficiently informed to be good rulers."
The New York Times, January 3, 1992, p.A27.

policy sector. We noted how there is a correlation between theoretical outlook, or the lack thereof, and the nature of decision making. Fragmentation and deficient vision in the theoretical field, we have seen, is mirrored in the *ad hoc* discontinuous aspect of practical decision making. The close relationship between theoretical and policy fragmentation may be discerned in a variety of other science and social science areas as well.

In the first part of this study, we sought to view space policy in terms of its interconnection with human socio-economical, political and national security interests. We noted that while the importance of man's activity in this area has steadily grown over the past three decades, both from a military and civilian point of view, the space variable has not been fully integrated into a multidimensional policy analysis. In an attempt to go beyond the fragmentation present in the policy literature, we sought to give an overview of the whole space program, discussing its military *and* civilian aspects. We also endeavored to provide a multidimensional time frame as we traced the genesis and development of U.S. space policy through superpower rivalry and competition. In the course of the *macro* overview of the field, we sought to identify problems in policy making so as to better understand the policy environment and the possibility for a different approach to future policy making. We noted how some of the problems with the space program included (a) a "reactive" stance to space decision making which cast the space program essentially in the guise of a competition with the Russians; (b) this "reactive" stance in turn did not provide clear grounds for an orderly technological development in the field but rather subjected long-term high technology programs to the vagaries of short-term political and social ends; (c) lack of long-term vision and of comprehensive planning for unexpected events, led to policy failures such as the decision to create a shuttle without a specific long-term mission and then, to ensure its financial viability, to make it the only launch system for all U.S. payloads, both civilian and military, with a series of cascading negative consequences for both the military and civilian sectors. Fragmentation in vision, therefore, resulted in discontinuity in policy design, implementation, and funding.

Through our <u>micro</u> analysis of a specific policy decision involving the Long March boosters, moreover, we saw how the space policy decision taken in the early 1970s by the Nixon administration to have the shuttle undertake all launch functions led to a national security crisis with a shuttle failure and delayed the development of the private U.S. commercial launch space industry. As a series of consequences impinged on one another through complex feedback processes, a threshold of change was reached whereby the West came to accept a closer relationship in the high technology area with a non-free market Communist economy. We have not concentrated on prediction but rather on analyzing the multiple forces at work and their feedback processes both from a long-term and a short-term point of view. Our focus has been on the interaction of events so as to obtain a better understanding of how *thresholds of change* are reached. As opposed to the aim in the classical paradigm, this endeavor is not directed at tracing linear chains of causality which can then be subjected to hypotheses and testing according to the rigorous scientific method employed in the natural sciences. In accordance with the requirements of nonlinear models, such as chaos theory, the end in this instance is to increase "intuitions about how the system works" so as to "interact with it more harmoniously."[253]

As we noted earlier, it may be that the long-term policy decisions required by sophisticated science and technology programs, such as in the case of civilian or defense space systems, are particularly difficult to make in a democracy. Political leaders tend to respond to current problems and fiscal constraints, especially if they wish to continue in

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[253]See the full passage quoted on p.? from: John Briggs and F. David Peat, Turbulent Mirror: An Illustrated Guide to Chaos Theory, p.175.

office beyond the next election. Science and technological projects, on the other hand, often demand very long lead times, in some cases even beyond the lifetimes of the political leaders who make them and of part of their constituents.[254] To undertake the hard choices required by long-term scientific and technological projects therefore requires a great deal of vision and a profoundly intuitive sense of where history may or should be directed. It also demands courage and the ability to argue the case before the electorate that funds should indeed be allocated to projects whose value will not become fully apparent until some time in the future. On the other hand, one might contend that it is best that it should be this way since it forces both political leaders and constituents to think options through and to arbitrate between the pressures of divergent interests more carefully than would otherwise be the case.

With regard to recent directions in space policy, during this turbulent era of rapid change and difficult economic times, the Reagan and Bush administrations opted for an agenda that in retrospect for the most part seems to have been suited to what French historian Fernand Braudel would call the "deeper currents" of historical development (while,

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[254]The U.S. Mars expedition, for example, is currently scheduled to take place almost thirty years from now, in 2019.

for example, the Nixon administration with its exclusive focus on the shuttle did not). Such policies do not occur, of course, without trade-offs vis-a-vis other social or scientific programs. President Reagan's Strategic Defense Initiative had both its supporters and very vocal detractors from the time it was put forward in 1983 to date. Yet today, as we learn more about the advanced research undertaken in the area by the Russians and as the propagation of technology has led to increasing proliferation of space systems, the necessity of having adequate strategic space defense monitoring systems is becoming more apparent.

An example of the interrelated nature of politics, science, technology, and national security may be seen in a curious twist of historical irony as research in the Strategic Defense Initiative area may now be used to further a "planetary defense system" against the threat of possible collisions with large asteroids. Scientists have begun to focus more intently on the dangers posed by the possible impact of a massive asteroid against the earth's surface, which apart from the devastation it would cause in the immediate area of contact, might raise enough dust into the atmosphere to create a nuclear winter on earth and annihilate civilization as we know it today. Close fly-bys by asteroids that cross the Earth's orbit are apparently not uncommon. Scientists estimate there may be 1,050 to 4,200 asteroids that intersect the Earth's path which have diameters above 0.62 miles. An impact of an asteroid of such magnitude has the potential for causing significant damage to life on earth.[255] Although the small ones are destroyed upon entry into earth's atmosphere, larger ones succeed in penetrating the atmosphere without disintegrating. At their high speed of travel, an impact becomes equivalent to a large nuclear explosion. A number of experts believe that such a collision, by inducing a nuclear winter, may have killed the dinosaurs and over 60% of other life forms on the planet 65 million years ago. More recently, at the beginning of the twentieth century in Siberia, scientists think an impact occurred that created the effects of a nuclear detonation in the area. In order to divert the orbit of any threatening asteroid, it is thought that high explosive charges delivered to the target in space might be utilized, which comes primarily within the purview of the research undertaken by the Strategic Defense Initiative Organization.[256]

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[255]See: William J. Broad, "Asteroid Defense: 'Risk Is Real,' Planners Say," The New York Times, Science Times, April 7, 1992, pp. C1, C7.

[256]In 1990 Congress instructed NASA to study the probability and danger of a possible collision with a large asteroid, based on an uncomfortably close fly by of a large asteroid in 1989. The asteroid in question crossed the earth's orbit at a point where the planet had been only six hours earlier. An impact with such a large body, in addition to the physical damage that would be caused by the collision which would be similar to a powerful nuclear explosion, would also likely unleash tidal waves, and send a lot of particles

(continued...)

The Bush administration, as we indicated, put into motion an extensive overhaul of the U.S. space program, articulating new directions in line with a vision of future evolution of society. In the aftermath of the soul-searching that followed the Challenger disaster, and investigations into its causes undertaken by President Reagan, the Bush administration commissioned broad-based studies such as the Augustine Commission report and the Stafford Commission re-

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[256](...continued) into the atmosphere creating the conditions of a nuclear winter, with concomitant changes in the world's climate leading to crop failures on a massive scale, probable starvation and a host of other life-negating consequences. The NASA team, comprised of 100 distinguished scientists from government and universities both from within and outside of the agency, released a report on March 29, 1992 in which they conclude that while the chances of impact are statistically small, they are real. Given the deadly results of any such impact, the team recommended the creation of a world-wide sky watch network of telescopes to identify and track any approaching asteroids. The network, which would comprise about 6 telescopes, would probably cost around $50 million to create and $10 million yearly to operate, which would be shared on an international basis. It also suggested further study on how to avert an impact should such a contingency arise, intimating that a large explosion in space would probably be necessary to either destroy the object or divert its orbit away from Earth. As quoted in The New York Times, the report concludes that "the probability of a major impact during the next century is very small...But the consequences of such an impact, especially if the object is larger than about one kilometer in diameter, are sufficiently terrible to warrant serious consideration." See: William J. Broad, "How to Break a Date With Doomsday," The New York Times, April 1, 1992, p.A18. Also: "In Orbit: Heading Off the Big One," The New York Times, The Week in Review, April 5, 1992, p.5; and William J. Broad, "Asteroid Defense: 'Risk Is Real,' Planners Say," The New York Times, Science Times, April 7, 1992, pp. C1, C7.

ports,[257] to identify problems in the space program as it had developed over the past thirty-plus years and options for their resolution. Through an examination of ideas from different sources, it sought to define an improved space program and create the consensus for its successful implementation. Despite criticism and tight budgets, it patiently sought to steer the nation toward that vision. It will remain for history to judge whether the direction was in line with the evolution of human civilization and for the Clinton administration to direct a clear course for the future, taking into account the multidimensional aspects of space activity as it forges new policies.

In the second part of this study, we discussed the theoretical problem involved in the fragmentation and sense of failure that is pervasive in theoretical analysis. We traced that fragmentation back to a Newtonian mechanistic world view, focused on prediction, that was unable to satisfactorily explain the dynamical processes of the world of nature. This Enlightenment world view was mirrored in the realist paradigm of reality. The reason for this, as we will discuss further below (see p.259ff.), is that the Newtonian approach was essentially based on a "closed" system governed by conditional parameters such as one might have in a

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[257] See Chapter Nine, pp.120 ff.

laboratory. In such a system, as in the case of our solar system, change is slow and linear laws may be applied. However, scientists in the past have taken exception to the universal validity of the Newtonian approach to gravity in terms of an attraction between two bodies and Henri Poincaré showed that the addition of a third body in the Newtonian system would lead to a chaotic evolution in his calculations.[258]

Today, we have increased acceptance of the fact that earthly systems are "open" as opposed to closed laboratory situations. In open systems, change can be rapid and initial conditions are constantly subjected to feedback and iteration which make long-term prediction impossible. Those analysts, therefore, who would try to impose linear cause and effect models on reality and attempt to achieve long-term predictions on this basis are bound to see their efforts fail.

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[258]Scientists are currently postulating that the solar system is chaotic and that the Moon may serve as a stabilizing factor and impede fluctuation of the Earth's orbit. See: John Noble Wilford, "Moon May Save Earth From Chaotic Tilting of Other Planets," The New York Times, March 2, 1993, p. C9 (Science Times). As Wilford writes, "The relatively new science of chaos explores the connections between different kinds of irregularities. Motions in nature, like flowing water, jagged lightning strokes, and cloud formations, may appear random and disorderly, but on closer examination, can be seen to be quite deterministic, since their motions are fully determined by preceding events in accordance with physical laws. Only recently have high-speed computers enabled scientists to conduct the lengthy, complex calculations that revealed the chaotic motions of planets."

In contrast to predictive state-centric models which are not suitable for nonlinear dynamical processes, in the second part of this study we identified certain new approaches that seek to deal with turbulent reality and accommodate nonlinearity. Given the highly interactive and changing reality of our present times, the realist paradigm in political science, based on division between domestic and international politics and economics and politics became increasingly ineffective in its attempt to illuminate reality. In addition, the emphasis on dividing complex reality into smaller and smaller areas so as to better comprehend it --so much a part of the scientific outlook of the Enlightenment based on the clockwork universe linear model-- became increasingly incapable of depicting a highly interdependent and interconnected world system. That approach might have been more successful in situations in which change is slow among discrete and distant state entities but was destined to fail in the closely wired modern world arena in which change is governed by accelerating technological advance and feedback.

The new approaches we highlighted which seek to deal with this new reality include the multidimensional perspective of the interaction-technology continuum, which can help direct our focus toward those apurposive forces that are unleashed when myriad human actions aggregate and combine in the global village, the eclecticism of the new international political economists, and promising prospects from the vantage point of chaotic dynamics. We indicated how these approaches, in the words of Kenneth Waltz quoted previously, involved the "depiction of the organization of a domain and of connections among its parts" and would link "otherwise disparate facts" into an interrelated whole.[259]

The Arguments for a Multidimensional Approach

Beyond the analysis of a specific policy sector, however, the aim of this inquiry was to search for the theoretical underpinnings that might afford a more coherent guide to policy making in tune with the turbulent, science and technology driven reality of our times. The study argues for the need to achieve a unitary vision and a new awareness of the close relationship between theoretical outlook and practical policy results. It suggests that greater consonance between the theoretical and the practical might lead to improved policy formulation. In our discussion, we have sought to highlight the nonlinear nature of contemporary reality and the necessity of adopting a holistic multidimensional approach to better understand that reality. Through an analysis of a specific policy sector --space policy-- we

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[259]Theory of International Politics, pp.8-10.

have endeavored to illustrate the broader assumptions laid out in our introduction that (a) a multidimensional systems perspective is preferable to a highly specialized, fragmented, one-dimensional analysis and may provide a fruitful matrix for approaching complex systems reality; (b) the scientific and technological variable should be an integral part of any political science analysis; (c) the globalization of domestic decision making has to a large degree abolished the distinction between national and international affairs (see p.17).

We departed from the premise that political analysis is anchored to a theoretical view of reality, or, as in the words of Keohane and Nye, "... theory is inescapable; all empirical or practical analysis rests on it."[260] In the words of astronomer Lloyd Motz, "the true [scientific] genius is guided by theory rather than by 'facts' or 'data,' whose veracity is questionable. Indeed, we can interpret a 'fact' only if we have a correct theory to guide us; 'fact' thus rests on theory and not the other way around."[261] The view of the phenomenal world changes or is revolutionized as human consciousness comes into contact with new realities and it expands or is modified through successive bifurcations and

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[260] Power and Interdependence: World Politics in Transition, p.4.

[261] Lloyd Motz, Letter to the New York Times dated January 25, 1990, The New York Times, February 13, 1990, p.A24.

metamorphoses in a continuous feedback process. Facts that are not correlated through the connective fabric of theory remain isolated events divorced from a contextual context that can give them comprehensive meaning.[262]

We observed that while in earlier times man was seen to contain a spark of the divine or eternal which eventually would realize its full potential --however that end might be defined-- the advance of scientific horizons in the seventeenth through the nineteenth centuries reduced man to a speck in the universe. With the advent of Darwinism, he was no longer considered separate and superior to other animals, but a cog in the universal struggle for survival. Within this context, outside social relations were perceived as anarchical and, in political terms, *might* became the determining factor of what was *right*. The interests of the newly

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[262]It should be noted, nonetheless, that theory is only one of the ways of comprehending reality. As in the words of Herman Weyl, reaffirmed by Prigogine, "Scientists would be wrong to ignore the fact that theoretical construction is not the only approach to the phenomena of life; another way, that of understanding from within (interpretation), is open to us...Of myself, of my own acts of perception, thought, volition, feeling and doing, I have direct knowledge entirely different from the theoretical knowledge that represents the 'parallel' cerebral processes in symbols. This inner awareness of myself is the basis for the understanding of my fellow-men whom I meet and acknowledge as beings of my own kind, with whom I communicate sometimes so intimately as to share joy and sorrow with them."
See: Herman Weyl, Philosophy of Mathematics and Natural Science (Princeton, NJ: Princeton University Press, 1949), quoted in Prigogine, Order Out of Chaos, p.311.

evolving nation-states came to rest on territorial size and military force.

We noted, moreover, that the classical world view handed down to us by the Enlightenment was based on the concept of the linearity of cause and effect. There was the Laplacian belief that the human mind could some day arrive at a more comprehensive understanding of the world because the whole was the linear sum of its parts. Conversely, it was felt that by studying the fragmented part, and identifying as many initial conditions as possible, one could achieve a vision of the whole.

Today, while man is still adrift in cosmic postmodern relativity, a shift has occurred in the human perception of change. There seems to be a growing feeling that at least in the case of open systems (i.e., outside of the controlled situation in a closed laboratory), the whole is no longer the *linear* sum of its parts but rather the product of the dynamic interrelationship of many diverse factors which can lead to unpredictable results based on the interrelated nature of world processes, sensitivity to initial conditions, and feedback. Through the work of chaos theorists, there is also renewed adherence to the ancient idea that flux and disorder are not completely random and incomprehensible, but that they generate their own new orders at successive thresholds of Change or Becoming.

Although the teleological view of universal evolution has fallen by the wayside, a new view of the *interconnected* nature of phenomena has emerged. Because of sensitivity to initial conditions, and if a fragile butterfly by flapping its diaphanous wings can change weather patterns around the world, then the importance of the role of the individual is newly affirmed. In this context, individual action can and does make a difference. Given the interconnected nature of social, economic and political reality, it can be argued that a framework based on multidimensionality and interdependence may most accurately describe the current world situation. At the same time, that very interrelatedness intensifies feedback and amplifies the complexity and nonlinear asymmetry between causes and consequences, input and outcome, whereby the aggregation and interaction of events leads to unintended or unanticipated results. It confirms what chaos theorists have pointed out, that a reality based on the aggregation and combination of nonlinear events, which characterize both the world of nature and that of man, is ultimately unpredictable.

The Purpose of the Social Scientist

If natural and human events are in the long run unpredictable, what then is the purpose of social science analysis? Most current political analysis is married to the classical idea of linear prediction. Researchers study *causes* and from them hope to deduce *effects* and policy recommendations. If reality is unpredictable, does this negate the value of social science analysis? Or should we try to adjust our mental or theoretical outlook to accept the fact of ultimate unpredictability and seek another justification and methodology for social science research? Varied answers may be given to this basic problem underlying contemporary political analysis. To illuminate the diverse facets of this issue, we will examine the answers proposed by three different social and political thinkers of our times: Karl Popper, Andrew M. Scott, and Aaron Wildavsky. We will seek to determine whether (to paraphrase Alvin Toffler in a different context)[263] we have perhaps been focusing on getting the right answers to the wrong questions based on a one-dimensional linear approach as opposed to a multidimensional nonlinear one.

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[263] In referring to a Marxist phase during his youth, and to the importance of asking fresh questions, Toffler writes: "I, like many young people, thought I had all the answers. I soon learned that my 'answers' were partial, one-sided, and obsolete. More to the point, I came to appreciate that the right question is usually more important than the right answer to the wrong question."
The Third Wave (New York: Bantam Books, 1980), p.6.

Karl Popper and the Nature of Scientific Prediction

Firstly, let us turn to Karl R. Popper's view of the role of the social scientist within the context of an unpredictable world. His outlook emerges clearly through his critique of historicism, which rests on the idea of historical prediction. Popper defines as "historicism" the doctrine that the aim of the social sciences should be to propound prophecies which are necessary for the rational conduct of politics. Though espoused by Marx in his theory of scientific socialism which sought to predict social revolution, Popper indicates this doctrine is characteristic of modes of thought that would see a plot in the unfolding of history. Those who can decipher the plot, moreover, are seen to "hold the key to the future."[264] As such, the concept goes back to antiquity. Popper proceeds to attack historicism and advances a different concept social science research.

In Popper's mind, the historicist approach to reality is "a relic of an ancient superstition, even though the people who believe in it are usually convinced that it is a very new, very progressive, revolutionary, and scientific theory." (p.276) The reason for this is that they do not distinguish

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[264]Karl R. Popper, "Prediction and Prophecy in the Social Sciences," address delivered to the Plenary Session of the Tenth International Congress of Philosophy, Amsterdam, 1948, in Theories of History, Patrick Gardiner, ed. (New York: The Free Press, 1959, 1964), p. 278.

between the conditional nature of scientific prediction and the dynamical--what he terms "unconditional"-- nature of social life:

> Ordinary predictions in science are conditional. They assert that certain changes (say, of the temperature of water in a kettle) will be accompanied by other changes (say the boiling of the water). Or to take a simple example from a social science: Just as we can learn from a physicist that under certain physical conditions a boiler will explode, so we can learn from the economist that under certain social conditions, such as shortage of commodities, controlled prices, and, say, the absence of an effective punitive system, a black market will develop.
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> Unconditional scientific predictions can sometimes be derived from these conditional scientific predictions, together with historical statements which assert that the conditions in question are fulfilled. (pp.278-79)

Unconditional situations are ones that lie outside of the controlled laboratory environment, such as those in normal social existence. Another way of describing an unconditional or unregulated situation would be to call it "chaotic" in the "bounded" sense the term is used by chaos theorists. Popper maintains that the historicist, despite claims to the contrary, can derive historical prophecies from conditional scientific predictions only if they refer to environments that demonstrate the properties of a closed system-- slow mobility of change and recurrence:

> My contentions are two.
> The first is that the historicist does not, as a matter of fact, derive his historical prophecies

> from conditional scientific predictions. The second (from which the first follows) is that he cannot possibly do so because long term prophecies can be derived from scientific conditional predictions only if they apply to systems which can be described as well isolated, stationary, and recurrent. These systems are very rare in nature, and modern society is surely not one of them. (p.279)

Our solar system reflects such characteristics because it is not subject to severe perturbations from other outside systems. However, as Popper points out, "Contrary to popular belief, the analysis of such repetitive systems is not typical of natural sciences. These repetitive systems are special cases where scientific prediction becomes particularly impressive--but that is all." (p.279) Given the slow evolution of biological systems, Popper indicates that predictions can be made concerning biological life cycles by treating the systems as stationary much in the same way as our solar system can be treated as such.

Since human and social affairs are subject to continuous and often rapid change, and the chances of exact repetition are remote, what then is the social scientist to do if prophecy is not possible?[265] What is his/her role in ana-

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[265]Popper accepts the fact that insofar as repetition does occur in history, conditional prediction is possible. He points to often similar conditions in the way religions or tyrannies arise from which one might be able, by examining past occurrences, to forecast the conditions under which they (continued...)

lyzing social reality? Does this diminish the social scientist's importance to the world of theory, politics, and policy? In effect Popper's answer is very much in line with Andrew M. Scott's and Aaron Wildavsky's as all base their reflections on the problem of the unpredictable nature of flux and change. For Popper, the main task of the social scientist is that of charting the unintended consequences of human action:

> ...the main task of the theoretical social sciences ...[is] to trace the unintended social repercussions of intentional human actions. I may give a simple example. If a man wishes urgently to buy a house in a certain district, we can widely assume that he does not wish to raise the market price of houses in that district. But the very fact that he appears on the market as a buyer will tend to raise market prices. And analogous remarks hold for the seller...(pp.281-82)

The end of the social sciences, according to Popper, is not prediction. Instead, they can serve as a means of reaching a *better understanding of possibilities for action and decision making*: "[the social sciences] may give us an idea of what can, and what cannot, be done in the political field." (p.282) The role of science in social life is "the modest one of helping us to understand even the more remote conse-

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[265](...continued) might arise once more. But he argues that the most important or "striking" instances of historical change are "non-repetitive." He concludes that "The fact that we can prophesy eclipses does not, therefore, provide a valid reason for expecting that we may predict revolutions." (pp.279-80)

quences of possible actions; in other words, to choose our actions more wisely." (pp.282-83)

Andrew Scott and the Growing Problem of Apurposive Global Forces

Turning now to Andrew M. Scott, we saw earlier in Chapter Two how in his work The Dynamics of Interdependence he also focuses on the unpredictable nature of social life.[266] For Scott, the interaction of natural processes has been amplified and merged with forces and processes set in motion by human beings in an ever escalating *interaction-technology continuum*. As the international system reaches new levels of complexity and interaction, small problems or quantitative changes that aggregate with other factors can suddenly trigger large and often unpredictable *qualitative system change* which, if severe enough, could produce catastrophic results. Our current problems with the ozone layer or with potentially destructive global warming due to uncontrolled emission of gases into the atmosphere are but two examples. Scott points out that people, however, are still prone to think in terms of low level cause and effect categories, and they thereby commit what he calls the "intentional fallacy," that is, they largely attribute outcomes in the global village directly to the intentions of

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[266]See pp.218ff.

the actors. Those who engage in this fallacy, according to Scott,

> presume a world in which aggregation, combination, and the production of inadvertent outcomes can safely be disregarded. They assume, that is, a pre-twentieth century global system in which there are relatively few actors, few actions, and in which technology has not bound the parts closely together. In that earlier world the purposes of actors were indeed important. Apurposive processes did not then play the role they now do, and events could therefore be explained in terms of actor purposes without doing serious violence to reality. Unfortunately, that simpler world has become more distant with each decade of this century. (p.38)

The real danger, according to Scott, is that human beings are creating forces that they can neither control nor manage safely because on the one hand they cannot grasp the totality of the vast chain reactions set in motion by a variety of uncoordinated individual actions and, on the other, because nations still base their policies on often short-term _national interest_ as opposed to short or long-term _global interest_. Unintended consequences due to the aggregation and combination of myriad actions of individuals, entities, and governments each pursuing their self-interest--the working of Adam Smith's invisible hand or Ricardian comparative advantage-- _at the global level_ do not necessarily lead to benign or beneficial outcomes in Scott's view. Interaction is not an "unqualified good" and must be viewed together with related costs. Scott describes the cumulation of "trains" of consequences as follows:

> Aggregation is not the only process going on in the "sink" of the ecosphere. Since behaviors and their consequences cannot be "thrown away," it is apparent that scores, or perhaps hundreds, of aggregative processes are going on at a given time and these processes must necessarily interact with one another. This may be referred to by the term "combination."
>
> Combination involves the linking of processes within functional categories as well as across functional boundaries. The resulting combinations, which may be quite elaborate, often offer impressive examples of interdependence. For example, industrial waste disposal practices may lead to increases in air pollution, which may change environmental conditions, which may, in turn, lead to changes in temperature and rainfall, which could precipitate a large drop in food production, which might lead to hunger and then to political instability and, perhaps, to war. (p.21)

Since the speed of aggregation and combination of consequences is outrunning man's ability to control it, Scott suggests that an attempt should be made to slow down the rate of movement along the interaction-technology continuum, although he realizes that in many cases this might be very difficult if not impossible. Slowdowns might be brought about through a reduction in international trade, the regulation of transnational actors, the creation of an international agency to establish guidelines for, and to monitor, science and technology. While a slowdown would entail substantial costs, in Scott's mind, permitting the present rate of acceleration to go unchecked might lead to far greater costs:

> the cost of *not* controlling global processes--of not limiting population growth, not slowing technological development, not slowing the rate of global interaction, not slowing resource use--would be far greater. The argument for a deliberate slowdown is not a conservative plea for the avoidance of change; change will remain rapid no matter what is done. It is rather an argument for an option that, if coupled with strenuous efforts to improve management capabilities, would hold some promise of allowing the global system to survive a worsening disorder crisis." (p.200-201)

What is the role of the political analyst in a world in which history is becoming "both harder to shape and harder to anticipate?"(p.207) As in the case of Popper, also Scott insists that analysts must devote greater attention to global problems and seek to comprehend the dynamics of interaction and interdependence. In his mind, the right kind of questions that the analyst might ask are: "What combination of processes moved the global system from what it was to what it now is? And what processes are now at work that will give it the configuration it will have in years to come? Can we see through events, and beneath them, and discern emerging patterns? Can we understand the way in which the newer kind of global problems are tied in with the more traditional issues of power politics?" (p.ix)

Aaron Wildavsky and Safety in Scientific and Technological Advance

While Andrew Scott proposes slowing down the rate of scientific and technological advance and global interaction, Aaron Wildavsky maintains that societal safety depends on *accelerated* scientific/technical activity and discovery. In Searching for Safety he argues that the perception of risk is very much based on present individual desires and needs as opposed to largely unknown future problems that lie more in the speculative realm than in that of fact. Differences of opinion on the uses of new technologies, for example, involve a highly social process of acceptance or rejection and become politicized when acted upon:

> No available evidence about safety and danger is likely to resolve current disputes about the consequences for life of new technology. Aside from lack of sufficient knowledge, the main reason is that these conflicts are largely social, not scientific. Supporting one's vision of the good life is bound to matter more than evidence that can hardly be compelling. Indeed, as philosophers of science tell us, it is people who must consent to validate facts, a social-cum-political process in which the rules scientists have evolved for what counts as evidence do play a part, but not necessarily (when social differences run deep) a conclusive part. Since perceptions of what is safe and what is dangerous also imply judgments about the societal institutions that produce these goods and bads, perception is partly a political act.[267]

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[267] Searching for Safety, p.205.

In Wildavsky's view, *less* technology does not necessarily mean greater safety. In evaluating the issue of safety versus risk, since safety is something we do not a priori know how to accomplish, its attainment should be viewed as a "search process." (p.207) Anticipatory regulation is not feasible because prediction of what is good or bad is not possible. The uncertainty principle[268] does not permit us to know the results of interactions which, as Scott has also indicated, can lead to unexpected consequences. Wildavsky, however, opts for greater progress and redundancy of global resources in seeking to control emergencies as opposed to Scott's notion of slowing down the interaction-technology

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[268]The German mathematical physicist Werner Karl Heisenberg (1901-1976), often considered the father of quantum mechanics, maintained that it was impossible to accurately know both the position and the momentum of a subatomic particle at the same time. This is due in part to nature of particles which is based on waves with different momenta. These waves superimpose and feedback affects initial conditions rendering precise definition of both position and momentum impossible. The difficulty of determining the simultaneous position and momenta of particles is also due to the disturbance introduced by the scientist attempting to observe the initial conditions. The wave-particle duality of matter and radiation led to the necessity of considering probability in attempting to define particle behavior. Ilya Prigogine took the uncertainty principle further by maintaining that there is a threshold of complexity above which systems will evolve in unforeseen directions, beyond the linear connection to their initial conditions. He postulated that this evolution created an "entropy" barrier which precluded reversibility in time and direction. In his view, this movement toward the entropy threshold is a positive step toward the creation of a new order of reality.
See: Ilya Prigogine and Isabelle Stengers, Order Out of Chaos, esp. pp.222ff, and 295ff. Also John Briggs and F. David Peat, Turbulent Mirror, pp.150-152.

continuum. Having the flexibility of bringing redundant resources to bear on unexpected problems is the best way, in his opinion, to cope with unanticipated consequences: "One way to deal with the possibility of unexpected dangers... is to generate economic growth and technical progress, in the expectation based on experience, that the accrued benefits will make society less vulnerable to whatever unanticipated risk may crop up." (p.221) He calls this a strategy of "resilience:"

> A strategy of resilience does not mean waiting for a disease to strike before trying to respond to it. Rather, it means preparing for the inevitable--the appearance of a new surprising disease--by expanding general knowledge and technical facility, and generalized command over resources. Knowledge also grows by responding to diseases as they develop, which knowledge can be used in unanticipated ways to combat newer threats. Solutions, as well as problems, are difficult to anticipate. Attempting to predict both a disease and its cure is less likely to increase safety than the ability to use generalized and specific knowledge in unexpected ways. (p.221)

Anticipation of risk should only be used for clearly apparent dangers, such as protective containment measures for nuclear reactors. Otherwise, the best method to achieve safety is an incremental procedure of trial and error experimentation, according to Wildavsky. Governments tend to favor large-scale anticipatory endeavors, but Wildavsky endorses the trials engaged in by the market economy. He views the achievement of safety as akin to Darwinian evolution, which does not guarantee optimization and therefore leaves room for further experimentation. Like evolution, also safety is a search process, which must be continuously pursued. Because conditions for safety change constantly, that which was safe today might decline tomorrow due to a new combination of circumstances: "..unless safety is continuously reaccomplished, it will decline, though this may not be known until it is too late. When we speak of having achieved some degree of safety...we are referring to some level of well-being under certain conditions not all of which can be specified, if only because they have not yet occurred." (p.209)

While Wildavsky's argument is in many respects persuasive, there is a troubling aspect to his train of thought. It may be true that countering interaction-technology induced problems with technological solutions may be the best way to proceed once the problem has occurred. Given the lack of knowledge and understanding of scientific thresholds and the potential for destructive chain reactions on a global scale, however, once an interlocking ecological, economic, and political process assumes a life and momentum of its own, it might be more prudent to engage in some form of regulation before interaction and aggregation lead to catastrophic unintended consequences.

The Social Scientist as the Integrator of Multidimensional Reality

All three of the preceding outlooks, while different in the conclusions they reach, attempt to deal with (a) the nature of a nonlinear reality; (b) how to approach it; (c) the new role for the social scientist who is faced with the task of illuminating the turbulent nature of that reality. All three indirectly reflect elements of a multidimensional outlook which would view the phenomenal world as a web of interacting and aggregating factors that ultimately may lead to unintended consequences. In line with the new sensibility to a turbulent environment, all three would rule out prediction as being the primary role of social science analysis. The social analyst's role is seen as a search *to understand and correlate* the multidimensional relationships involved in process and change. Popper views the task of the social scientist as a search to improve our understanding of the complex web of interlocking factors that determine the direction of human events. Andrew Scott would favor some human intervention, where possible, in seeking to slow down the interaction-technology continuum until human comprehension and management capabilities are able to cope with the complexity and unforeseen consequences of change. Wildavsky, on the other hand, would instead opt for a free market approach in social affairs, trusting that new scientific and technological advances are the best antidote for potential catastrophes induced by rapid scientific and technological human progress.

In their different theoretical approaches, Andrew Scott, Karl Popper, Aaron Wildavsky, or Susan Strange all offer evidence of the paradigm shift that is taking place at the end of the twentieth century. This shift entails movement away from the "fine-toothed analysis"[269] of smaller and smaller segments of reality that has characterized the classical Enlightenment paradigm based on the notion of linearity of cause and effect, time reversibility, and prediction. Our theorists all adhere to the notion that in times of rapid and turbulent change, such as our present end-of-century reality, linear models are less effective than nonlinear ones which seek to capture the "eclectic" (in Susan Strange's words) interconnections and feedback processes that shape socio-political and economic reality. Such an eclectic outlook leads Strange to abandon the state-centric point of view characteristic of the classical paradigm and opt for an approach that would encompass markets, technology and other factors as primary explanatory variables. This in turn guides

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[269]In the words of Alvin Toffler, "In a culture of warring specialisms, drowned in fragmented data and fine-toothed analysis, synthesis is not merely useful--it is crucial."
The Third Wave (New York: Bantam Books, 1981), p.2.

her toward a multidimensional approach that better enables her to comprehend the multiplicity of new forces at work in shaping the global economy, such as the increasing importance of the role of firms as leading actors in influencing the making and changing of policy at both the domestic and world levels. As an instance of this new role of the firm, we saw how Hughes Aircraft Company succeeded in modifying established U.S. policy toward Communist China in order to meet the needs and opportunities of newly emerging global market requirements.

Andrew Scott's interaction-technology continuum model also helps shed light on the nonlinear processes involved in the highly interdependent political, economic, technological aspect of the evolution of U.S. space policy (e.g. the action-reaction aspect of the initial evolution of space policy determined by Cold War realities; the unintended consequences of the shuttle decision which led to security, commercial/market, and technological problems years later).

Aaron Wildavsky's argument that greater technological advance and redundancy of global resources is preferable given the uncertainty principle in human affairs finds support in unexpected consequences such as those involved in the Challenger disaster. When a general worldwide failure of booster systems occurred in the mid-1980's, the fact that

Chinese resources were available to help launch grounded payloads helped offset the severity of the impact of these unforeseen events. The generation, in Wildavsky's words, of "economic growth and technological progress" is one way of offsetting the advent of unanticipated consequences.

The situation of dynamical real-world systems is not a conditional "closed" laboratory environment that can be closely controlled by human participants, as Popper observes. Open nonlinear systems do not lend themselves to prediction in the classical sense. The human analyst, moreover, as social scientist Dankwart Rustow has pointed out, is always a "<u>participant</u> observer." As opposed to the laboratory where neat chains of causality can be constructed without undue influence exerted by the scientist/observer, as Rustow writes, the social scientist brings his cumulative everyday experience as a <u>social</u> being to bear on his subject matter:

> Observer, subject matter and audience form a triangle in the process of explanation, and the difficulty of social science reappears at each corner: The observer is too close to his subject matter. Science starts from the overthrow of pre-scientific notions, and in a field such as physics these commonsense roots lie in pre-Galilean and pre-Socratic times. For centuries or more, therefore, the concepts of the natural sciences have been effectively insulated from the lay audience....
>
> The social scientist can neither manipulate nor even observe his subjects at will and he crosses his threshold of uncertainty much sooner, usually as he leaves the library and arrives in the field...The sociologist's or the political scien-

> tist's research cannot help being a series of social or political acts--he is always a *participant* observer. Therefore, as he hooks into an existing network of communication, he must be aware of the static or feedback that he inevitably engenders.[270]

Moreover, the interaction of audience and subject matter also tends to complicate matters further. The social scientist's forecasts, Rustow indicates, are likely to turn into "self-fulfilling or self-defeating prophecies--something that rules our scientific stock-market forecasts and complicates election predictions."(p.489)

The study of the global space market and space policy conversely reveals the interweaving of domestic and international, technological, political, and economic factors that mutually impact each other in a series of cascading feedback processes that would rule out the neat linear analysis of cause and effect. A range of multiple causes affected by feedback processes would seem to negate the possibility of long term prediction. And if scientific prediction is not possible, the role of the social scientist then becomes one of seeking to understand "the margin of choice offered by the human condition and to clarify the choices within that margin," (Rustow, p.496) or in Karl Popper words, "to trace

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[270]Dankwart A. Rustow, "Relevance in Social Science, or the Proper Study of Mankind," The American Scholar, 40, 3 (Summer 1971), 488-489.

the unintended social repercussions of intentional human actions."

Translated into policy, these diverse multidimensional approaches would lead to somewhat different ways of searching for, analyzing, and integrating data than the linear models of the past. They would all entail a holistic outlook focused on a broad view of events which would seek to correlate surface patterns and events with the "deeper currents" that French historian Fernand Braudel maintained were better indicators of historical evolution. In terms of actual policy making, this would involve examining and correlating factors that are not merely limited to short-term objectives and local or circumscribed data. It would require taking into consideration and actively seeking out those distant international and global factors which, in a symphony of cascading pressure points around the planet, can impact from afar a "local" decision from which they would seem far removed.

Policy in a Turbulent World

In prior pages, we have observed how today's international situation is characterized by rapid change or turbulence in all of the major areas affecting social existence: the political, the economic, the social, the environmental, the cultural and civilizational. Turbulence is further fueled by the weakness of world economies emerging debt-ridden from the excesses and sorry management of the 1980s. These find themselves poorly equipped to deal with accelerating socio-economic and political problems that are global in reach and require global input for their resolution.

The independent power of the nation-state has become progressively weaker as large-scale changes transform the reality of the past. These changes include (a) those brought to the fore by the disintegration of the Communist ideology and economic system around the world (with the notable exception of China); (b) fresh international conflicts and dangers based on old nationalisms long repressed or the rapid growth of new ones as nations, freed from the controls of a bipolar world, desire to conquer a position of preeminence in a multipolar one; (c) the rising proliferation of weapons and defensive systems both on earth and in space which require international intervention, substantial funds, and deep pockets; (d) the danger of world-wide environmental degradation that affects the sustainability of life on the planet and the high costs associated with adopting remedies; and finally, (e) the multi-faceted problems of civilizational transition which sees the old economic and political structures of industrial society being transformed by the "deeper currents" shaping historical evolution, what Alvin Toffler has called the "Third Wave:"

> A powerful tide is surging across much of the world today, creating a new, often bizarre environment in which to work, play, marry, raise children or retire. In this bewildering context, businessmen swim against highly erratic economic currents; politicians see their ratings bob wildly up and down; universities, hospitals, and other institutions battle desperately against inflation. Value systems splinter and crash, while the lifeboats of family, church, and state are hurled madly about.
>
> Looking at these violent changes, we can regard them as isolated evidences of instability, breakdown, and disaster. Yet, if we stand back for a longer view, several things become apparent that otherwise go unnoticed.
>
> To begin with, many of today's changes are not independent of one another. Nor are they random. For example, the crack up of the nuclear family, the global energy crisis, the spread of cults and cable television, the rise of flextime and new fringe-benefit packages, the emergence of separatist movements from Quebec to Corsica, may all seem like isolated events. Yet precisely the reverse is true. These and many other seemingly unrelated events or trends are interconnected. They are, in fact, parts of a much larger phenomenon: the death of industrialism and the rise of a new civilization.[271]

Given the high turbulence that accompanies profound societal change, what does this mean in terms of policy outlook and implementation? In the case of space policy, as well as in other areas, a holistic multidisciplinary outlook on reality would suggest that decision making be governed by a long-term view in both the civilian and space sectors. This view would take into consideration the new trends in societal change, and incorporate and correlate in the policy

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[271]The Third Wave, pp.1-2.

equation the social, economic, political, and cultural trends together with hierarchical power and relational space factors. Moreover, given the fact that, as the chaos theorists would argue, you cannot deduce long-term forecasts and predictions because of sensitivity to initial conditions and feedback, it behooves the prudent decision maker to maintain leadership in those areas of space activity that may affect national--and by extension, global-- security.

It should always be remembered that any nation which gains access to the high ground of space can develop the potential to create significant problems in both the military and non-military spheres for those that live below. The concept of space as a force multiplier is relevant not only to the military sphere but also to the economic and social spheres. It is no longer sufficient to ask the tough analytical questions concerning space policy within the context of near-term, domestically oriented parameters. A fast-paced, globally conditioned environment requires transnational vision and an attempt on the part of the analyst to understand the far-flung nonlinear forces that impinge on one another and lead to thresholds of change.

GLOSSARY

Arianespace

The Arianespace organization is a quasipublic joint venture, one-third of which is owned by the French National Space Agency while the other two-thirds are owned by a group of European aerospace companies and banks. The European Space Agency, itself a consortium of several European nations--Belgium, Denmark, France, Germany, Ireland, Italy, the Netherlands, Spain, Sweden, Switzerland, the United Kingdom--undertakes research and development work for Arianespace.

AsiaSat

The Asia Satellite Telecommunications Company Ltd., or AsiaSat, is a joint venture partnership between the Cable and Wireless Company, PLC., a British concern; Hutchinson Telecommunications Limited, a major trade and investment firm located in Hong Kong; CITIC Technology Corporation, a subsidiary of the China International Trust and Investment Corporation which oversees China's investment activities abroad and serves as a capitalist means of obtaining hard currency to further Chinese trade. The partnership's goal was to offer communication satellite services in East Asia, including Hong Kong, China, Macau, Thailand, Burma, Pakistan, Nepal, Korea, and Bangladesh. The AsiaSat satellite was successfully launched on April 7, 1990.

Attractor

The area of magnetic attraction or center of a dynamical system's phase space. The system's energy rotates around this magnetic attractor and can be mapped by the movement of a point in its phase space that embodies the movement of the whole system through time. The attractor may be fixed point, limit cycle, torus, or the aperiodic strange attractor.

Aussat Pty. Ltd.

Aussat Pty. Ltd was created in 1981. 75% of the company is owned by the Australian government and 25% by the Australian Telecommunications Commission. The company is required to function on a commercial profit-making basis. It furnishes telecommunication services to Australia and New Zealand through three satellites built by Hughes and a network of 60 directly owned earth stations and 15,000 customer owned stations. In 1988, Aussat had decided to purchase and launch two new satellites as replacements for Aussat A satellites whose life span was estimated to end in 1992 and 1993 due to fuel exhaustion. It decided to purchase the new Aussat B satellites from Hughes Aircraft Company, and through Hughes, to launch them on Chinese Long March boosters.

Ballistic missile

This type of missile is launched by a rocket and completes a reentry trajectory through a free fall, affected only be gravitational and atmospheric forces.

Bifurcation

The sudden qualitative change in a system or a set of equations for a nonlinear system when a parameter is varied. The point of bifurcation, or threshold at which iteration of initial conditions causes the system to undertake a completely new direction. The system may then, through cascading bifurcations and period doublings descend toward bounded chaos, or it may stabilize once again until another perturbation amplifies initial conditions to the point of bifurcation once again.

Chaos

The unpredictable behavior caused by sensitivity to initial conditions and nonlinearities in a dynamical system which, however, is "bounded" within certain parameters and not completely random.

COCOM

The Paris-based COCOM or Coordinating Committee, composed of the nations of the Atlantic Alliance minus Iceland and including Japan, was set up in 1949 under U.S. pressure, as part of the Cold War effort to control the export of sensitive technology (both military and dual-use civilian technology) to Communist regimes. It was hoped that members would voluntarily refrain from making available to targeted nations the list of strategic embargoed items compiled by the organization. To assure compliance, the U.S. subsequently passed the Mutual Defense Assistance Control Act in 1951, through which it could reject requests for economic or military aid to those countries that violated the COCOM agreements. In addition to the United States, member nations of COCOM include: Canada, Belgium, Denmark, France, Greece, Italy, Luxembourg, the Netherlands, Norway, Portugal, Turkey, United Kingdom, West Germany, and Japan.

Exoatmospheric and endoatmospheric missiles

Exoatmospheric missiles are those that travel outside the earth's atmosphere, generally above 100 kilometers, as opposed to endoatmospheric missiles that remain within the earth's atmosphere.

Fractional Orbit Bombardment System (FOBS)

A nuclear warhead sent into orbit on a spacecraft and then redirected toward its target before completing a full orbit of the Earth. Developed by the Soviets in the 1960s, the system can be placed in very low orbit and therefore evade the precise radar detection that occurs at higher altitudes. The system is somewhat less accurate than ballistic missiles and the warhead takes longer to reach its target. Although tested in space, it was never fully deployed by the Russians. If the system makes more than one orbit, it is called a MOBS or Multiple Orbit Bombardment System.

Geostationary orbit

A geostationary orbit for a satellite is located 22,300 miles (36,000 km.) above the equator. In that position, as the satellite travels from West to East at roughly the same speed as the Earth, it appears to be stationary at a set point.

This is the preferred orbit for certain types of satellites, such as those dedicated to communications and navigation, since their high position gives them a large footprint and their relatively stable location enables them to be in constant communication with an Earth station.

Kinetic energy weapons

Kinetic energy weapons are designed to destroy a target through a high speed impact as opposed to an explosive charge; laser weapons use directed energy photons to burn, incinerate, or melt the target; radio frequency and other technologies are also being investigated for ASAT purposes.

Tactical Nuclear Weapons

Tactical nuclear weapons, as opposed to strategic ones, have a shorter range, generally lower yield, are normally placed close to their targets and are designed to support specific areas of military engagement. They would include weapons like nuclear artillery shells, surface to surface missiles, nuclear bombs on tactical aircraft, nuclear tipped anti-aircraft missiles, etc.

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    - ABM TREATY AMENDMENT

APPENDIX I. HISTORICAL U.S. BUDGET SUMMARY FOR SPACE ACTIVITIES

Space Activities of the U.S. Government

HISTORICAL BUDGET SUMMARY—BUDGET AUTHORITY

(in millions of dollars)

Fiscal Year	NASA		Defense	Other	Energy	Com-merce	Interior	Agricul-ture	NSF	DOT	EPA	Total Space
	Total	Space[a]										
1959	331	261	490	...	34	...	...	...	...	...	...	785
1960	524	462	561	...	43	...	...	...	0.1	...	...	1,066
1961	964	926	814	...	68	...	...	...	0.6	...	...	1,808
1962	1,825	1,797	1,298	...	148	51	...	...	1.3	...	...	3,295
1963	3,673	3,626	1,550	...	214	43	...	...	1.5	...	...	5,435
1964	5,100	5,016	1,599	...	210	3	...	...	3.0	...	...	6,831
1965	5,250	5,138	1,574	...	229	12	...	...	3.2	...	...	6,956
1966	5,175	5,065	1,689	...	187	27	...	...	3.2	...	...	6,970
1967	4,966	4,830	1,664	...	184	29	...	...	2.8	...	...	6,710
1968	4,587	4,430	1,922	...	145	28	0.2	0.5	3.2	...	...	6,529
1969	3,991	3,822	2,013	...	118	20	0.2	0.7	1.9	...	...	5,976
1970	3,746	3,547	1,678	...	103	8	1.1	0.8	2.4	...	...	5,341
1971	3,311	3,101	1,512	127	95	27	1.9	0.8	2.4	...	...	4,741
1972	3,307	3,071	1,407	97	55	31	5.8	1.6	2.8	...	...	4,575
1973	3,406	3,093	1,623	109	54	40	10.3	1.9	2.6	...	...	4,825
1974	3,037	2,759	1,766	116	42	60	9.0	3.1	1.8	...	...	4,641
1975	3,229	2,915	1,892	107	30	64	8.3	2.3	2.0	...	...	4,914
1976	3,550	3,225	1,983	111	23	72	10.4	3.6	2.4	...	...	5,320
Transitional Quarter	932	849	460	31	5	22	2.6	0.9	0.6	...	...	1,341
1977	3,818	3,440	2,412	131	22	91	10	6	2	...	...	5,983
1978	4,060	3,623	2,738	157	34	103	10	8	2	...	...	6,518
1979	4,596	4,030	3,036	178	59	98	10	8	2	...	...	7,244
1980	5,240	4,680	3,848	160	40	93	12	14	2	...	...	8,689
1981	5,518	4,992	4,828	158	41	87	12	16	2	...	...	9,978
1982	6,044[b]	5,528	6,679	234	61	145	12	15	2	...	...	12,441
1983	6,875[c]	6,328	9,019	242	39	178	5	20	...[d]	...	...	15,589
1984	7,248	6,648	10,195	293	34	236	3	19	...	...	...	17,136
1985	7,573	6,925	12,768	474	34	423	2	15	...	...	...	20,167
1986	7,766	7,165	14,126	368	35	309	2	23	...	...	...	21,659
1987	10,507	9,809[e]	16,287	352	48	278	8	19	...	1	...	26,448
1988	9,026	8,302	17,679	626	241	352	14	18	...	1	...	26,607
1989	10,969	10,098	17,906	440	97	301	17	21	...	3	1	28,443
1990	13,073	12,142	15,616	330	79	202	19	26	...	4	1	28,089
1991	14,004	13,036	14,181	375	108	211	24	27	...	4	1	27,592

[a]Excludes amounts for air transportation (subfunction 402).
[b]Includes $33.5 million unobligated funds that lapsed.
[c]Includes $37.6 million for reappropriation of prior year funds.
[d]NSF funding of balloon research transferred to NASA.
[e]Includes $2.1 billion for replacement of shuttle orbiter Challenger.

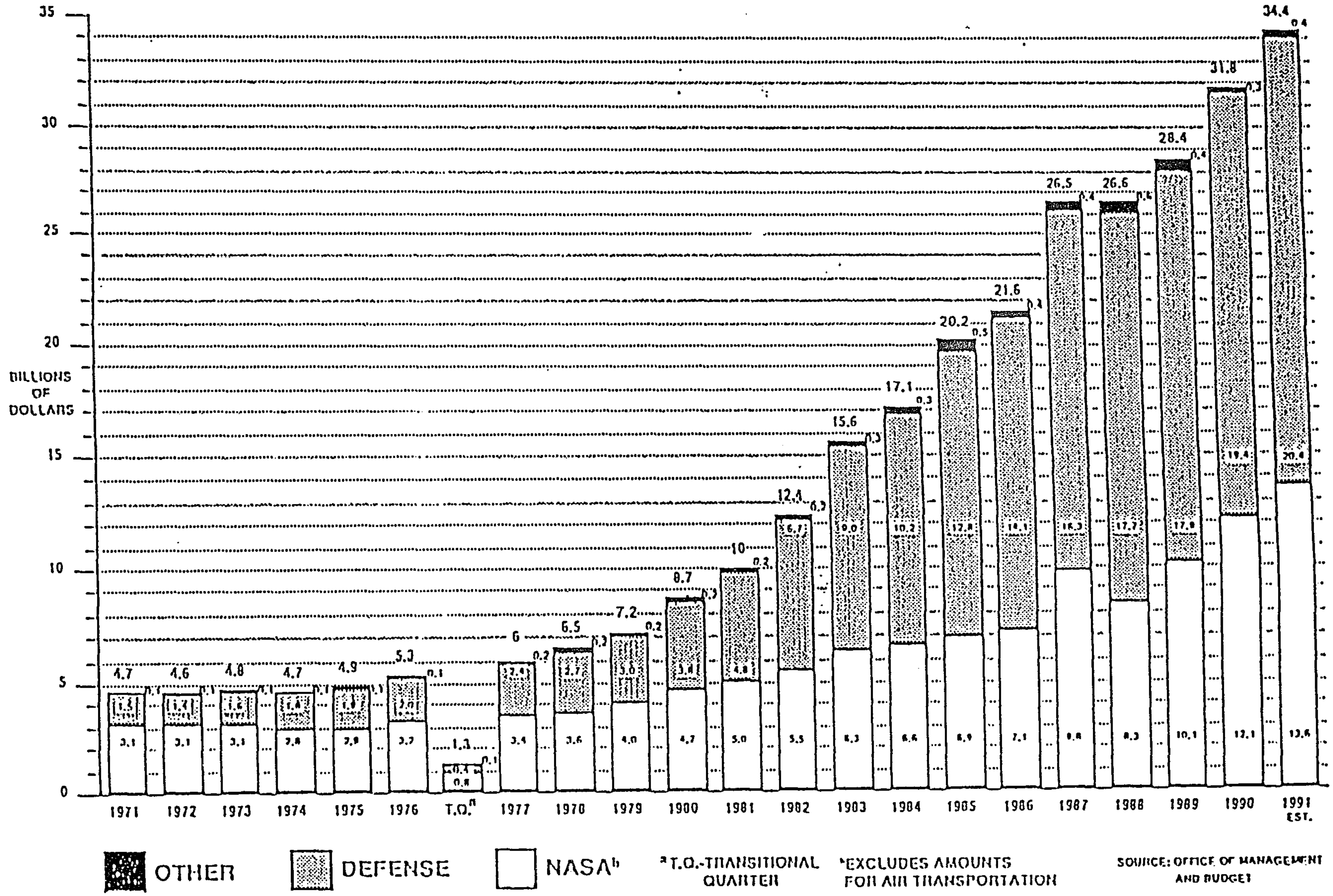
SOURCE: Office of Management and Budget.

Source: NASA, Aeronautics and Space Report of the President, 1992.

APPENDIX II. U.S. SPACE BUDGET AUTHORITY FY 1971-1990

U.S. Space Budget—Budget Authority FY 1971-1990

(may not add because of rounding)



APPENDIX III. WORLD RECORD OF SUCCESSFUL SPACE LAUNCHES

World Record of Space Launches Successful in Attaining Earth Orbit or Beyond

(Enumerates launches rather than spacecraft; some launches orbited multiple spacecraft.)

Calendar Year	United States	U.S.S.R.	France	Italy	Japan	People's Republic of China	Australia	United Kingdom	European Space Agency	India	Israel
1957		2									
1958	5	1									
1959	10	3									
1960	16	3									
1961	29	6									
1962	52	20									
1963	38	17									
1964	57	30									
1965	63	48	1								
1966	73	44	1								
1967	57	66	2	1			1				
1968	45	74									
1969	40	70									
1970	28	81	2	1[a]	1	1					
1971	30	83	1	2[a]	2	1		1			
1972	30	74		1	1						
1973	23	86									
1974	22	81		2[a]	1						
1975	27	89	3	1	2	3					
1976	26	99			1	2					
1977	24	98			2						
1978	32	88			3	1					
1979	16	87			2				1		
1980	13	89			2					1	
1981	18	98			3	1			2	1	
1982	18	101			1	1					
1983	22	98			3	1			2	1	
1984	22	97			3	3			4		
1985	17	98			2	1			3		
1986	6	91			2	2			2		
1987	8	95			3	2			2		
1988	12	90			2	4			7		
1989	17	74			2				7		1
1990	27	75			3	5			5		1
TOTAL	922	2,256	10	8	41	28	1	1	35	3	2
1991 (through Sep. 30)	10[b]	45			2				6	1	
TOTAL	932	2,301	10	8	43	28	1	1	41	4	2

[a]Includes foreign launches of U.S. spacecraft.
[b]This excludes four commercial expendable launches.

Source: NASA, *Aeronautics and Space Report of the President*, 1992.

APPENDIX IV. U.S. NATIONAL SPACE POLICY - 1989

THE WHITE HOUSE
Office of the Press Secretary

For Immediate Release November 16, 1989

FACT SHEET
U.S. National Space Policy

On November 2, 1989, the President approved a national space policy that updates and reaffirms U.S. goals and activities in space. The updated policy is the result of a review undertaken by the National Space Council. The revisions clarify, strengthen, and streamline selected aspects of the policy. Areas affected include civil and commercial remote sensing, space transportation, space debris, federal subsidies of commercial space activities, and Space Station Freedom.

Overall, the President's newly-issued national space policy revalidates the ongoing direction of U.S. space efforts and provides a broad policy framework to guide future U.S. space activities.

The policy reaffirms the nation's commitment to the exploration and use os space in support of our national well being. United States leadership in space continues to be fundamental objective guiding U.S. space activities. The policy recognizes that leadership requires United States preeminence in key areas of space activity critical to achieving our national security, scientific, technical, economic, and foreign policy goals. The policy also retains the long-term goal of expanding human presence and activity beyond Earth orbit into the Solar System. This goal provides the overall policy framework for the President's human space exploration initiative, announced July 20, 1989, in which the President called for completing Space Station Freedom, returning permanently to the Moon, and exploration of the planet Mars.

These and other aspects of U.S. national space policy are contained in the attached document entitled "National Space Policy."

Attachment

NATIONAL SPACE POLICY

UNCLASSIFIED

NATIONAL SPACE POLICY

November 2, 1989

INTRODUCTION

This document contains national policy, guidelines, and implementing actions with respect to the conduct of United States space programs and related activities.

United States space activities are conducted by three separate and distinct sectors: two strongly interacting governmental sectors (Civil and National Security) and a separate, non-governmental Commercial Sector. Close coordination, cooperation, and technology and information exchange will be maintained among these sectors to avoid unnecessary duplication and promote attainment of United States space goals.

GOALS AND PRINCIPLES

A fundamental objective guiding United States space activities has been, and continues to be, space leadership. Leadership in an increasingly competitive international environment, does not require United States preeminence in all areas and disciplines of space enterprise. It does require United States preeminence in the key areas of space activity critical to achieving our national security, scientific, technical, economic, and foreign policy goals.

- The overall goals of United States space activities are: (1) to strengthen the security of the United States; (2) to obtain scientific, technological and economic benefits for the general population and to improve the quality of life on Earth through space-related activities; (3) to encourage continuing United States private-sector investment in space and related activities; (4) to promote international cooperative activities taking into account United States national security, foreign policy, scientific, and economic interests; (5) to cooperate with other nations in maintaining the freedom of space for all activities that enhance the security and welfare of mankind; and, as a long-range goal; (6) to expand human presence and activity beyond Earth orbit into the solar system.

-- United States space activities shall be conducted in accordance with the following principles:

-- The United States is committed to the exploration and use of outer space by all nations for peaceful purposes and for the benefit of all mankind. "Peaceful purposes" allow for activities in pursuit of national security goals.

-- The United States will pursue activities in space in support of its inherent right of self-defense and its defense commitments to its allies.

-- The United States rejects any claims to sovereignty by any nation over outer space or celestial bodies, or any portion thereof, and rejects any limitations on the fundamental right of sovereign nations to acquire data from space.

-- The United States considers the space systems of any nation to be national property with the right of passage through and operations in space without interference. Purposeful interference with space systems shall be viewed as an infringement on sovereign rights.

-- The United States shall encourage and not preclude the commercial use and exploitation of space technologies and systems for national economic benefit. These commercial activities must be consistent with national security interests, and international and domestic legal obligations.

-- The United States will, as a matter of policy, pursue its commercial space objectives without the use of direct Federal subsidies.

-- The United States shall encourage other countries to engage in free and fair trade in commercial space goods and services.

-- The United States will conduct international cooperative space-related activities that are expected to achieve sufficient scientific, political, economic, or national security benefits for the nation. The United States will seek mutually beneficial international participation in space and space-related programs.

CIVIL SPACE POLICY

- The United States civil space sector activities shall contribute significantly to enhancing the Nation's science, technology, economy, pride, sense of well-being and direction, as well as United States world prestige and leadership. Civil sector activities shall comprise a balanced strategy of research, development, operations, and technology for science, exploration, and appropriate applications.

- The objectives of the United States civil space activities shall be (1) to expand knowledge of the Earth, its environment, the solar system, and the universe; (2) to create new opportunities for use of the space environment through the conduct of appropriate research and experimentation in advanced technology and systems; (3) to develop space technology for civil applications and, wherever appropriate, make such technology available to the commercial sector; (4) to preserve the United States preeminence in critical aspects of space science, applications, technology, and manned space flight; (5) to establish a permanently manned presence in space; and (6) to engage in international cooperative efforts that further United States overall space goals.

COMMERCIAL SPACE POLICY

The United States government shall not preclude or deter the continuing development of a separate non-governmental Commercial Space Sector. Expanding private sector investment in space by the market-driven Commercial Sector generates economic benefits for the Nation and supports governmental Space Sectors with an increasing range of space goods and services. Governmental Space Sectors shall purchase commercially available space goods and services to the fullest extent feasible and shall not conduct activities with potential commercial applications that preclude or deter Commercial Sector space activities except for national security or public safety reasons. Commercial Sector space activities shall be supervised or regulated only to the extent required by law national security, international obligations, and public safety.

NATIONAL SECURITY SPACE POLICY

The United States will conduct those activities in space that are necessary to national defense. Space activities will contribute to national security objectives by (1) deterring, or if necessary, defending against enemy attack; (2) assuring that forces of hostile nations cannot prevent our own use of space; (3) negating, if necessary, hostile space systems; and (4) enhancing operations of United States and Allied forces. Consistent with treaty obligations, the national security space program shall support such functions as command and control, communications, navigation, environmental monitoring, warning, surveillance, and force application (including research and development programs which support these functions).

INTER-SECTOR POLICIES

This section contains policies applicable to, and binding on, the national security and civil space sectors.

- The United States Government will maintain and coordinate separate national security and civil operational space systems where differing needs of the sectors dictate.

- Survivability and endurance of national security space systems, including all necessary system elements, will be pursued commensurate with the planned use in crisis and conflict, with the threat, and with the availability of other assets to perform the mission.

- Government sectors shall encourage to the maximum extent feasible, the development and use of United States private sector space capabilities.

- A continuing capability to remotely sense the Earth from space is important to the achievement of United States space goals. To ensure that the necessary capability exists, the United States government will: (a) ensure the continuity of LANDSAT-type remote sensing data; (b) discuss remote sensing issues and activities with foreign governments operating or regulating the private operation of remote sensing systems; (c) continue government research and development for future advanced remote sensing technologies or systems; and (d) encourage the development of commercial systems, which image the Earth from space, competitive with, or superior to, foreign-operated civil or commercial systems.

- Assured access to space, sufficient to achieve all United States space goals, is a key element of national space policy. United States space transportation systems must provide a balanced, robust, and flexible capability with sufficient resiliency to allow continued operations despite failures in any single system. The United States government will continue research and development on component technologies in support of future transportation systems. The goals of United States space transportation policy are: (1) to achieve and maintain safe and reliable access to, transportation in, and return from, space; (2) to exploit the unique attributes of manned and unmanned launch and recovery systems; (3) to encourage to the maximum extent feasible, the development and use of United States private sector space transportation capabilities; and (4) to reduce the costs of space transportation and related services.

- Communications advancements are critical to all United States space sectors. To ensure necessary capabilities exist, the United States government will continue research and development efforts for future advanced space communications technologies.

- The United States will consider and, as appropriate, formulate policy positions on arms control measures governing activities in space, and will conclude agreements on such measures only if they are equitable, effectively verifiable, and enhance the security of the United States and our allies.

- All space sectors will seek to minimize the creation of space debris. Design and operations of space tests, experiments and systems will strive to minimize or reduce accumulation of space debris consistent with mission requirements and cost effectiveness. The United States government will encourage other space-faring nations to adopt policies and practices aimed at debris minimization.

IMPLEMENTING PROCEDURES

Normal interagency procedures will be employed wherever possible to coordinate the policies enunciated in this directive.

Executive Order No. 12675 established the National Space Council to provide a coordinated process for developing a national space policy and strategy and for monitoring its implementation.

The Vice President serves as the Chairman of the Council, and as the President's principal advisor on national space policy and strategy. Other members of the Council are the Secretaries of State, Treasury, Defense, Commerce, and Transportation; the Chief of Staff to the President, the Director of the Office of Management and Budget, the Assistant to the President for National Security Affairs, the Assistant to the President for Science and Technology, the Director of Central Intelligence, and the Administrator of the National Aeronautics and Space Administration. The Chairman, from time to time, invites the Chairman of the Joint Chiefs of Staff, the heads of executive agencies and other senior officials to participate in meetings of the Council.

* * * *

POLICY GUIDELINES AND IMPLEMENTING ACTIONS

The following Policy Guidelines and Implementing Actions provide a framework through which the policies in this directive shall be carried out. Agencies will use these sections as guidance on priorities, including preparation, review, and execution of budgets for space activities, within the overall resource and policy guidance provided by the President. Affected Government agencies shall ensure that their current policies are consistent with this directive and, where necessary, shall establish policies to implement these practices.

CIVIL SPACE SECTOR GUIDELINES

- Introduction. In conjunction with other agencies: NASA will continue the lead role within the Federal Government for advancing space science, exploration, and appropriate applications through the conduct of activities for research, technology, development and related operations; National Oceanic and Atmospheric Administration will gather data, conduct research, and make predictions about the Earth's environment; DOT will license and promote commercial launch operations which support civil sector operations.

- Space Science. NASA, with the collaboration of other appropriate agencies, will conduct a balanced program to support scientific research, exploration, and experimentation to expand understanding of: (1) astrophysical phenomena and the origin and evolution of the universe; (2) the Earth, its environment and its dynamic relationship with the Sun; (3) the origin and evolution of the solar system; (4) fundamental physical, chemical, and biological processes; (5) the effects of the space environment on human beings; and (6) the factors governing the origin and spread of life in the universe.

- Space Exploration. In order to investigate phenomena and objects both within and beyond the solar system, NASA will conduct a balanced program of manned and unmanned exploration.

-- Human Exploration. To implement the long-range goal of expanding human presence and activity beyond Earth orbit into the solar system, NASA will continue the systematic development of technologies necessary to enable and support a range of future manned missions. This technology program (Pathfinder) will be oriented toward a Presidential decision on a focused program of manned exploration of the solar system.

-- Unmanned Exploration. NASA will continue to pursue a program of unmanned exploration where such exploration can most efficiently and effectively satisfy national space objectives by among other things: achieving scientific objectives where human presence is undesirable or unnecessary; exploring realms where the risks or costs of life support are unacceptable; and providing data vital to support future manned missions.

- Permanent Manned Presence. NASA will develop the space Station to achieve permanently manned operational capability by the mid-1990s. Space Station Freedom will: (1) Contribute to United States preeminence in critical aspects of manned spaceflight; (2) provide support and stability to scientific and technological investigations; (3) provide early benefits, particularly in the materials and life sciences; (4) promote private sector experimentation preparatory to independent commercial activity; (5) allow evolution in keeping with the needs of Station users and the long-term goals of the United States; (6) provide opportunities for commercial sector participation; and (7) contribute to the longer term goad of expanding human presence and activity beyond Earth orbit into the solar system.

- Manned Spaceflight Preeminence. Approved programs such as efforts to improve and safely operate the Space Transportation System (STS) and to develop, deploy, and use the Space Station, are intended to ensure United States preeminence in critical aspects of manned spaceflight.

- Space Applications. NASA and other agencies will pursue the identification and development of appropriate applications flowing from their activities. Agencies will seek to promote private sector development and implementation of applications.

-- Such applications will create new capabilities, or improve the quality or efficiency of continuing activities, including long-term scientific observations.

-- NASA will seek to ensure its capability to conduct selected critical missions through an appropriate mix of assured access to space, on-orbit sparing, advanced automation techniques, redundancy, and other suitable measures.

-- Agencies may enter cooperative research and development agreements on space applications with firms seeking to advance the relevant state-of-the-art consistent with United States Government space objectives.

-- Management of Federal civil operational remote sensing is the responsibility of the Department of Commerce. The Department of Commerce will: (a) consolidate Federal needs for civil operational remote sensing products to be met either by the private sector or the Federal government; (b) identity needed civil operational system research and development objectives; and (c) in coordination with other departments or agencies, provide for the regulation of private sector operational remote sensing systems.

- Civil Government Space Transportation. The unique Space Transportation System (STS) capability to provide manned access to space will be exploited in those areas that offer the greatest national return, including contributing to United States preeminence in critical aspects of manned spaceflight. The STS fleet will maintain the Nation's capability and will be used to support critical programs requiring manned presence and other unique STS capabilities. In support of national space transportation goals, NASA will establish sustainable STS flight rates to provide for planning and budgeting of Government space programs. NASA will pursue appropriate enhancements to STS operational capabilities, upper stages, and systems for deploying, servicing, and retrieving spacecraft as national and user requirements are defined.

- International Cooperation. The United States will foster increased international cooperation in civil space activities by seeking mutually beneficial international participation in civil space and space-related programs. The National space Council shall be responsible for oversight of civil space cooperation with the Soviet Union. No such cooperative activity shall be initiated until an appropriate interagency review has been completed. United States cooperation in international civil space activities will:

-- United States participation in international space ventures, whether public or private, must be consistent with United States technology transfer laws, regulations, Executive Orders and presidential directives.

-- Support the public, nondiscriminatory direct readout of data from Federal civil systems to foreign ground stations and the provision of data to foreign users under specified conditions.

-- Be conducted in such a way as to protect the commercial value of intellectual property developed with

Federal support. Such cooperation will not preclude or deter commercial space activities by the United States private sector, except as required by national security or public safety.

COMMERCIAL SPACE SECTOR GUIDELINES

- NASA, and the Departments of Commerce, Defense, and Transportation will work cooperatively to develop and implement specific measures to foster the growth of private sector commercial use of space. A high-level focus for commercial space issues has been created through establishment of the National Space Council.

- To stimulate private sector investment, ownership, and operation of space assets, the United States Government will facilitate private sector access to appropriate U.S. space-related hardware and facilities, and encourage the private sector to undertake commercial space ventures. Governmental Space Sectors shall:

-- Utilize commercially available goods and services to the fullest extent feasible, and avoid actions that may preclude or deter commercial space sector activities except as required by national security or public safety. A space good or service is "commercially available" if it is currently offered commercially, or if it could be supplied commercially in response to a government service procurement request. "Feasible" means that such goods or services meet mission requirements in a cost-effective manner.

-- Enter into appropriate cooperative agreements to encourage and advance private sector basic research, development, and operations while protecting the commercial value of the intellectual property developed;

-- Provide for the use of appropriate Government facilities on a reimbursable basis;

-- Identify, and eliminate or propose for elimination, applicable portions of United States laws and regulations that unnecessarily impede commercial space sector activities;

-- Encourage free and fair trade in commercial space activities. Consistent with the goals, principles, and policies set forth in this directive, the United States Trade Representative will consult, or, as appropriate, negotiate with other countries to encourage free and fair trade in commercial space activities. In entering into space-related technology development and transfer agreements with other countries, Executive Departments and agencies will take into consideration whether such countries practice and encourage free and fair trade in commercial space activities.

-- Provide for the timely transfer of Government-developed space technology to the private sector in such a manner as to protect its commercial value, consistent with national security.

-- Price Government-provided goods and services consistent with OMB Circular A-25.

NATIONAL SECURITY SPACE SECTOR GUIDELINES

- General:

-- The Department of Defense (DOD) will develop, operate, and maintain an assured mission capability through an appropriate mix of robust satellite control, assured access to space, on-orbit sparing, proliferation, reconstitution or other means.

-- The national security space program, including dissemination of data, shall be conducted in accordance with Executive Orders and applicable directives for the protection of national security information and commensurate with both the missions performed and the security measures necessary to protect related space activities.

-- DOD will ensure that the national security space program incorporates the support requirements of the Strategic Defense Initiative.

- Space Support:

-- The national security space sector may use both manned and unmanned launch systems as determined by specific mission requirements. Payloads will be distributed among launch systems and launch sites to minimize the impact of loss of any single launch system of launch site on mission performance. The DOD will procure unmanned launch vehicles or services and maintain launch capability on both the East and West coasts. DOD will also continue to enhance the robustness of its satellite control capability through and appropriate mix of satellite autonomy and survivable command and control, processing, and data dissemination systems.

-- DOD will study concepts and technologies which would support future contingency launch capabilities.

- Force Enhancement:

-- The national security space sector will develop, operate, and maintain space systems and develop plans and architectures to meet the requirements of operational land, sea, and air forces through levels of conflict commensurate with their intended use.

- Space Control:

-- The DOD will develop, operate, and maintain enduring space systems to ensure its freedom of action in space. This requires an integrated combination of antisatellite, survivability, and surveillance capabilities.

-- Antisatellite (ASAT) Capability. The United States will develop and deploy a comprehensive capability with programs as required and with initial operations capability at the earliest possible date.

-- DOD space programs will pursue a survivability enhancement program with long-term planning for future requirements. The DOD must provide for the survivability of selected, critical national security space assets (including associated terrestrial components) to a degree commensurate with the value and utility of the support they provide to national-level decision functions, and military operational forces across the spectrum of conflict.

-- The United States will develop and maintain an integrated attack warning, notification, verification, and contingency reaction capability which can effectively detect and react to threats to United States space systems.

- Force Application. The DOD will, consistent with treaty obligations, conduct research, development, and planning to be prepared to acquire and deploy space systems should national security conditions dictate.

<u>INTER-SECTOR GUIDELINES</u>

The following paragraphs identigy selected, high priority cross-sector efforts and responsibilities to implement plans supporting major United States space policy objectives:

- Space Transportation Guidelines.

-- The United States national space transportation capability will be based on a mix of vehicles, consisting of the Space Transportation System (STS), unmanned launch vehicles (ULVs), and in-space transportation systems. The elements of this mix will be defined to support the mission needs of national security and civil government sectors of united States space activities in the most cost effective manner.

-- As determined by specific mission requirements, national security space sector will use the STS and ULVs. In coordination with NASA, the DOD will assure the Shuttle's utility to national defense and will integrate missions into the Shuttle system. Launch priority will be provided for national security missions as implemented by NASA-DOD agreements. Launches necessary to preserve and protect human life in space shall have the highest priority except in times of national security emergency.

-- The STS will continue to be managed and operated in an institutional arrangement consistent with the current NASA/DOD Memorandum of Understanding. Responsibility will remain in NASA for operational control of the STS for civil missions, and in the DOD for operational control of the STS for national security missions. Mission management is the responsibility of the mission agency.

-- United States commercial launch operations are an integral element of a robust national space launch capability. NASA will not maintain an expendable launch vehicle (ELV) adjunct to the STS. NASA will provide launch services for commercial and foreign payloads only where those payloads must be man-tended, require the unique capabilities of the STS, or it is determined that launching the payloads on the STS is important for national security or foreign policy purposes. Commercial and foreign payloads will not be launched on government owned or operated ELV systems except for national security or foreign policy reasons.

-- Civil Government agencies will encourage, to the maximum extent feasible, a domestic commercial launch industry by contracting for necessary ELV launch services directly from the private sector or with DOD.

-- NASA and the DOD will continue to cooperate in the development and use of military and civil space transportation systems and avoid unnecessary duplication of activities. They will pursue new launch and support concepts aimed at improving cost-effectiveness, responsiveness, capability, reliability, availability, maintainability, and flexibility. Such cooperation between the national security and civil sectors will ensure efficient and effective use of national resources.

- Guidelines for the Federal Encouragement of Commercial Unmanned Launch Vehicles (ULVs):

-- The Department of Transportation (DOT) is the lead agency within the Federal Government for developing, coordinating, and articulating Federal policy and regulatory guidance pertaining to United States commercial launch activities in consultation with DOD, State, NASA, and other concerned agencies. All Executive departments and agencies shall assist the DOT in carrying out its responsibilities, as set forth in the Commercial Space Launch Act and Executive Order 12465.

-- The United States Government encourages the use of its launch and launch-related facilities for United States commercial launch operations.

-- The United States Government will have priority use of government facilities and support services to meet national security and critical mission requirements. The United States Government will make all reasonable efforts to minimize impacts on commercial operations.

-- The United States Government will not subsidize the commercialization of ULVs, but will price the use of its facilities, equipment, and services with the goal of encouraging viable commercial ULV activities in accordance with the Commercial Space Launch Act.

-- The United States Government will encourage free market competition within the United States private sector. The United States Government will provide equitable treatment for all commercial launch operators for the sale or lease of Government equipment and facilities consistent with its economic, foreign policy, and national security interests.

-- NASA and DOD, for those unclassified and releasable capabilities for which they have responsibility, shall, to the maximum extent feasible:

--- Use best efforts to provide commercial launch firms with access, on a reimbursable basis, to national launch and launch-related facilities, equipment, tooling, and services to support commercial launch operations;

--- Develop, in consultation with the DOT, contractual arrangements covering access by commercial launch firms to national launch and launch-related property and services they request in support of their operations;

--- Provide technical advice and assistance to commercial launch firms on a reimbursable basis, consistent with the pricing guidelines herein; and

--- Conduct, in coordination with DOT, appropriate environmental analyses necessary to ensure that commercial launch operations conducted at Federal launch facilities are in compliance with the National Environmental Policy Act.

- Government ULV Pricing Guidelines. The price charged for the use of United States Government facilities, equipment, and service, will be based on the following principles:

-- Price all services (including those associated with production and launch of commercial ULVs) based on the direct costs incurred by the United States Government. Reimbursement shall be credited to the appropriation from which the cost of providing such property or service was paid.

-- The United States Government will not seek to recover ULV design and development costs or investments associated with any existing facilities or new facilities required to meet United States Government needs to which the U.S. Government retains title;

-- Tooling, equipment, and residual ULV hardware on hand at the completion of the United States Government's program will be priced on a basis that is in the best overall interest of the United States Government, taking into consideration that these sales will not constitute a subsidy to the private sector operator.

- Commercial Launch Firm Requirements. Commercial launch firms shall:

-- Maintain all facilities and equipment leased from the United States Government to a level of readiness and repair specified by the United States Government;

-- ULV operators shall comply with all requirements of the Commercial Space Launch Act, all regulations issued under the Act, and all terms, conditions or restrictions of any license issued or transferred by the Secretary of Transportation under the Act.

- Technology Transfer Guidelines.

-- The United States will work to stem the flow of advanced western space technology to unauthorized destinations. Executive departments and agencies will be fully responsible for protecting against adverse technology transfer in the conduct of their programs.

-- Sales of United States space hardware, software, and related technologies for use in foreign space projects will be consistent with relevant international and bilateral agreements and arrangements.

- Space Infrastructure. All Sectors shall recognize the importance of appropriate investments in the facilities and human resources necessary to support United States space objectives and maintain investments that are consistent with such objectives. The National Space Council will conduct a feasibility study of alternate methods for encouraging private sector investment, including capital funding, of United States space infrastructure such as ground facilities, launcher developments, and orbital assembly and test facilities.

- The primary forum for negotiations on nuclear and space arms is the Nuclear and Space Talks (NST) with the Soviet Union in Geneva. The instructions to the United States Delegation will be consistent with this National Space Policy directive, established legal obligations, and additional guidance by the President. The United States will continue to consult with its Allies on these negotiations and ensure that any resulting agreements enhance the security of the United States and its Allies. Any discussions on arms control relating to activities in space in forums other than NST must be consistent with, and subordinate to, the foregoing activities and objectives.

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APPENDIX V. EXECUTIVE ORDER 12675 FOR THE ESTABLISHMENT OF THE NATIONAL SPACE COUNCIL

EXECUTIVE ORDER 12675

ESTABLISHING THE NATIONAL SPACE COUNCIL

By the authority vested in me as President by the Constitution and laws of the United States of America, and in order to provide a coordinated process for developing a national space policy and strategy and for monitoring its implementation, it is hereby ordered as follows:

Section.1. Establishment and Composition of the National Space Council.

(a) There is established the national Space Council ("the Council").

(b) The Council shall be composed of the following members:
 (1) The Vice President, who shall be Chairman of the Council;
 (2) The Secretary of State;
 (3) The Secretary of the Treasury;
 (4) The Secretary of Defense;
 (5) The Secretary of Commerce;
 (6) The Secretary of Transportation;
 (7) The Director of the Office of Management and Budget;
 (8) The Chief of Staff to the President;
 (9) The Assistant to the President for National Security Affairs;
 (10) The Assistant to the President for Science and Technology;
 (11) The Director of Central Intelligence; and
 (12) The Administrator of the National Aeronautics and Space Administration.

(c) The Chairman shall, from time to time, invite the following to participate in meetings of the Council:

 (1) The Chairman of the Joint Chiefs of Staff; and
 (2) The heads of other executive departments and agencies and other senior officials in the Executive Office of the President.

Section 2. Functions of the Council.

(a) The Council shall advise and assist the President on national space policy and strategy, and perform such other duties as the President may from time to time prescribe.

(b) In addition, the Council is directed to:

(1) review United States Government space policy, including long-range goals, and develop a strategy for national space activities;
(2) develop recommendations for the President on space policy and space-related issues;
(3) monitor and coordinate implementation of the objectives of the President's national space policy by executive departments and agencies; and
(4) foster close coordination, cooperation, and technology and information exchange among the civil, national security, and commercial space sectors, and facilitate resolution of differences concerning major space and space-related policy issues.

(c) The creation and operation of the Council shall not interfere with existing lines of authority and responsibilities in the departments and agencies.

Section 3. Responsibilities of the Chairman.

(a) The Chairman shall serve as the President's principal advisor on national space policy and strategy.

(b) The Chairman shall, in consultation with the members of the Council, establish procedures for the Council and establish the agenda for Council activities.

(c) The Chairman shall report to the President on the activities and recommendations of the Council. The Chairman shall advise the Council as appropriate regarding the President's directions with respect to the Council's activities and national space policy generally.

(d) The Chairman shall authorize the establishment of such committees of the Council, including an executive committee, and of such working groups, composed of senior designees of the Council members and of other officials invited to participate in Council meetings, as he deems necessary or appropriate for the efficient conduct of Council functions.

Section 4. National Space Policy Planning Process.

(a) The Council will establish a process for developing and monitoring the implementation of national space policy and strategy.

(b) To implement this process. each agency represented on the Council shall provide such information regarding its current and planned space activities as the Chairman shall request.

(c) The head of each executive department and agency shall ensure that its space-related activities conform to national space policy and strategy.

Section 5. Establishment of Vice President's Space Policy Advisory Board.

(a) The Vice President shall establish: in accordance with the provisions of the Federal Advisory Committee Act, as amended (5 U.S.C. App.2), governing Presidential advisory committees, an advisory committee of private citizens to advise the Vice President on the space policy of the United States ("the Board").

(b) The Board shall be composed and function as follows:

(1) The Board shall be composed of members appointed by the Vice President.
(2) The Vice President shall designate a Chairman from among the members of the Board. The Executive Secretary of the national Space Council shall serve as the Secretary to the Board.
(3) Members of the board shall serve without any compensation for their work on the Board. However, they shall be entitled to travel expenses, including per diem in lieu of subsistence, as authorized by law, for persons serving intermittently in the Government service (5 U.S.C. 5701-5707), to the extent funds are available for that purpose.
(4) Necessary expenses of the Board shall be paid from funds available for the expenses of the National Space Council.
(5) Notwithstanding the provisions of any other Executive order, the responsibilities of the President under the Federal Advisory Committee Act, as amended, except that of reporting annually to the Congress, which are applicable to the Board established by this order, shall be performed on a reimbursable basis by the Director of the Office

of Administration in the Executive Office of the President, in accordance with the guidelines and procedures established by the Administrator of General Services.

Section 6. Microgravity Research Board.

Section 1(c) of Executive Order No. 12660 is amended by deleting "Economic Policy Council" and inserting in lieu thereof "National Space Council."

Section 7. Administrative Provisions.

(a) The Office of Administration in the Executive Office of the President shall provide the Council with such administrative support on a reimbursable basis as may be necessary for the performance of the functions of the Council.

(b) The President shall appoint an Executive Secretary who shall appoint such staff as may be necessary to assist in the performance of the Council's functions.

(c) All Federal departments, agencies, and interagency councils and committees having an impact on space policy shall extend as appropriate, such cooperation and assistance to the Council as is necessary to carry out its responsibilities under this order.

(d) The head of each agency serving on the Council or represented on any working group or committee of the Council shall provide such administrative support as may necessary, in accordance with law and subject to the availability of appropriations, to enable the agency head or its representative to carry out his responsibilities.

Section 8. Report.

The Council shall submit an annual report setting forth its assessment of and recommendations for the space policy and strategy of the United States Government.

George Bush

The White House.
April 20, 1989

APPENDIX VI. U.S. COMMERCIAL SPACE POLICY GUIDELINES - 1991

THE WHITE HOUSE
Office of the Press Secretary

For Immediate Release February 12, 1991

STATEMENT BY THE PRESS SECRETARY

The President has approved U.S. Commercial Space Policy Guidelines aimed at expanding private sector investment in space by the market-driven commercial Space Sector. These guidelines are the result of a nine month interagency review of the commercial space sector conducted by the Vice President and the National Space Council.

The U.S. Commercial Space Policy Guidelines recognize that a robust commercial space sector has the potential to generate new technologies, markets, jobs, and other important economic benefits to the nation. The guidelines contain new provisions and definitions of key concepts to provide for more effective implementation of the National Space Policy by U.S. agencies.

U.S. COMMERCIAL SPACE POLICY GUIDELINES

A fundamental objective guiding United States space activities has been space leadership, which requires preeminence in key areas of space activity. In an increasingly competitive international environment, the U.S. Government encourages the commercial use and exploitation of space technologies and systems for national economic benefit. These efforts to encourage commercial activities must be consistent with national security and foreign policy interests, international and domestic legal obligations, including U.S. commitments to stem missile proliferation, and agency mission requirements.

United States space activities are conducted by three separate and distinct sectors: two U.S. Government sectors -- the civil and national security -- and a non-governmental commercial space sector. The commercial space sector includes a broad cross-section of potential providers and users, including both established and new market participants. There also has been a recent emergence of State government initiatives related to encouraging commercial space activities. the commercial space sector is comprised of at least give market areas, each encompassing both earth and space-based activities, with varying degrees of market maturity or potential:

<u>Satellite communications</u> - the private development, manufacture, and operation of communications satellites and marketing of satellite telecommunications services, including position location and navigation;

<u>Launch and Vehicle Services</u> - the private development, manufacture, and operation of launch and reentry vehicles, and the marketing of space transportation services;

<u>Remote Sensing</u> - the private development, manufacture, and operation of remote sensing satellites and the processing and marketing of remote sensing data;

<u>Materials Processing</u> - the experimentation with, and production of, organic and inorganic materials and products utilizing the space environment; and

<u>Commercial Infrastructure</u> - the private development and provision of space-related support facilities, capabilities and services.

In addition, other market-driven commercial space sector opportunities are emerging.

The U.S. Government encourages private investment in, and broader responsibility for, space-related activities that can result in products and services that meet the needs of government and other customers in a competitive market. As a matter of policy, the U.S. Government pursues its commercial space objectives without the use of direct federal subsidies. A robust commercial space sector has the potential to generate new technologies, products, markets, jobs, and other economic benefits for the nation, as well as indirect benefits for national security.

Commercial space sector activities are characterized by the provision of products and services such that

-- private capital is at risk

-- there are existing, or potential, non-governmental customers for the activity;

-- the commercial market ultimately determines the viability of the activity; and

-- primary responsibility and management initiative for the activity resides with the private sector.

Implementing Guidelines

The following implementing guidelines shall serve to provide the U.S. private sector with a level of stability and predictability in its dealings with agencies of the U.S. Government. The agencies will work separately but cooperatively, as appropriate, to develop specific measures to implement this strategy. U.S. Government agencies shall, consistent with national security and foreign policy interests, international and domestic legal obligations and agency mission requirements,m encourage the growth of the U.S. commercial space sector in accordance with the following guidelines:

- U.S. Government agencies shall utilize commercially available space products and services to the fullest extent feasible. This policy of encouraging U.S. Government agencies to purchase, and the private sector to sell, commercial space products and services has potentially large economic benefits.

-- A space product or service is "commercially available" if it is currently offered commercially , or if it could be supplied commercially in response to a government procurement request.

-- "Feasible" means that products and services meet mission requirements in a cost-effective manner.

-- "Cost-effective" generally means that the commercial product or service costs non more than governmental development or directed procurement where such government costs include applicable government labor and overhead costs, as well as contractor charges and operations costs.

-- However, the acquisition of commercial space products and services shall generally be considered cost effective if they are procured competitively using performance-based contracting techniques. Such contracting techniques give contractors the freedom and financial incentive to achieve economies-of-scale by combining their government and commercial work as well as increased productivity through innovation.

-- U.S. Government agencies shall actively consider, at the earliest appropriate time, the feasibility of their using commercially available products and services in agency programs and activities.

-- U.S. Government agencies shall continue to take appropriate measures to protect from disclosure any proprietary data which is shared with the U.S. Government in the acquisition of commercial space products and services.

- U.S. Government agencies shall promote the transfer of U.S. Government-developed technology to the private sector.

-- U.S. Government-developed unclassified space technology will be transferred to the U.S. commercial space sector in as timely a manner as possible and in ways that protect its commercial value.

-- U.S. Government agencies may undertake cooperative research and development activities with the private sector, as well as State and local governments, consistent with policies and funding, in order to fulfill mission requirements in a manner which encourages the creation of commercial opportunities.

-- With respect to technologies generated in the performance of government contracts, U.S. Government agencies shall obtain only those rights necessary to meet government needs and mission requirements, as directed by Executive Order 12591.

- U.S. Government agencies may make unused capacity of space assets, services and infrastructure available for commercial space sector use.

  -- Private sector use of U.S. Government agency space assets, services, and infrastructure shall be made available on a reimbursable basis consistent with OMB Circular A-25 or appropriate legislation.

- U.S. Government agencies may make available to the private sector those assets which have been determined to be excess to the requirements of the U.S. Government in accordance with U.S. law and applicable international treaty obligations. Due regard shall be given to the economic impact such transfer may have on the commercial space sector, promoting competition, and the long-term public interest.

- The U.S. Government shall avoid regulating domestic space activities in a manner that precludes or deters commercial space sector activities, except to the extent necessary to meet international and domestic legal obligations, including those of the Missile Technology Control Regime. Accordingly, agencies shall identify and propose for revision or elimination, applicable portions of U.S. laws and regulations that unnecessarily impede commercial space sector activities.

- U.S. Government agencies shall work with the commercial space sector to promote the establishment of technical standards for commercial space products and services.

- U.S. Government agencies shall enter into appropriate cooperative agreements to encourage and advance private sector basic research, development, and operations. Agencies may reduce initial private sector risk by agreeing to future use of privately supplied space products and services where appropriate.

-- "Anchor Tenancy" is an example of such an arrangement whereby U.S. Government agencies can provide initial support to a venture by contracting for enough of the future product or service to make the venture viable in the short term. Long-term viability and growth must come primarily from the sale of the product or service to customers outside the U.S. Government.

-- There must be demonstrable U.S. Government mission or program requirements for the proposed commercial space good or service. In assessing the Government's mission or program requirements for these purposes, the procuring agency may consider consolidating all anticipated U.S. Government needs for the particular product or service, top the maximum extent feasible.

-- U.S. Government agencies entering into such arrangements may take action, consistent with current policies and funding availability, to provide compensation to commercial space providers for future termination of missions for which the products or services were required.

- The United States will work toward establishment of an international trading environment that encourages market-oriented competition by working with its trading partners to:

  -- Establish clear principles for international space markets that provide an atmosphere favorable to stimulating greater private investment and market development;

  -- Eliminate direct government subsidies and other unfair practices that undermine normal market competition among commercial firms;

  -- Eliminate unfair competition by governments for business in space markets consistent with domestic policies that preclude or deter U.S. Government competition with commercial space sector activities.

The U.S. Commercial Space Policy Guidelines are consistent with the National Space Policy and the U.S. Commercial Space Launch Policy which remain fully applicable to activities of the governmental space sectors and the commercial space sector.

Reporting Requirements

U.S. Government agencies affected by these guidelines are directed to report by October 1, 1991, to the National Space Council on their activities related to the implementation of these policy guidelines.

APPENDIX VII: NATIONAL SPACE LAUNCH STRATEGY - 1991

THE VICE PRESIDENT'S OFFICE

Office of the Press Secretary

FOR IMMEDIATE RELEASE July 24, 1991

VICE PRESIDENT ANNOUNCES NATIONAL SPACE LAUNCH STRATEGY

Today, the Vice President announced a new National Space Launch Strategy which provides a long range plan to meet America's space launch needs. The strategy, which has been approved by the President, calls for maintaining current launch systems and facilities and extending their useful lifetimes well into the first decade of the new century. The new policy states that while the current fleet of Space Shuttles will continue to meet manned spaceflight needs, the purchase of additional Shuttle orbiters is not planned.

In the future, the nation's core launch needs will be met by a new family of vehicles -- a new national launch system -- to be developed jointly by the Department of Defense and the National Aeronautics and Space Administration. These new launchers will make space more accessible by reducing operating costs and improving reliability, responsiveness, and mission performance.

The strategy calls for a vigorous space launch technology program which can provide the basis for revolutionary improvements in launch capability in the future. The strategy also provides guidance which will ensure that actions taken to meet U.S. government launch needs also serve to strengthen the U.S. commercial space industry and enhance America.s international competitiveness.
The National Space Launch Strategy was developed by the National Space Council, chaired by the Vice President.

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Attachment

NATIONAL SPACE LAUNCH STRATEGY

I. Introduction

a. National space policy provides a framework within which agencies plan and conduct U.S. government space activities. The National Space Launch Strategy provides guidance for implementation of that policy with respect to access to and from space.

b. Assured access to space is the key element of U.S. national space policy and a foundation upon which U.S. civil, national security, and commercial space activities depend.

c. United States space launch infrastructure, including launch vehicles and supporting facilities, should: (1) provide safe and reliable access to, transportation in, and return from space; (2) reduce the costs of space transportation and related services, thus encouraging expanded space activities; (3) exploit the unique attributes of manned and unmanned launch and recovery systems; and, (4) encourage, to the maximum extent feasible, the development and growth of U.S. private sector space transportation capabilities which can compete internationally.

II. Space Launch Strategy

a. The National Space Launch Strategy is composed of four elements.

(1) Ensuring that existing space launch capabilities, including support facilities, are sufficient to meet U.S. Government manned and unmanned space launch needs.

(2) Developing a new unmanned, but man-rateable, space launch system to greatly improve national launch capability with reductions in operating costs and improvements in launch system reliability, responsiveness, and mission performance.

(3) Sustaining a vigorous space launch technology program to provide cost effective improvements to current launch systems, and to support development of advanced launch capabilities, complementary to the new launch system.

(4) Actively considering commercial space launch needs and factoring them into decisions on improvements in launch facilities and launch vehicles.

b. These strategy elements will be implemented within the overall resource and policy guidance provided by the President.

III. Strategy Guidelines

a. Existing Space Launch Capability

(1) A mixed fleet comprised of the Space Shuttle and existing expendable launch vehicles will be the primary U.S. government means to transport people and cargo to and from space through the current decade and will be important components of the nation's launch capability well into the first decade of the 21st century.

(2) To meet U.S. government needs, agencies will conduct programs to systematically maintain and improve the Space Shuttle, current U.S. expendable launch vehicle fleets, and supporting launch site facilities and range capabilities. Such programs shall be cost effective relative to current and programmed mission needs and to investments in new launch capabilities.

(3) As the nation is moving toward development of a new space launch system, the production of additional Space Shuttle orbiters is not planned. The production of spare parts should continue in the near term to support the existing Shuttle fleet, and to preserve an option to acquire a replacement orbiter in the event of an orbiter loss or other demonstrable need . By continuing to operate the Shuttle conservatively, by taking steps to increase the reliability and lifetime of existing orbiters, and by developing a new launch system, the operational life of the existing orbiter fleet will be extended. The Space Shuttle will be used only for those important missions that require manned presence or other unique Shuttle capabilities, or for which use of the Shuttle is determined to be important for national security, foreign policy, or other compelling purposes.

(4) Consistent with U.S. national security and national space policy, the U.S. government may seek to recover residual value form ballistic missile which are, or subsequently become, surplus to the needs of the Department of Defense. Prior to any release of such missiles, including components, beyond those already approved for use as space launch vehicles, the Department of Defense will conduct, and the National Space Council and the National Security Council

will review, an assessment of alternative disposition options for such missiles.

Disposition options will be evaluated in terms of their consistency with U.S. national security and foreign policy interests, available agency resources, defense industrial base considerations, and with due regard to economic impact on the commercial space sector, promoting competition, and the long-term public interest.

b. New Space Launch System

(1) The Department of Defense and the National Aeronautics and Space Administration will undertake the joint development of a new space launch system to meet civil and national security needs. The goal of this launch program is to greatly improve national launch capability with reductions in operating costs and improvements in launch system reliability, responsiveness and mission performance.

(2) The new launch system, including manufacturing processes and production and launch facilities, will be designed to support a range of medium to heavy-lift performance requirements and to facilitate evolutionary change as requirements evolve. The design may take advance of existing components from both the Space Shuttle and existing expendable rockets in or to expedite initial capability and reduce development costs. While initially unmanned, the new launch system will be designed to be "man-rateable" in the future.

(3) The new launch system will be managed, funded, and developed jointly by the Department of Defense and the National Aeronautics and Space Administration. The development program will be structured in the near term toward the goal of a first flight in 1999. However, the program should allow for several schedule options for the first flight and should identify key intermediate milestones. Since the new launch system will provide the opportunity for significant long-term benefits to the commercial space launch industry, the agencies should actively explore the potential for U.S. private sector participation. Final decisions on the program schedule, including the date of the first flight, will be made during fiscal year 1993, based on updated requirements and technical and budgetary considerations at that time. A joint program plan will be prepared by the Department of Defense and the National Aeronautics and Space Administration and reviewed by the National Space Council.

(4) The Department of Defense and the National Aeronautics and Space Administration will plan for the transition of selected space programs from current launch systems to the new launch system at appropriate program milestones to insure mission continuity and to minimize satellite and other transition costs.

c. Space Launch Technology

(1) In addition to conducting the focused development program for a new launch system, appropriate U.S. government agencies will continue to conduct broadly based research and focused technology programs to support long-term improvements in national space launch capabilities. This technology effort shall address launch system components (e.g., engines, materials, structures, avionics); upper stages; improved launch processing concepts; advanced launch system concepts (e.g., single-stage-to-orbit concepts including the National AeroSpace Plane); and experimental flight vehicle programs.

(2) The Department of Defense, the Department of Energy, and the National Aeronautics and Space Administration will coordinate space launch technology efforts and, by December 1, 1991, jointly prepare a 10-year space launch technology plan.

d. Commercial Space Launch Considerations

(1) In addition to addressing government needs, improvement of space launch capabilities can facilitate the ability of the U.S. commercial space launch industry to compete. Consistent with U.S. space policy, U.S. government agencies will actively consider commercial space launch needs and factor them into decisions on exiting space launch capabilities, development of a new space launch system, and implementation of space launch technology programs in the following ways:

a) U.S. government funded investments will be consistent with approved budgets and U.S. government requirements.

b) U.S. government agencies, in acquiring space launch related capabilities, should:

(1) Allow contractors, to the fullest extent feasible, the flexibility to accommodate commercial needs when developing launch vehicles and infrastructure to meet government needs.

(2) Emphasize procurement strategies which are based on: "best value" rather than lowest cost, performance-based functional requirements, commercial production and quality-assurance standards and techniques, and the use of commercially-offered space products and services.

(3) Encourage commercial, state, and local government investment and participation in the development and improvement of U.S. launch systems and facilities.

(4) Provide for private sector retention of technical data rights, except those rights necessary to meet government needs or to comply with statutory responsibilities.

(c) U.S. government agencies should seek to remove, where appropriate, legal or administrative impediments to private sector arrangements such as industry teams, consortia, cost-sharing, and joint production agreements which may benefit U.S. government needs and economic competitiveness. Agencies should also seek legislative authority for stable long-term commitments to purchase space transportation services.

(d) Within applicable law, U.S. government agencies are encouraged to use industry advisory groups to facilitate the identification of commercial space launch needs and the elimination of barriers that unnecessarily impede commercial space launch activities. U.S. agencies are also encouraged to consult with state and local governments.

IV. Reporting Requirements

U.S. Government agencies affected by these strategy guidelines are directed to report by December 1, 1991, to the National Space Council on their activities related to the implementation of these policies.

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APPENDIX VIII: LANDSAT REMOTE SENSING STRATEGY - 1992

THE VICE PRESIDENT'S OFFICE

Office of the Press Secretary

For Immediate Release February 13, 1992

VICE PRESIDENT ANNOUNCES LANDSAT POLICY

The Vice President announced today that President Bush has approved a National Space Policy Directive which reaffirms the importance of Landsat-type multispectral imaging and provides a plan for maintaining continuity of Landsat coverage into the 21st century.

Landsat is an important satellite program which provides multispectral pictures of the Earth. It supports U.S. government needs, including those related to national security and global change research, and benefits the U.S. private sector. In May 1989, President Bush directed that continuity of Landsat-type remote sensing data be maintained, and approved a series of near term actions to implement this policy. The new National Space Council chaired by Vice President Quale, establishes a comprehensive, long-range strategy and assigns agency responsibilities for the future.

A key element of this strategy is the assignment of management and funding responsibility for the next satellite, Landsat 7, to the agencies which have the primary requirements for the data, NASA and the Department of Defense. The strategy seeks to minimize the cost of Landsat-type images for U.S. government uses, calls on agencies to eliminate unnecessary regulations governing private sector remote sensing activities, and foster development of advanced remote sensing technologies to reduce the cost and improve the performance of future satellites.

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LANDSAT REMOTE SENSING STRATEGY

I. Policy Goals

A remote sensing capability such as is currently being provided by Landsat satellites 4 and 5 benefits the civil and national security interests of the United States and makes contributions to the private sector which are in the public interest. For these reasons, the United States government will seek to maintain continuity of Landsat-type data. The U.S. government will:

(a) Provide data which are sufficiently consistent in terms of acquisition geometry, coverage characteristics and spectral characteristics with previous Landsat data to allow comparisons for change detection and characterization;

(b) Make Landsat data available to meet the needs of national security, global change research, and other federal users; and,

(c) Promote and not preclude private sector commercial opportunities in Landsat-type remote sensing.

II. Landsat Strategy

a. The Landsat strategy is composed of the following elements:

(1) Ensuring that Landsat satellites 4 and 5 continue to provide data as long as they are technically capable of doing so, or until Landsat 6 becomes operational.

(2) Acquiring a Landsat 7 satellite with the goal of maintaining continuity of Landsat-type data beyond the projected Landsat 6 end-of-life.

(3) Fostering the development of advanced remote sensing technologies, with the goal of reducing the cost and increasing the performance of future Landsat-type satellites to meet U.S. government needs, and potentially, enabling substantially greater opportunities for commercialization.

(4) Seeking to minimize the cost of Landsat-type data for U.S. government agencies and to provide data for use in global change research in a manner consistent with the Administration's Data Management for Global Change Research Policy Statements.

(5) Limiting U.S. government regulations affecting private sector remote sensing activities to only those required in the interest of national security, foreign policy, and public safety.

(6) Maintaining an archive, within the United States, of existing and future Landsat-type data.

(7) Considering alternatives for maintaining continuity of data beyond Landsat 7.

b. These strategy elements will be implemented within the overall resource and policy guidance provided by the President.

III. <u>Implementing Guidelines</u>

a. The Department of Commerce will:

(1) Complete and launch Landsat 6.

(2) In coordination with OMB, arrange for the continued operation of Landsat satellites 4 and 5 until Landsat 6 becomes operational.

b. The Department of Defense and the National Aeronautics and Space Administration will:

(1) Develop and launch a Landsat 7 satellite of at least equivalent performance to replace Landsat 6 and define alternatives for maintaining data continuity beyond Landsat 7.

(2) Prepare a plan by March 1, 1992, which addresses management and funding responsibilities, operations, data archiving and dissemination, and commercial considerations associated with the Landsat program. This plan will be coordinated with other U.S. government agencies, as appropriate, and reviewed by the National Space Council.

(3) With support of the Department of Energy and other appropriate agencies, prepare a coordinate technology plan that has as its goals improving the performance and reducing the cost of future Landsat-type remote sensing systems.

c. The Department of the Interior will continue to maintain a national archive of Landsat-type remote sensing data.

d. Affected agencies will identify funds, within their approved fiscal year 1993 budget, necessary to implement this strategy.

IV. Reporting Requirements

U.S. government agencies affected by these strategy guidelines are directed to report by March 15, 1992, to the National Space Council on the implementation of this strategy.

APPENDIX IX: SPACE EXPLORATION STRATEGY - 1992

THE VICE PRESIDENT'S OFFICE

Office of the Press Secretary

For Immediate Release March 13, 1992

VICE PRESIDENT ANNOUNCES SPACE EXPLORATION INITIATIVE STRATEGY

The Vice President announced today that President Bush has approved a National Space Policy Directive reaffirming the U.S. commitment to space exploration. The new Space Exploration Initiative Strategy outlines the next steps to be taken by the Naitonal Aeronautics and Space Administration (NASA), the Department of Defense (DoD), the Department of Energy (DoE), and other federal agencies regarding the planning for and conduct of the nation's Space Exploration Initiative (SEI).

The policy directive, which was developed by the National Sapce Council chaired by Vice President Quale, establishes NASA as the principal implementing agency for the SEI. DoD and DoE, as participating agencies, will have major roles in support of SEI in the conduct of technolgoy development and concept definition.

The directive establishes an exploration office headed by the NASA Associate Administrator for Exploration and staffed by NASA and representatives from other participating agencies. It also calls for a Steering Committeee for Space Exploration to be estblished as the senior interagency forum for coordinating SEI-related activities and for identifying those issues requiring consideration by the National Space Council.

The policy directive affrims that the exploration of space is one fo the fundamental goals fo the U.S. civil space program. The SEI objectives include a return to the moon -- this time to stay -- and human expeditions to Mars.

This directive augments previous PResidential directives and recognizes the recommendations of both the Advisory Committee on the Future of the U.S. Space Program and the SEI Synthesis Group.

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SPACE EXPLORATION INITIATIVE STRATEGY

i. Introduction

The Space Exploration Initiative Strategy approves the next in a series of steps to be taken by the National Aeronautics and Space Administration (NASA), the Department of Defense (DoD), the Department of Energy (DoE), and other federal agencies regarding the planning for, and conduct of, the nation's Space Exploration Initiative (SEI) which includes both Lunar and Mars elements, manned and robotic missions and supporting technology. This series of steps augments previous Presidential directives and recognizes the recommendations of both the Advisory Committee on the Future of the U.S. Space Program and the SEI Synthesis Group. The exploration of space is one of the fundamental goals of the U.S. civil space program. The SEI objectives which build upon previous accomplishments, as well as upon exiting programs, include a return to the moon - this time to stay - and human expeditions to Mars. In addition, the objectives will provide a strategic framework for the conduct of the U.S. civil space program and will help focus investments in many areas of goal-oriented research and development by government, industry and academia. Consistent with the Commercial Space Policy, this framework is also intended to encourage private sector activities which augment or support the SEI objectives.

NASA is the principal implementing agency for the SEI. DoD and DoE, as participating agencies, will have major roles in support of the SEI in the conduct of technology development and concept definition. Other U.S. government agencies are encouraged to participate by developing activities supportive of the SEI.

II. Exploration Responsibilities & Actions

To establish a firm foundation and clear direction for the SEI, the following actions shall be undertaken immediately.

(a) NASA shall establish an exploration office headed by the Associate Administrator for Exploration and staffed by NASA and representatives from other participating agencies. The Associate Administrator shall be responsible for architecture and mission studies, planning, and program execution, as well as the definition of resulting requirements for research, technology, infrastructure, mission elements and program implementation. As director of the exploration office,the Associate Administrator shall prepare an annual status report. The NASA Administrator shall present this report to the National Space Council.

(b) Working with participating agencies, NASA's Associate Administrator for Exploration shall develop a strategic plan for the SEI to establish the basis for integrating existing and future SEI-related activities. This plan shall address research, technology development and operations and identify the relationships between the SEI mission elements and the U.S. space infrastructure.

(c) A Steering Committee for Space Exploration shall be established, chaired by NASA's Associate Administrator for Exploration, and shall include representation from participating agencies. The Committee shall be the senior interagency forum for coordinating organizational interfaces, reports, plans and activities, and SEI-related programs and budgets; and for identifying those issues requiring consideration by the National Space Council. The Department of State shall participate in any meetings of the Committee related to international cooperations or other international activity.

III. Exploration Guidelines

To insure that necessary preparatory activities are accomplished, the following steps shall be taken:

(a) The participating agencies shall address critical, long-lead research and technology development activities which are supportive of the exploration strategic plan.

(b) The Department of Commerce and other appropriate agencies shall encourage the development of SEI-related proposals which foster private sector investments, ownership and operation of space-related projects and ventures, as well as promote U.S. economic competitiveness. These agencies shall seek increased cooperation with the private sector through mechanisms such as technology transfer agreements, cooperative research and development agreements, and consortia, as appropriate.

(c) Exploration requirements shall be incorporated into the evolutionary plans for the new national launch system.

(d) NASA, DoD, and DoE shall continue technology development for space nuclear power and propulsion while ensuring that these activities are performed in a safe and environmentally acceptable manner and consistent with exiting laws and regulations, treaty obligations and agency mission requirements.

(e) NASA and appropriate participating agencies shall implement a definitive life science program in support of the human exploration of the Moon and Mars.

(f) All participating agencies should include space exploration in their respective educational programs. In addition, participating agencies shall take advantage of university research capabilities and cooperative education programs in SEI-related activities.

(g) International cooperation in this endeavor is feasible and could offer significant benefits to the United States, subject to the satisfaction of national security, foreign policy, scientific and economic interests.

(h) Expanding on individual agency efforts to improve and streamline acquisition procedures, the Associate Administrator for Exploration, and participating agencies, shall work with the Office of Management and Budget and the Office of Federal Procurement Policy to develop improved U.S. government procurement practices available for SEI acquisition.

(i) The exploration office shall seek innovative ideas by encouraging input from all sectors of American society.

IV. Reporting Requirements

(a) By November 1992, the first annual status report shall be presented to the National Space Council.It shall address options for exploration architectures and initial capabilities.

(b) The initial version of the Strategic Plan for the Space Exploration Initiative shall be presented to the National Space Council by April 1992, and updated regularly, thereafter. The initial version shall focus on technology development and alternate mission architectures.

APPENDIX X: MAJOR SPACE RELATED TREATIES

- Outer Space Treaty (1967)
- Moon Treaty (1979)
- Limited Test Ban Treaty (1963)
- Salt I (1972)
- Anti-ballistic Missile Treaty (1972)
- ABM Treaty Amendment (1974)

Outer Space Treaty

Treaty on principles governing the activities of states in the exploration and use of outer space, including the Moon and other celestial bodies

The States Parties to this Treaty,

Inspired by the great prospects opening up before mankind as a result of man's entry into outer space,

Recognising the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes.

Believing that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development.

Desiring to contribute to broad international co-operation in the scientific as well as the legal aspects of the exploration and use of outer space for peaceful purposes.

Believing that such co-operation will contribute to the development of mutual understanding and to the strengthening of relations between States and peoples,

Recalling resolution 1962 (XVIII), entitled "Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space," which was adopted unanimously by the United Nations General Assembly on 13 December 1963,

Recalling resolution 1884 (XVIII), calling upon States to refrain from placing in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction or from installing such weapons on celestial bodies, which was adopted unanimously by the United Nations General Assembly on 17 October 1963,

Taking account of United Nations General Assembly resolution 110 (II) of 3 November 1947, which condemned propaganda designed or likely to provoke or encourage any threat to the peace, breach of the peace or act of aggression, and considering that the aforementioned resolution is applicable to outer space,

Convinced that a Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, will further the Purposes and Principles of the Charter of the United Nations,

Have agreed on the following:

ARTICLE I

The exploration and use of outer space, including the Moon and celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.

Outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.

There shall be freedom of scientific investigation in outer space, including the Moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation.

ARTICLE II

Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.

ARTICLE III

States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the Moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding.

ARTICLE IV

States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner.

The Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purpose shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the Moon and other celestial bodies shall also not be prohibited.

ARTICLE V

States Parties to the Treaty shall regard astronauts as envoys of mankind in outer space and shall render to them all possible assistance in the event of accident, distress, or emergency landing on the territory of another State Party or on the high seas. When astronauts make such a landing, they shall be safely and promptly returned to the State of registry of their space vehicle.

In carrying on activities in outer space and on celestial bodies, the astronauts of one State Party shall render all possible assistance to the astronauts of other States Parties.

States Parties to the Treaty shall immediately inform the other States Parties to the Treaty or the Secretary-General of the United Nations of any phenomena they discover in outer space, including the Moon and other celestial bodies, which could constitute a danger to the life or health of astronauts.

ARTICLE VI

States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorisation and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the Moon and other celestial bodies, by an international organisation, responsibility for compliance with this Treaty shall be borne both by the international organisation and by the States Parties to the Treaty participating in such organisation.

ARTICLE VII

Each State Party to the Treaty that launches or procures the launching of an object into outer space including the Moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or judicial persons by such object or its component parts on the Earth, in air space or in outer space, including the Moon and other celestial bodies.

ARTICLE VIII

A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body. Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth. Such objects or component parts found beyond the limits of the State Party to the Treaty on whose registry they are carried shall be returned to that State Party, which shall upon request, furnish identifying data prior to their return.

ARTICLE IX

In the exploration and use of outer space, including the Moon and other celestial bodies, States Parties to the Treaty shall be guided by the principles of co-operation and mutual assistance and shall conduct all their activities in outer space, including the Moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty. States Parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose. If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, may request consultation concerning the activity or experiment.

ARTICLE X

In order to promote international co-operation and use of outer space, including the Moon and other celestial bodies, in conformity with the purposes of this Treaty, the States Parties to the Treaty shall consider on a basis of equality any requests by other States Parties to the Treaty to be afforded an opportunity to observe the flight of space objects launched by those States.

The nature of such an opportunity for observation and the conditions under which it could be afforded shall be determined by agreement between the States concerned.

ARTICLE XI

In order to promote international co-operation in the peaceful exploration and use of outer space, States Parties to the Treaty conducting activities in outer space, including the Moon and other celestial bodies, agree to inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of the nature, conduct, locations and results of such activities. On receiving the said information, the Secretary-General of the United Nations should be prepared to disseminate it immediately and effectively.

ARTICLE XII

All stations, installations, equipment and space vehicles on the Moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity. Such representatives shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited.

ARTICLE XIII

The provisions of this Treaty shall apply to the activities of States Parties to the Treaty in the exploration and use of outer space, including the Moon and other celestial bodies, whether such activities are carried on by a single State Party to the Treaty or jointly with other States, including cases where they are carried on within the framework of international intergovernmental organisations.

Any practical questions arising in connection with activities carried on by international intergovernmental organisations in the exploration and use of outer space, including the Moon and other celestial bodies, shall be resolved by the States Parties to the Treaty either with the appropriate international organisation or with one or more States members of that international organisation.

ARTICLE XIV

1. This Treaty shall be open to all States for signature. Any State which does not sign this Treaty before its entry into force in accordance with paragraph 3 of this article may accede to it at any time.
2. This Treaty shall be subject to a ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the United States of America, the United Kingdom of Great Britain and Northern Ireland and the Union of Soviet Socialist Republics, which are hereby designted the Depository Governments.
3. This Treaty shall enter into force upon the deposit of instruments of ratification by five Governments including the Governments designated as Depository Governments under this Treaty.

MOON TREATY

Agreement governing the activities of states on the Moon and other celestial bodies (Moon Treaty, 1979)

OPENED FOR SIGNATURE: New York, 5 December 1979
ENTERED INTO FORCE: 11 July 1984
DEPOSITARY: UN Secretary-General
PARTIES: 5

The States Parties to this Agreement,

Noting the achievements of States in the exploration and use of the moon and other celestial bodies,

Recognizing that the moon, as a natural satellite of the earth, has an important role to play in the exploration of outer space,

Determined to promote on the basis of equality the further development of co-operation among States in the exploration and use of the moon and other celestial bodies,

Desiring to prevent the moon from becoming an area of international conflict,

Bearing in mind the benefits which may be derived from the exploitation of the natural resources of the moon and other celestial bodies,

Recalling the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, the Convention on International Liability for Damage Caused by Space Objects, and the Convention on Registration of Objects Launched into Outer Space,

Taking into account the need to define and develop the provisions of these international instruments in relation to the moon and other celestial bodies, having regard to further progress in the exploration and use of outer space,

Have agreed on the following:

Article I

1. The provisions of this Agreement relating to the moon shall also apply to other celestial bodies within the solar system, other than the earth, except in so far as specific legal norms enter into force with respect to any of these celestial bodies.
2. For the purpose of this Agreement reference to the moon shall include orbits around or other trajectories to or around it.
3. This Agreement does not apply to extra-terrestrial materials which reach the surface of the earth by natural means.

Article 2

All activities on the moon, including its exploration and use, shall be carried out in accordance with international law, in particular the Charter of the United Nations, and taking into account the Declaration on Principles of International Law concerning Friendly Relations and Co-operation among States in accordance with the Charter of the United Nations, adopted by the General Assembly on 24 October 1970, in the interests of maintaining international peace and security and promoting international co-operation and mutual understanding, and with due regard to the corresponding interests of all other States Parties.

Article 3

1. The moon shall be used by all States Parties exclusively for peaceful purposes.
2. Any threat or use of force or any other hostile act or threat of hostile act on the moon is prohibited. It is likewise prohibited to use the moon in order to commit any such act or to engage in any such threat in relation to the earth, the moon, spacecraft, the personnel of spacecraft or man-made space objects.
3. States Parties shall not place in orbit around or other trajectory to or around the moon objects carrying nuclear weapons or any other kinds of weapons of mass destruction or place or use such weapons on or in the moon.
4. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on the moon shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration and use of the moon shall also not be prohibited.

Article 4

1. The exploration and use of the moon shall be the province of all mankind and shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development. Due regard shall be paid to the interests of present and future generations as well as to the need to promote higher standards of living and conditions of economic and social progress and development in accordance with the Charter of the United Nations.
2. States Parties shall be guided by the principle of co-operation and mutual assistance in all their activities concerning the exploration and use of the moon. International co-operation in pursuance of this Agreement should be as wide as possible and may take place on a multilateral basis, on a bilateral basis or through international intergovernmental organizations.

Article 5

1. States Parties shall inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of their activities concerned with the exploration and use of the moon. Information on the time, purposes, location, orbital parameters and duration shall be given in respect of each mission to the moon as soon as possible after launching, while information on the results of each mission, including scientific results, shall be furnished upon completion of the mission. In the case of a mission lasting more than thirty days, information on conduct of the mission, including any scientific results, shall be given periodically at thirty days' intervals. For missions lasting more than six months, only significant additions to such information need be reported thereafter.

2. If a State Party becomes aware that another State Party plans to operate simultaneously in the same area or in the same orbit around or trajectory to or around the moon, it shall promptly inform the other State of the timing of and plans for its own operations.

3. In carrying out activities under this Agreement, States Parties shall promptly inform the Secretary-General, as well as the public and the international scientific community, of any phenomena they discover in outer space, including the moon, which could endanger human life or health, as well as of any indication of organic life.

Article 6

1. There shall be freedom of scientific investigation on the moon by all States Parties without discrimination of any kind, on the basis of equality and in accordance with international law.

2. In carrying out scientific investigations and in furtherance of the provisions of this Agreement, the States Parties shall have the right to collect on and remove from the moon samples of its mineral and other substances. Such samples shall remain at the disposal of those States Parties which caused them to be collected and may be used by them for scientific purposes. States Parties shall have regard to the desirability of making a portion of such samples available to other interested States Parties and the international scientific community for scientific investigation. States Parties may in the course of scientific investigations also use mineral and other substances of the moon in quantities appropriate for the support of their missions.

3. States Parties agree on the desirability of exchanging scientific and other personnel on expeditions to or installations on the moon to the greatest extent feasible and practicable.

Article 7

1. In exploring and using the moon, States Parties shall take measures to prevent the disruption of the existing balance of its environment whether by introducing adverse changes in that environment, by its harmful contamination through the introduction of extra-environmental matter or otherwise. States Parties shall also take measures to avoid harmfully affecting the environment of the earth through the introduction of extraterrestrial matter or otherwise.

2. States Parties shall inform the Secretary-General of the United Nations of the measures being adopted by them in accordance with paragraph 1 of this article and shall also, to the maximum extent feasible, notify him in advance of all placements by them of radio-active materials on the moon and of the purposes of such placements.

3. States Parties shall report to other States Parties and to the Secretary-General concerning areas of the moon having special scientific interest in order that, without prejudice to the rights of other States Parties, consideration may be given to the designation of such areas as international scientific preserves for which special protective arrangments are to be agreed upon in consultation with the competent bodies of the United Nations.

Article 8

1. States Parties may pursue their activities in the exploration and use of the moon anywhere on or below its surface, subject to the provisions of this Agreement.

2. For these purposes States Parties may, in particular:

(*a*) Land their space objects on the moon and launch them from the moon;

(*b*) Place their personnel, space vehicles, equipment, facilities, stations and installations anywhere on or below the surface of the moon. Personnel, space vehicles, equipment, facilities, stations and installations may move or be moved freely over or below the surface of the moon.

3. Activities of States Parties in accordance with paragraphs 1 and 2 of this article shall not interfere with the activities of other States Parties on the moon. Where such interference may occur, the States Parties concerned shall undertake consultations in accordance with article 15, paragraphs 2 and 3 of this Agreement.

Article 9

1. States Parties may establish manned and unmanned stations on the moon. A State Party establishing a station shall use only that area which is required for the needs of the station and shall immediately inform the Secretary-General of the United Nations of the location and purposes of the station. Subsequently, at annual intervals that State shall likewise inform the Secretary-General whether the station continues in use and whether its purposes have changed.

2. Stations shall be installed in such a manner that they do not impede the free access to all areas of the moon by personnel, vehicles and equipment of other States Parties conducting activities on the moon in accordance with the provisions of this Agreement or of article I of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies.

Article 10

1. States Parties shall adopt all practicable measures to safeguard the life and health of persons on the moon. For this purpose they shall regard any person on the moon as an astronaut within the meaning of article V of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies and as part of the personnel of a spacecraft within the meaning of the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space.

2. States Parties shall offer shelter in their stations, installations, vehicles and other facilities to persons in distress on the moon.

Article 11

1. The moon and its natural resources are the common heritage of mankind, which finds its expression in the provisions of this Agreement and in particular in paragraph 5 of this article.

2. The moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by any other means.

3. Neither the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become property of any State, international intergovernmental or non-governmental organization, national organization or non-governmental entity or of any natural person. The placement of personnel, space vehicles, equipment, facilities, stations and installations on or below the surface of the moon, including structures connected with its surface or subsurface, shall not create a right or ownership over the surface or the subsurface of the moon or any areas thereof. The foregoing provisions are without prejudice to the international régime referred to in paragraph 5 of this article.

4. States Parties have the right to exploration and use of the moon without discrimination of any kind, on a basis of equality and in accordance with international law and the terms of this Agreement.

5. States Parties to this Agreement hereby undertake to establish an international régime, including appropriate procedures, to govern the exploitation of the natural resources of the moon as such exploitation is about to become feasible. This provision shall be implemented in accordance with article 18 of this Agreement.

6. In order to facilitate the establishment of the international régime referred to in paragraph 5 of this article, States Parties shall inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of any natural resources they may discover on the moon.

7. The main purposes of the international régime to be established shall include:

(*a*) The orderly and safe development of the natural resources of the moon;

(*b*) The rational management of those resources;

(*c*) The expansion of opportunities in the use of those resources;

(*d*) An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the moon, shall be given special consideration.

8. All the activities with respect to the natural resources of the moon shall be carried out in a manner compatible with the purposes specified in paragraph 7 of this article and the provisions of article 6, paragraph 2, of this Agreement.

Article 12

1. States Parties shall retain jurisdiction and control over their personnel, vehicles, equipment, facilities, stations and installations on the moon. The ownership of space vehicles, equipment, facilities, stations and installations shall not be affected by their presence on the moon.

2. Vehicles, installations and equipment or their component parts found in places other than their intended location shall be dealt with in accordance with article 5 of the Agreement on Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space.

3. In the event of an emergency involving a threat to human life, States Parties may use the equipment, vehicles, installations, facilities or supplies of other States Parties on the moon. Prompt notification of such use shall be made to the Secretary-General of the United Nations or the State Party concerned.

Article 13

A State Party which learns of the crash landing, forced landing or other unintended landing on the moon of a space object, or its component parts, that were not launched by it, shall promptly inform the launching State Party and the Secretary-General of the United Nations.

Article 14

1. States Parties to this Agreement shall bear international responsibility for national activities on the moon, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in this Agreement. States Parties shall ensure that non-governmental entities under their jurisdiction shall engage in activities on the moon only under the authority and continuing supervision of the appropriate State Party.

2. States Parties recognize that detailed arrangements concerning liability for damage caused on the moon, in addition to the provisions of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies and the Convention on International Liability for Damage caused by Space Objects, may become necessary as a result of more extensive activities on the moon. Any such arrangements shall be elaborated in accordance with the procedure provided for in article 18 of this Agreement.

Article 15

1. Each State Party may assure itself that the activities of other States Parties in the exploration and use of the moon are compatible with the provisions of this Agreement. To this end, all space vehicles, equipment, facilities, stations and installations on the moon shall be open to other States Parties. Such States Parties shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited. In pursuance of this article, any State Party may act on its own behalf or with the full or partial assistance of any other State Party or through appropriate international procedures within the framework of the United Nations and in accordance with the Charter.

2. A State Party which has reason to believe that another State Party is not fulfilling the obligations incumbent upon it pursuant to this Agreement or that another State Party is interfering with the rights which the former State has under this Agreement may request consultations with that State Party. A State Party receiving such a request shall enter into such consultations without delay. Any other State Party which requests to do so shall be entitled to take part in the consultations. Each State Party participating in such consultations shall seek a mutually acceptable resolution of any controversy and shall bear in mind the rights and interests of all States Parties. The Secretary-General of the United Nations shall be informed of the results of the consultations and shall transmit the information received to all States Parties concerned.

3. If the consultations do not lead to a mutually acceptable settlement which has due regard for the rights and interests of all States Parties, the parties concerned shall take all measures to settle the dispute by other peaceful means of their choice appropriate to the circumstances and the nature of the dispute. If difficulties arise in connexion with the opening of consultations or if consultations do not lead to a mutually acceptable settlement, any State Party may seek the assistance of the Secretary-General, without seeking the consent of any other State Party concerned, in order to resolve the controversy. A State Party which does not maintain diplomatic relations with another State Party shall participate in such consultations, at its choice, either itself or through another State Party or the Secretary-General as intermediary.

Article 16

With the exception of articles 17 to 21, references in this Agreement to States shall be deemed to apply to any international intergovernmental organization which conducts space activities if the organization declares its acceptance of the rights and obligations provided for in this Agreement and if a majority of the States members of the organization are States Parties to this Agreement and to the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies. States members of any such organization which are States Parties to this Agreement shall take all appropriate steps to ensure that the organization makes a declaration in accordance with the foregoing.

Article 17

Any State Party to this Agreement may propose amendments to the Agreement. Amendments shall enter into force for each State Party to the Agreement accepting the amendments upon their acceptance by a majority of the States Parties to the Agreement and thereafter for each remaining State Party to the Agreement on the date of acceptance by it.

Article 18

Ten years after the entry into force of this Agreement, the question of the review of the Agreement shall be included in the provisional agenda of the General Assembly of the United Nations in order to consider, in the light of past application of the Agreement, whether it requires revision. However, at any time after the Agreement has been in force for five years, the Secretary-General of the United Nations, as depositary, shall, at the request of one third of the States Parties to the Agreement and with the concurrence of the majority of the States Parties, convene a conference of the States Parties to review this Agreement. A review conference shall also consider the question of the implementation of the provisions of article 11, paragraph 5, on the basis of the principle referred to in paragraph 1 of that article and taking into account in particular any relevant technological developments.

Article 19

1. This Agreement shall be open for signature by all States at United Nations Headquarters in New York.
2. This Agreement shall be subject to ratification by signatory States. Any State which does not sign this Agreement before its entry into force in accordance with paragraph 3 of this article may accede to it at any time. Instruments of ratification or accession shall be deposited with the Secretary-General of the United Nations.
3. This Agreement shall enter into force on the thirtieth day following the date of deposit of the fifth instrument of ratification.
4. For each State depositing its instrument of ratification or accession after the entry into force of this Agreement, it shall enter into force on the thirtieth day following the date of deposit of any such instrument.
5. The Secretary-General shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification or accession to this Agreement, the date of its entry into force and other notices.

Article 20

Any State Party to this Agreement may give notice of its withdrawal from the Agreement one year after its entry into force by written notification to the Secretary-General of the United Nations. Such withdrawal shall take effect one year from the date of receipt of this notification.

Article 21

The original of this Agreement, of which the Arabic, Chinese, English, French, Russian and Spanish texts are equally authentic, shall be deposited with the Secretary-General of the United Nations, who shall send certified copies thereof to all signatory and acceding states.

IN WITNESS WHEREOF the undersigned, being duly authorized thereto by their respective Governments, have signed this Agreement, opened for signature at New York on

Limited Test Ban Treaty

The Governments of the United States of America, the United Kingdom of Great Britain and Northern Ireland, and the Union of Soviet Socialist Republics, hereinafter referred to as the "Original Parties",

Proclaiming as their principal aim the speediest possible achievement of an agreement on general and complete disarmament under strict international control in accordance with the objectives of the United Nations which would put an end to the armaments race and eliminate the incentive to the production and testing of all kinds of weapons, including nuclear weapons,

Seeking to achieve the discontinuance of all test explosions of nuclear weapons for all time, determined to continue negotiations to this end, and desiring to put an end to the contamination of man's environment by radioactive substances,

Have agreed to as follows:

ARTICLE I

1. Each of the Parties to this Treaty undertakes to prohibit, to prevent, and not to carry out any nuclear weapon test explosion, or any other nuclear explosion, at any place under its jurisdiction or control:
   (a) In the atmosphere; beyond its limits, including outer space; or under water, including territorial waters or high seas; or
   (b) In any other environment if such explosion causes radioactive debris to be present outside the territorial limits of the State under whose jurisdiction or control such explosion is conducted. It is understood in this connection that the provisions of this subparagraph are without prejudice to the conclusion of a treaty resulting in the permanent banning of all nuclear test explosions, including all such explosions underground, the conclusion of which, as the Parties have stated in the Preamble to this Treaty, they seek to achieve.
2. Each of the Parties to this Treaty undertakes furthermore to refrain from causing, encouraging, or in any way participating in, the carrying out of any nuclear weapon test explosion, or any other nuclear explosion, anywhere which would take place in any of the environments described, or have the effect referred to, in paragraph 1 of this Article.

ARTICLE II

1. Any Party may propose amendments to this Treaty. The text of any proposed amendment shall be submitted to the Depository Governments which shall circulate it to all Parties to this Treaty. Thereafter, if requested to do so by one-third or more of the Parties, the Depository Government shall convene a conference, to which they shall invite all of the Parties, to consider such amendment.
2. Any amendment to this Treaty must be approved by a majority of the votes of all the Parties to this Treaty, including the votes of all of the Original Parties. The amendment shall enter into force for all Parties upon the deposit of instruments of ratification by a majority of all the Parties, including the instruments of ratification of all of the Original Parties.

ARTICLE III

1. This Treaty shall be open to all States for signature. Any State which does not sign this Treaty before its entry into force in accordance with paragraph 3 of this Article may accede to it at any time.

2. This Treaty shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the Original Parties — the United States of America, the United Kingdom of Great Britain and Northern Ireland, and the Union of Soviet Socialist Republics — which are hereby designated the Depository Governments.

3. This Treaty shall enter into force after its ratification by all the Original Parties and the deposit of their instruments of ratification.

4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Treaty, it shall enter into force on the date of the deposit of their instruments of ratification or accession.

5. The Depository Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification of an accession to this Treaty, the date of its entry into force, and the date of receipt of any requests for conferences or other notices.

6. This Treaty shall be registered by the Depository Governments pursuant to Article 102 of the Charter of the United Nations.

ARTICLE IV

This Treaty shall be of unlimited duration.

Each Party shall in exercising its national sovereignty have the right to withdraw from the Treaty if it decides that extraordinary events, related to the subject matter of this Treaty, have jeopardised the supreme interests of its country. It shall give notice of such withdrawal to all other Parties to the Treaty three months in advance.

ARTICLE V

This Treaty, of which the English and Russian texts are equally authentic, shall be deposited in the archives of the Depository Governments. Duly certified copies of this Treaty shall be transmitted by the Depository Governments to the Governments of the signatory and acceding States.

IN WITNESS WHEREOF the undersigned, duly authorised, have signed this Treaty.

DONE in triplicate at the city of Moscow the fifth day of August, one thousand nine hundred and sixty-three.

For the Government of the United States of America	For the Government of the United Kingdom of Great Britain and Northern Ireland	For the Government of the Union of Soviet Socialist Republics
Dean Rusk	Alex Douglas-Home	A. Gromyko

SALT I Treaty

The United States of America and the Union of Soviet Socialist Republics, hereinafter referred to as the Parties,

Convinced that the Treaty on the Limitation of Anti-Ballistic Missile Systems and this Interim Agreement on Certain Measures with Respect to the Limitation to Strategic Offensive Arms will contribute to the creation of more favourable conditions for active negotiations on limiting strategic arms as well as to the relaxation of international tension and the strengthening of trust between States,

Taking into account the relationship between strategic offensive and defensive arms,

Mindful of their obligations under Article VI of the Treaty on the Non-Proliferation of Nuclear Weapons,

Have agreed as follows:

ARTICLE I

The Parties undertake not to start construction of additional fixed land-based intercontinental ballistic missile (ICBM) launchers after July 1, 1972.

ARTICLE II

The Parties undertake not to convert land-based launchers for light ICBMs or for ICBMs of older types deployed prior to 1964, into land-based launchers for heavy ICBMs of types deployed after that time.

ARTICLE III

The Parties undertake to limit submarine-launched ballistic missile (SLBM) launchers and modern ballistic missile submarines to the numbers operational and under construction on the date of signature of this Interim Agreement, and in addition to launchers and submarines constructed under procedures established by the Parties, replacements for an equal number of ICBM launchers of older types deployed prior to 1964 or for launchers on older submarines.

ARTICLE IV

Subject to the provisions of this Interim Agreement, modernisation and replacement of strategic offensive ballistic missiles and launchers covered by this Interim Agreement may be undertaken.

ARTICLE V

1. For the purpose of providing assurance of compliance with the provisions of this Interim Agreement, each Party shall use national technical means of verification at its disposal in a manner consistent with generally recognized principles of international law.

2. Each Party undertakes not to interfere with the national technical means of verification of the other Party operating in accordance with paragraph 1 of this Article.

3. Each Party undertakes not to use deliberate concealment measures which impede verification by national technical means of verification in compliance with the provisions of this Interim Agreement. This obligation shall not require changes in current construction, assembly, conversion, or overhaul practices.

ARTICLE VI

To promote the objectives and implementation of the provisions of this Interim Agreement, the Parties shall use the Standing Consultative Commission established under Article XIII of the Treaty on the Limitation of Anti-Ballistic Missile Systems in accordance with the provisions of that Article.

ARTICLE VII

The Parties undertake to continue active negotiations for limitations on strategic offensive arms. The obligations provided for in this Interim Agreement shall not prejudice the scope or terms of the limitations on strategic offensive arms which may be worked out in the course of further negotiations.

ARTICLE VIII

1. This Interim Agreement shall enter into force upon exchange of written notices of acceptance by each Party, which exchange shall take place simultaneously with the exchange of instruments of ratification of the Treaty on the Limitation of Anti-Ballistic Missile Systems.

2. This Interim Agreement shall remain in force for a period of five years unless replaced earlier by an agreement on more complete measures limiting strategic offensive arms. It is the objective of the Parties to conduct active follow-on negotiations with the aim of concluding such an agreement as soon as possible.

3. Each Party shall, in exercising its national sovereignty, have the right to withdraw from this Interim Agreement if it decides that extraordinary events related to the subject matter of this Interim Agreement have jeopardized its supreme interests. It shall give notice of its decision to the other Party six months prior to withdrawal from this Interim Agreement. Such notice shall include a statement of the extraordinary events the notifying Party regards as having jeopardised its supreme interests.

DONE at Moscow on May 26, 1972, in two copies, each in the English and Russian languages, both texts being equally authentic.

For the United States of America:

RICHARD NIXON,
President of the United States of America.

For the Union of Soviet Socialist Republics:

L. I. BREZHNEV,
General Secretary of the Central Committee of the CPSU.

ABM TREATY

The United States of America and the Union of the Soviet Socialist Republics, hereinafter referred to as the Parties,

Proceeding from the premise that nuclear war would have devastating consequences for all mankind,

Considering that effective measures to limit anti-ballistic missile systems would be a substantial factor in curbing the race in strategic offensive arms and would lead to a decrease in the risk of the outbreak of war involving nuclear weapons,

Proceeding from the premise that the limitation of anti-ballistic missile systems, as well as certain agreed measures with respect to the limitation of strategic offensive arms, would contribute to the creation of more favourable conditions for further negotiations on limiting strategic arms,

Mindful of their obligations under Article VI of the Treaty on the Non-Proliferation of Nuclear Weapons,

Declaring their intention to achieve at the earliest possible date the cessation of the nuclear arms race and to take effective measures toward reductions in strategic arms, nuclear disarmament, and general and complete disarmament,

Desiring to contribute to the relaxation of international tension and the strengthening of trust between States,

Have agreed as follows:

ARTICLE I

1. Each Party undertakes to limit anti-ballistic missile (ABM) systems and to adopt other measures in accordance with the provisions of this Treaty.
2. Each Party undertakes not to deploy ABM systems for a defence of the territory of its country and not to provide a base for such a defence, and not to deploy ABM systems for defence of an individual region except as provided for in Article III of this Treaty.

ARTICLE II

1. For the purposes of this Treaty an ABM system is a system to counter strategic ballistic missiles or their elements in flight trajectory, currently consisting of:
   (a) ABM interceptor missiles, which are interceptor missiles constructed and deployed for an ABM role, or of a type tested in an ABM mode;

(b) ABM launchers, which are launchers constructed and deployed for launching ABM interceptor missiles: and

(c) ABM radars, which are radars constructed and deployed for an ABM role, or of a type tested in an ABM mode.

2. The ABM system components listed in paragraph 1 of this Article include those which are:

(a) operational;

(b) under construction;

(c) undergoing testing:

(d) undergoing overhaul, repair or conversion; or

(e) mothballed.

ARTICLE III

Each Party undertakes not to deploy ABM systems or their components except that:

(a) within one ABM system deployment area having a radius of one hundred and fifty kilometres and centred on the Party's national capital, a Party may deploy: (1) no more than one hundred ABM launchers and no more than one hundred ABM interceptor missiles at launch sites, and (2) ABM radars within no more than six ABM radar complexes, the area of each complex being circular and have a diameter of no more than three kilometres; and

(b) within one ABM system deployment area having a radius of one hundred and fifty kilometres and containing ICBM silo launchers, a Party may deploy: (1) no more than one hundred ABM launchers and no more than one hundred ABM interceptor missiles at launch sites, (2) two large phased-array ABM radars comparable in potential to corresponding ABM radars operational or under construction on the date of signature of the Treaty in an ABM system deployment area containing ICBM silo launchers, and (3) no more than eighteen ABM radars each having a potential less than the potential of the smaller of the above-mentioned two large phased-array ABM radars.

ARTICLE IV

The limitations provided for in Article III shall not apply to ABM systems or their components used for development or testing, and located within current or additionally agreed test ranges. Each Party may have no more than a total of fifteen ABM launchers at test ranges.

ARTICLE V

1. Each Party undertakes not to develop, test, or deploy ABM systems or components which are sea-based, air-based, space-based, or mobile land-based.

2. Each Party undertakes not to develop, test, or deploy ABM launchers for launching more than one ABM interceptor missile at a time from each launcher, nor to modify deployed launchers to provide them with such a capability, nor to

develop, test, or deploy automatic or semi-automatic or other similar systems for rapid reload of ABM launchers.

ARTICLE VI

To enhance assurance of the effectiveness of the limitations on ABM systems and their components provided by this Treaty, each Party undertakes:

(a) not to give missiles, launchers, or radars, other than ABM interceptor missiles, ABM launchers, or ABM radars, capabilities to counter strategic ballistic missiles or their elements in flight trajectory, and not to test them in an ABM mode; and

(b) not to deploy in the future radars for early warning of strategic ballistic missile attack except at locations along the periphery of its national territory and oriented outward.

ARTICLE VII

Subject to the provisions of this Treaty, modernisation and replacement of ABM systems or their components may be carried out.

ARTICLE VIII

ABM systems or their components in excess of the numbers or outside the areas specified in this Treaty, as well as ABM systems or their components prohibited by this Treaty, shall be destroyed or dismantled under agreed procedures within the shortest possible agreed period of time.

ARTICLE IX

To assure the viability and effectiveness of this Treaty, each Party undertakes not to transfer to other States, and not to deploy outside its national territory, ABM systems or their components limited by this Treaty.

ARTICLE X

Each Party undertakes not to assume any international obligations which would conflict with this Treaty.

ARTICLE XI

The Parties undertake to continue active negotiations for limitations on strategic offensive arms.

ARTICLE XII

1. For the purpose of providing assurance of compliance with the provisions of this Treaty, each Party shall use national technical means of verification at its disposal in a manner consistent with generally recognised principles of international law.

2. Each Party undertakes not to interfere with the national technical means of verification of the other Party operating in accordance with paragraph 1 of this Article.

3. Each Party undertakes not to use deliberate concealment measures which impede verification by national technical means of compliance with the provisions of this Treaty. This obligation shall not require changes in current construction, assembly, conversion, or overhaul practices.

ARTICLE XIII

1. To promote the objectives and implementation of the provisions of this Treaty, the Parties shall establish promptly a Standing Consultative Commission, within the framework of which they will:
   (a) consider questions concerning compliance with the obligations assumed and related situations which may be considered ambiguous;
   (b) provide on a voluntary basis such information as either Party considers necessary to assure confidence in compliance with the obligations assumed;
   (c) consider questions involving unintended interference with national technical means of verification;
   (d) consider possible changes in the strategic situation which have a bearing on the provisions of this Treaty;
   (e) agree upon procedures and dates for destruction or dismantling of ABM systems or their components in cases provided for by the provisions of this Treaty;
   (f) consider, as appropriate, possible proposals for further increasing the viability of this Treaty, including proposals for amendments in accordance with the provisions of this Treaty;
   (g) consider, as appropriate, proposals for further measures aimed at limiting strategic arms.

2. The Parties through consultation shall establish, and may amend as appropriate, Regulations for the Standing Consultative Commission governing procedures, composition and other relevant matters.

ARTICLE XIV

1. Each Party may propose amendments to this Treaty. Agreed amendments shall enter into force in accordance with the procedures governing the entry into force of this Treaty:

2. Five years after entry into force of this Treaty, and at five year intervals thereafter, the Parties shall together conduct a review of this Treaty.

ARTICLE XV

1. This Treaty shall be of unlimited duration.

2. Each Party shall, in exercising its national sovereignty, have the right to withdraw from this Treaty if it decides that extraordinary events related to the subject matter of this Treaty have jeopardized its supreme interests. It shall give notice of its decision to the other Party six months prior to withdrawal from the Treaty. Such notice shall include a statement of the extraordinary events the notifying Party regards as having jeopardized its supreme interests.

ARTICLE XVI

1. This Treaty shall be subject to ratification in accordance with the constitutional procedures of each Party. The Treaty shall enter into force on the day of the exchange of instruments of ratification.

2. This Treaty shall be registered pursuant to Article 102 of the Charter of the United Nations.

DONE at Moscow on May 26, 1972, in two copies, each in the English and Russian languages, both texts being equally authentic.

For the United States of America:

RICHARD NIXON,
President of the United States of America.

For the Union of Soviet Socialist Republics:

L. I. BREZHNEV,
General Secretary of the Central Committee of the CPSU.

ABM Treaty Amendment

Protocol to the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems

Signed at Moscow July 3, 1974
Ratification advised by US Senate November 10, 1975
Ratified by US President March 19, 1976
Instruments of ratification exchanged May 24, 1976
Proclaimed by US President July 6, 1976
Entered into force May 24, 1976

The United States of America and the Union of Soviet Socialist Republics, hereinafter referred to as the Parties.

Proceeding from the Basic Principles of Relations between the United States of America and the Union of Soviet Socialist Republics signed on May 29, 1972,

Desiring to further the objectives of the Treaty between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems signed on May 26, 1972, hereinafter referred to as the Treaty,

Reaffirming their conviction that the adoption of further measures for the limitation of strategic arms would contribute to strengthening international peace and security,

Proceeding from the premise that further limitation of anti-ballistic missile systems will create more favourable conditions for the completion of work on a permanent agreement on more complete measures for the limitation of strategic offensive arms,

Have agreed as follows:

ARTICLE I

1. Each Party shall be linked at any one time to a single area out of the two provided in Article III of the Treaty for deployment of anti-ballistic missile (ABM) systems or their components and accordingly shall not exercise its right to deploy an ABM system or its components in the second of the two ABM system deployment areas permitted by Article III of the Treaty, except as an exchange of one permitted area for the other in accordance with Article II of this Protocol.

2. Accordingly, except as permitted by Article II of this Protocol: the United States of America shall not deploy an ABM system or its components in the area centred on its capital, as permitted by Article II (a) of the Treaty, and the Soviet Union shall not deploy an ABM system or its components in the deployment area

of intercontinental ballistic missile (ICBM) silo launchers as permitted by Article III (b) of the Treaty.

ARTICLE II

1. Each Party shall have the right to dismantle or destroy its ABM system and the components thereof in the area where they are presently deployed and to deploy an ABM system or its components in the alternative area permitted by Article III of the Treaty, provided that prior to initiation of construction, notification is given in accord with the procedure agreed to in the Standing Consultative Commission, during the year beginning October 3, 1977 and ending October 2, 1978, or during any year which commences at five year intervals thereafter, those being the years for periodic review of the Treaty, as provided in Article XIV of the Treaty. This right may be exercised only once.

2. Accordingly, in the event of such notice, the United States would have the right to dismantle or destroy the ABM system and its components in the deployment area of ICBM silo launchers and to deploy an ABM system or its components in an area centred on its capital, as permitted by Article III (a) of the Treaty, and the Soviet Union would have the right to dismantle or destroy the ABM system and its components in the area centred on its capital and to deploy an ABM system or its components in an area containing ICBM silo launchers, as permitted by Article III (b) of the Treaty.

3. Dismantling or destruction and deployment of ABM systems or their components and the notification thereof shall be carried out in accordance with Article VIII of the ABM Treaty and procedures agreed in the Standing Consultative Commission.

ARTICLE III

The rights and obligations established by the Treaty remain in force and shall be complied with by the Parties except to the extent modified by this Protocol. In particular, the deployment of an ABM system or its components within the area selected shall remain limited by the levels and other requirements established by the Treaty.

ARTICLE IV

This Protocol shall be subject to ratification in accordance with the constitutional procedures of each Party. It shall enter into force on the day of the exchange of instruments of ratification and shall thereafter be considered an integral part of the Treaty.

DONE at Moscow on July 3, 1974, in duplicate, in the English and Russian languages, both texts being equally authentic.

For the United States of America:

RICHARD NIXON
President of the United States of America

For the Union of Soviet Socialist Republics:

L. I. BREZHNEV
General Secretary of the Central Committee of the CPSU

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