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Private Sector Activities in Outer Space

"We are surrounded by boundless space capable of providing a home for countless millions of human beings."[1]

"The activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty."[2]

"America has always been greatest when we dared to be great. We can reach for greatness again. We can follow our dreams to distant stars, living and working in space for peaceful economic and scientific gain."[3]

Outer space is the latest spiritual and economic frontier to challenge free enterprise capitalism. Before business can develop the vast resources of space, with resulting benefits for all humanity, a simple and flexible legal regime must evolve to authorize and supervise continuously commercial space activities. This article outlines present space activities and speculates on what space industry could accomplish by the year 2020. In addition, the framework of existing law that influences business in space is examined with

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1. K. TSIOLKOVSKY, THE CALL OF THE COSMOS (1960), 251. Konstantin Eduardovich Tsiolkovsky (1857–1935) was born in what is now part of the Soviet Union. He is noted as a research scientist in aeronautics and astronautics, a pioneer in rocket and space research, and as the developer of the first wind tunnel which was built to test models of an all-metal dirigible. His publications in the field of space are among the earliest available and include GRYOZY O ZEMLE I NEBE (Dreams of Earth and Sky) (1895) and EXPLORATION OF COSMIC SPACE BY MEANS OF REACTION DEVICES (1896). While many of Tsiolkovsky's speculations appear outlandish today, when viewed in the context of contemporary scientific knowledge, he is a visionary who helped to usher in the concept of space exploration and the utilization of outer space for human purposes. His original concepts include the theory of reaction propulsion (that a rocket will work in the vacuum of space), the use of liquid propellants, and the use of the atmosphere as a "brake" for vehicles returning from space.

2. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, T.I.A.S. 6347, 610 U.N.T.S. 205 (effective Oct. 10, 1967).

3. President Ronald Reagan, State of the Union Message, Jan. 25, 1984.

special reference to the history of the first private spaceflight. Finally a few suggestions, emphasizing minimum regulation, are offered to promote the growth of commercial space activities.

I. Historical Background

A. Ancient Law

The legal status of the space situated above the earth was an object of theoretical analysis and positive regulation under the laws of the Roman Empire. Justinian's Institutes qualified the air we breathe in the same category as rivers, oceans and, sea coasts, i.e., *res omnium communis*, those things that are open to the free use of all people.[4] Because of its vast extent, air was thought to be incapable of appropriation.[5] Even the Romans, however, recognized that space above land could be owned privately or publicly, whenever some practical use could be made of it.[6] According to Blackstone, "Land hath also, in its legal signification, an indefinite extent, upwards as well as downwards. *Cujus est solum ejus usque ad coelum*, is the maxim of the law."[7] Hugo Grotius, in 1625, assumed that the air, like the sea, could not, as a whole, belong to anybody, because of both its huge size and the fact that there is enough for everybody.[8] Despite the flight of balloons and kites, air law remained the province of academics and philosophers until new technology forced a closer examination.

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4. Under Roman law, some things were deemed to be conducive to private ownership while others were considered by natural law to be common to all and not subject to ownership by individuals. Air, running water, the sea, and the seashore were among the things constituting common property: "*Et quidem naturali iure communia sunt omnium haec: aer et aqua profluens et mare et per hoc litora maris.*" II Institutions 1. *See also* XLIII Digest 8, 3, 1; I, 8, 2, 1.

5. The concept that subjects incapable of division are thereby held in common was endorsed by Gaius who stated "(O)cean, air, and light, as opposed to the earth, are by their nature essentially *res communis*. Being incapable of appropriation, they have not been appropriated and are held in common." Gaius, Elements of Roman Law, 152 (3d ed., Oxford, 1890). It should be noted, however, that this maxim applies to those subjects incapable of being appropriated for individual use, and not to subjects as to which individual appropriation would be undesirable. In United States v. Causey, 328 U.S. 256 (1946), the Supreme Court held, in a case of first impression, that, although airspace is a public highway, it is obvious that if the landowner is to have full enjoyment of the land, he must have exclusive control of at least as much of the space above the ground as he can occupy or use in connection with the land. *Id.* at 264. While the owner does not in any physical manner occupy or make use of this statum in the conventional sense, the landowner as an incident to his ownership has a claim to it because invasions of that airspace are tantamount to invasions of the surface. *Id.* at 265.

6. For a comprehensive analysis of the concept of *res communis*, *see* Gorove, Studies in Space Law; Its Challenges and Prospects, 7–13 (L.Q.C. Lamar Society of International Law Monograph Series No. 2, 1977). For the same subject by a socialist writer *see* Gorbiel, Outer Space in International Law, 4–20 (Acta Universitatis Lodziensis, Politologia 8, Lodz, Poland 1981).

7. 2 Blackstone, Commentaries 18. *See also* W. Burby, Real Property 13, (3d ed. 1965).

8. 1 Grotius, De Iure Belli As Pacis Libri Tres 261 (Paris 1625).

B. Modern Jurisdiction Over Airspace

When heavier-than-air flight began in the early part of this century, it became necessary to weigh the long-prevailing academic concept of unlimited freedom of navigation for aircraft against the political and economic desire of states to control air activities above and around their territory. As national interests in commercial aviation became real and important, the "freedom of the air," which treated the airspace above all states as the common heritage of mankind, gave way to specific international conventions on civil aviation. These conventions explicitly recognized that ". . . every State has complete and exclusive sovereignty over air space above its territory."[9] These conventions determined, after lengthy and violent controversy, that every state has a right to subject the airspace over and around its territory to national appropriation by claim of sovereignty. By exercising jurisdiction and ownership over the critical resource that makes air commerce possible, i.e., airspace, states were able to evolve national legal regimes to authorize and supervise those who sought their fortunes in the sky. Such national legal regimes assure that each state's citizens' air activities are: (1) undertaken in a manner compatible with the legal, social and economic institutions of the supervising state; (2) responsive to the politically perceived national security interests of the state; and (3) encouraged by the state in order to quickly advance the progress of the useful arts and sciences required for success in aerial commerce.

From our vantage point in the 1980s, the fierce dispute between "freedom of the air" as part of the common heritage of mankind and "national sovereignty over airspace" as the critical resource required to develop air commerce, seems remote. Its outcome appears obvious. Especially in the early days of flight, for example, the United States government's grant of air routes, development of airports, support of research into aerodynamics, and subsidy of airlines with mail contracts and military purchases, were critical to the success of United States business on this new economic and technical frontier. Clear and reasonable regulations controlling the use of airspace by business entities were a *sine qua non* for individuals and institutions to invest in such risky ventures. Many of the important advances in aviation came from small corporations. It is difficult to believe that sufficient private money would have been put at risk to start our airlines if the federal government lacked the authority to designate routes and set safety standards for flight over the United States. If we had presumed that an interna-

9. Convention on International Civil Aviation (signed in Chicago, December 7, 1944), art. I, 15 U.N.T.S. 296. Similarly, the Convention on the Regulation of Aerial Navigation which was signed in Paris, October 13, 1919, recognized the sovereignty of air space, stating "The High Contracting Parties recognize that every Power has complete and exclusive sovereignty over the air space above its territory." 11 Societe des Nations, Recueil des Traites 173 (1922).

tional organization should have authorized and supervised air flight during those early years, can we be reasonably certain that such an organization, e.g, the League of Nations, would have authorized Charles Lindbergh to fly alone across the Atlantic Ocean in an untested Ryan monoplane?

Today we stand at a crossroads similar to that faced by earlier decision-makers. We are now formulating the law that will control private activities conducted in and related to outer space. Current public and private space activities, and the law relating to them, are extensive and growing explosively. The committees at the United Nations that drafted existing multilateral space-law treaties have become increasingly ineffective as new technical innovations and business arrangements create real differences of substance between states. In order to determine what laws are appropriate, it is, of course, necessary to understand the subject matter sought to be controlled; that subject matter is discussed immediately below.

II. Present and Future Space Activities

Space is an infinite, relatively empty place near this crowded world where we now live. It offers a new environmental niche for the growth of human society. Space has vast resources; among them are unlimited solar energy that could be captured and used on earth,[10] and thousands of times more raw materials, of all types, than are available on earth.[11] These resources must be harvested[12] before most of the world's people can hope to enjoy a

10. Extensive studies of the technical, environmental and economic feasibility of a solar satellite energy system were initiated in 1978 by the Department of Energy with the cooperation of the National Aeronautics and Space Administration (NASA). The purpose of the program was fourfold: (1) to identify and define the most attractive solar power satellite system in view of economic and technical considerations; (2) to evaluate the potential environmental health and safety implications, if any; (3) to address the impact of such a system on society; and (4) to integrate the program's findings and prepare a comparative assessment of varied energy systems including fossil fuel, nuclear, terrestrial solar energy, ocean thermal energy conversion, wind energy, biomass energy, and solar power satellite systems. U.S. DEP'T OF ENERGY, SATELLITE POWER SYSTEM (SPS) PROGRAM SUMMARY (1978).

11. *See* Staehle, *Finding "Paydirt" on the Moon and Asteroids*, 21 ASTRONAUTICS & AERONAUTICS, No. 11, 44 (1983). For a comprehensive study of the techniques of processing extraterrestrial materials for use in space, *see* W. STEURER, EXTRATERRESTRIAL MATERIALS PROCESSING (JPL Publication 82-41, 1982); and W. CARROLL, RESEARCH ON THE USE OF SPACE RESOURCES (JPL Publication 83-36, 1983) (the two sources refer to the same ongoing study.) *See also* CONVAIR DIVISION, GENERAL DYNAMICS, LUNAR RESOURCES UTILIZATION FOR SPACE CONSTRUCTION (1979). The last-mentioned study defines alternative methods of manufacturing in space using lunar materials and compares the lunar-resources-utilization techniques with a baseline earth-material-construction scenario. Lunar resources utilization is demonstrated to be potentially competitive with earth-based construction. Cost projections, while considering economic uncertainties, indicate that an ambitious solar power satellite program should break even within a 30-year period.

12. NASA has been evaluating the role of machine intelligence, including automation and robotics, in extracting and processing extraterrestrial materials. NASA CONFERENCE PUBLICATION 2255 ADVANCED AUTOMATION FOR SPACE MISSIONS 77–188 (1982). For an engineering study of space manufacturing and habitation, *see* NASA SP-428, SPACE RESOURCES AND SPACE SETTLEMENTS (1979).

standard of living equal to that in the United States today. Thus, the movement of industry into space to harvest resources for the benefit of all mankind is a central challenge of our age.

In the 24 years from 1957 to 1980, the nations of the world have spent at least $240 billion on space.[13] From 1981 to 1986, the United States will spend over $64 billion.[14] As large as past expenditures have been in the space community, it is only now being opened for private commercial business. Future growth is expected to be rapid in the private commercial sector. McDonnell Douglas Corporation has estimated that the 1984–94 United States space market will total $34–67 billion.[15]

A "Tax Status of Space Act" was introduced in Congress to give space business legal status similar to business done on the earth's surface.[16] Representative D. K. Akaka (D-Ha.), founder of the 164-member bipartisan Congressional Space Caucus, has stated, "by the year 2000, commercial space activity may be worth as much as $200-300 billion to our national economy and maybe as many as 10 million jobs."[15] Furthermore, Representative Robert S. Walker (R-Penn.) has stated that the United States should commit itself to a goal of building a $500 billion economy in space to generate 20 million new jobs by the year 2000.

A. Launch Vehicles and Orbital Facilities

Since 1957, several nations (i.e., the United States, the U.S.S.R., France, China, India, Japan, and the U.K.) have developed the ability to launch satellites into space.[19] Many others will soon have this ability. By 1984, the United States had sent several missions to the moon and developed a reusable space vehicle (the Space Shuttle). Also during this period, the U.S.S.R. established the first manned space station, and the United States committed itself to establishing a permanently manned station.

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13. Eagle Engineering Study Report for Martin Marietta Corp., April 1981, p. 10, noting Aviation Week & Space Technology Annual Aerospace Forecasts 1975–81.

14. *Id.* at 18.

15. The markets are estimated to be as follows: communications—$10–20 billion; remote sensing—$1 billion; materials and manufacturing—$20–40 billion; and orbital transport—$4–6 billion. McDonnell Douglas Corp. marketing reports, Charts, McDonnell Douglas—NASA Headquarters Studies, Pre-Phase B, 1983 (on file with the author). Other studies estimate that the space-produced drug market will be $27 billion by 1995, *see* Houston Post, Aug. 30, 1984, at 3B, and that there will be a $30–35 billion benefit from remote sensing by 1995, *see* General Accounting Office Report GAO/RCED-83-111, March 1983.

16. Houston Chronicle, August 12, 1984, § 1, at 19.

17. L-5 News, June 1984, at 9.

18. Aerospace Daily, April 10, 1984, at 230.

19. For a comprehensive historical guide which includes the current space technology as well as analyses of the potential for such concepts as satellite solar power stations, bases on the moon, and space colonies, *see* K. Gatland, The Illustrated Encyclopedia of Space Technology (1981) (obtainable from Harmony Books, One Park Ave., New York, NY 10016, $24.95).

The Space Shuttle can carry over 60,000 pounds to orbit and can bring a substantial fraction of that mass back to the ground. It is a routinely reusable commercial space transport system. From 1991 to 2000, Space Shuttle mission costs alone are estimated to be $93 billion,[20] and NASA expects to turn the Space Shuttle over to private commercial operators by 1988–89.[21] The U.S.S.R. has offered to provide launch services to commercial users on their PROTON vehicle, which can place over 40,000 pounds in orbit, and is considering the establishment of an Aeroflot-type commercial space organization.[22] The U.S.S.R. has estimated that the economic impact of "extra-terrestrial industry" may reach 50 billion rubles as early as the 1990s.[23] To encourage this expansion of the Soviet economic frontier, the U.S.S.R. is developing a launch vehicle capable of carrying 200-400 tons to space—10-20 times the payload of the Shuttle.[24] The French corporation, Arianespace, also offers private space transportation on "Le Lanceur Ariane."

Some twelve companies are now seeking to develop private launch vehicles or make a commercial business out of government expendable launch vehicles[25] (the first private construction and launch of a space vehicle is described below). At least two of these companies have offered to sell stock or units in limited partnerships to finance their operations.[26]

B. Communications

Commercial space activities have already earned billions of dollars, largely for the first space industry, communications.[27] As of June 30, 1984,

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20. Aviation Week & Space Technology, Annual Aerospace Forecast & Inventory Issues, 3/17/75, 3/15/76, 3/21/77, 3/12/79, 3/3/80, and 3/9/81; Mission Requirements for Shuttle Derived Vehicles—Report to Martin Marietta Corporation, Eagle Engineering, Inc., April 1981 (report on file with the author).

21. Aviation Week & Space Technology, pp 20–21, 116, June 25, 1984.

22. Conversation of the author with Dr. Yuri Kolosov, Soviet Foreign Ministry, in New York, October 27, 1984.

23. TASS, Moscow, Sept. 29, 1983.

24. Salyut Takes Over, (Novost Press Agency Publishing House, Moscow, 1983).

25. La Lanceur Ariane, Notice 1, Les Enjeux de L-Espace, Supplement Aux Cahiers Francais No. 206–207, Mai-Septembre 1982. For a list of commercial space transportation companies as of January 1984, *see* Vol. 8, No. 1, The Commercial Space Report 3–4 (January, 1984).

26. As shown by, among others, a Confidential Private Offering Memorandum dated Nov. 10, 1983 whereby Shearson/American Express Inc. offered $50,000,000 of Limited Partnership Interests on behalf of Orbital Research Partners, L.P. (a Delaware Limited Partnership). The net proceeds of this offering will be used by the partnership for the research and development of an upper stage rocket for use primarily with the Space Shuttle to deliver communications satellites and other payloads from the Space Shuttle to higher orbits.

27. For a detailed retrospective technology assessment of the development of global satellite communications and the direct broadcasting satellite controversy, *see* D. Smith, Communication via Satellite (Via Satellite: Policy Issues in Satellite Applications 1, 1976);

the Communication Satellite Corporation alone had 3,146 employees, 66,632 shareholders and a net income of over $50 million on sales of over $440 million.[28] As large as these figures seem, they are just the beginning. In May 1983, the Federal Communications Commission authorized launch of nineteen new domestic communications satellites. On January 23, 1984, Japan launched the first commercial direct broadcast satellite (DBS) for television, which can broadcast programs directly to small antennas on individual home televisions.[29] This satellite cost over $260 million to develop and launch, yet it is expected to be far more profitable than current communications satellites. By mid-October 1984, four companies had received final license approval for United States DBS television channels. Those companies are now completing spacecraft construction and launch schedules.[30] DBSs are an example of an emerging technology that raises fundamental legal issues among the United States, which supports a relatively free interchange of information, and other groups of states, which would limit and control the information available to their nationals to varying degrees.[31]

Georgetown Space Law Group, DBS Under FCC and International Regulation, 37 VAND L. REV. 67 (1984). *See also* D. SMITH, TELESERVICES VIA SATELLITE (Via Satellite: Policy Issues in Satellite Applications 2, 1978) (chronicling various experiments in social applications of satellite communications and exploring means of transferring experimental programs into operational systems).

28. These figures are based on the Communications Satellite Corporation's 10-Q dated June 30, 1984 and Annual Report dated 1982.

29. A direct television broadcast satellite developed by Toshiba and General Electric's Space Systems Division at Valley Forge, Pa., was launched from the Tanegashima launch site on January 23, 1984. The satellite (which is called the "Yuri-2A") was developed for the Japanese National Space Development Agency and will be used for transmission of two color television channels to remote areas and urban areas with very high buildings. Initially the satellite was put into a 124 × 22,857-mile transfer orbit. Ultimately it will be transferred to a geostationary orbit over Borneo. A back-up satellite will be launched in August. The BS-2 series satellite program will cost approximately $260 million, 60% of which will be borne by Nihon Hoso Kyokai-Japan Broadcasting Corp., with the rest paid by the National Space Development Agency of Japan. The service life of the BS-2A satellite is estimated to be five years. AVIATION WEEK & SPACE TECHNOLOGY, January 30, 1984, at 19. For a list of the users and orbital positions of the 19 new domestic communications satellites, *see* AVIATION WEEK & SPACE TECHNOLOGY, May 9, 1983.

30. AVIATION WEEK & SPACE TECHNOLOGY, Oct. 15, 1984, at 22, col. 1.

31. The problems of operating by consensus are aptly demonstrated in K. QUEENEY, DIRECT BROADCAST SATELLITES AND THE UNITED NATIONS (1978). The author sets out all the significant interplays of the various United Nations committees, agencies and other national and international organizations in connection with the direct broadcasting debates. The Soviet position is stated aptly "A state is entitled to decide for itself what information may be supplied to its population. State control over foreign sources of information on its territory comes within its 'domestic jurisdiction', that is, its exclusive jurisdiction, and is a sovereign right of a state." S. PIRADOV, INTERNATIONAL SPACE LAW 185 (1976).

C. Military Development

Military communication, observation and navigation satellites have helped maintain peace by ensuring and verifying the balance of power. Such systems are permitted by the self-defense provisions of the Charter of the United Nations and are protected against interference under the terms of the Strategic Arms Limitation Treaty (SALT) accords of 1972.[32] The United States has an active military space program coordinated by the Department of Defense, and the entire space program of the U.S.S.R. is conducted under the control of the Soviet military, specifically the strategic rocket forces.[33] A number of treaties specifically ban nuclear weapons and weapons of mass destruction from outer space.[34] Despite these, both the United States and the U.S.S.R. have tested anti-satellite weapon systems.[35] A Soviet proposal is now before the United Nations that would forbid states from placing any weapons, even those that are entirely defensive, in space.[36]

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32. *See* Article V, paragraph I, Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems, 23 UST 3437, TIAS 7503, *entered into force* October 3, 1972; reaffirmed, Article III, Protocol to the Treaty, 27 UST 1647, TIAS 8276, *entered into force* May 24, 1976. The Charter of the United Nations provides an exception to the general obligation to refrain from the unilateral use or threat of force in international relations. This exception deals with the "inherent right of individual or collective self-defense if an armed attack occurs against a Member of the United Nations." U.N. Charter art. 51. Under the terms of the Strategic Arms Limitation Treaty of 1972, neither the United States nor the Soviet Union shall interfere with the national "technical means of verification" of the other.

33. After the launch of *Sputnik I* in 1957, Premier Nikita Khrushchev set up an independent military missile force coequal with the army, navy and air force. Field Marshal Mitrofan Nedelin, a former artillery expert was put in command of the entire Soviet missile forces and became operational commander over Korolev, the chief Soviet rocket designer. J. Oberg, Red Star in Orbit 33–34 (1981).

34. *See supra* note 2, at art. IV. Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water 480 U.N.T.S. 43, art. I (1963), *reprinted in* 2 I.L.M. 889 (1963).

35. The United States Air Force is conducting a series of 12 planned tests of an air-launched anti-satellite weapon. The weapon operates by firing, from a modified McDonnell Douglas F-15 fighter, a miniature vehicle mounted on a two-stage booster. The miniature vehicle uses an infrared guidance system to home in on spacecraft targets and should be operational by 1987. Initial tests involve only the launch of the booster from the F-15. Test shots with the miniature vehicle mounted on the booster were to be completed by August, 1984. If successfully developed, the system will give the United States its first operational anti-satellite weapon capability since 1975 when nuclear-armed weapons were phased out of service. The Soviet Union has two anti-satellite systems: a co-orbital conventional weapon launched from the ground on a booster and a space-based laser system expected to be operational in 1990. The United States system will not intercept the Soviet anti-satellite weapons, but is geared to intercept spacecraft only in low earth orbit. Aviation Week & Space Technology, December 19, 1983, at 20–22. The Air Force Space Command is also examining the need for developing a laser anti-satellite weapon for high altitude satellite-kill capacity. Aviation Week & Space Technology, March 21, 1983, at 18–19.

36. The "Draft Treaty on Banning the Use of Force in Space and From Space With Respect to the Earth" proposed by the Soviet Union, would prohibit the use of force and the threat of use of force in space, the atmosphere, and on earth through the use of space objects in earth

This proposal comes at the same time that groups in the United States are proposing to use space-based defensive weapons systems as a technically practical and economic means of defending against nuclear attack by ballistic missiles.[37]

Limitation of defensive weapons in space is another area of critical interest that the United Nations seems unable to address in any meaningful manner. Indeed, its recent attempt to deal with this issue caused a breakdown in the United Nations' normal procedures and raised the possibility that the United States might withdraw its delegation from the United Nations Committee for the Peaceful Use of Outer Space (COPUOS).[38]

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orbit, stationed on celestial bodies or deployed in space in any other manner as a means of destruction. The testing or deployment of space-based weapons is prohibited, as are the testing or use of manned spacecraft for military (including anti-satellite) purposes and the testing or development of new anti-satellite systems. Existing anti-satellite systems are to be eliminated. Additionally, the Draft Treaty contains a prohibition against destroying, damaging or disrupting the normal functioning of other states' space objects or changing their flight trajectories. PRAVDA, August 22, 1983, at 4 (in Russian).

37. For a comprehensive overview of the technical, policy and strategic issues implicit in actually defending the United States against attack by nuclear armed ballistic missiles, *see* SPACE AND ASSURED SURVIVAL; The Report of the Summer, 1983 Council Meeting; CITIZENS ADVISORY COUNCIL ON NATIONAL SPACE POLICY (available from the L-5 Society, 1060 East Elm Street, Tucson, AZ).

38. For a description of COPUOS development, see *infra* note 59. In 1962, a carefully drafted compromise voting procedure was adopted by COPUOS which was the result of extensive negotiations between the United States and the U.S.S.R. COPUOS would proceed by consensus whenever possible and dispense with the need for voting with the understanding that the General Assembly rules of procedure, making voting possible, if needed, would apply. The rationale underlying the consensus procedure was the general recognition that the agreement of the two major space powers was critical if any course of action was going to be effective. K. QUEENEY, DIRECT BROADCAST SATELLITES AND THE UNITED NATIONS 23 (1978). For 21 years COPUOS maintained the tradition of consensus decisionmaking. In its report to the Special Political Committee on Nov. 29, 1983, however, it was revealed that the members were unable to reach a consensus on draft resolution A/SPC/38/L. 28 dealing with the mandate of COPUOS. The controversy within the Working Group on International Cooperation in the Peaceful Use of Outer Space resulted in the submission of A/SPC/38/L.28 in the name of the Austrian delegation instead of in the name of the Working Group (Mr. Lehne of the Austrian delegation was chairman of the Working Group). Controversy was centered upon three issues: (a) the manner in which matters relating to the definition and delimitation of outer space, outer space activities, and the use of geostationary orbits would be handled in the Legal Subcommittee of COPUOS; (b) what actions should be taken to prevent an arms race in outer space and the role to be played by COPUOS in that context vís-a-vís the General Assembly's designation of the Committee on Disarmament as the "single multilateral disarmament negotiating forum;" and (c) some members had reservations concerning the proposal that the United Nations bear the cost of experts nominated by member states to conduct various studies on remote sensing, direct television broadcasting, and geostationary orbits. 38 U.N. GAOR, Special Political Committee (43rd mtg.) 2–3, U.N. Doc. A/SPC/38/SR. 39 (1983).

The lack of consensus in COPUOS was reflected in the Special Political Committee, which ultimately voted on A/SPC/38/L. 38. Mr. Lehne reported that his delegation had held discussions with the authors of two amendments proposed to the draft resolution, but had been unable to reach agreement with them. The Committee would therefore have to vote on the draft resolution and on the amendments proposed thereto, a "regrettable departure" from the Committee's practice of adopting resolutions on space by consensus. 38 U. N. GAOR, Special Political Committee (43rd mtg.) 14 U. N. Doc. A/SPC/38/SR. 43 (1983). Both amendments

D. Observation Satellites

Earth resources and weather observation satellite systems are now a part of everyday economic life throughout the world. As of October 19, 1983, the United States Landsat system of earth observation satellites had provided over 680,000 images to United States users and over 557,000 images to foreign ground stations in ten foreign countries.[39] As of September 30, 1984, the meteorological archives of the United States stored over 2.5 million satellite images.[40] In the United States, any person can purchase these 30-meter resolution Landsat images or even the raw data used to make the images.[41] On January 3, 1984, the United States government released a request for a proposal to transfer the United States Land Remote Sensing Program to the private sector.[42] In 1985, the French plan to use the SPOT (Satellite Probatoire d'Observation de le Terre), a commercial system that

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were passed and the draft resolution, as amended, was adopted by 98 votes to 12, with 8 abstentions. *Id.* at 18. In the aftermath of the vote, the delegate for the United States stated that "it was unfortunate that the decision taken by the Committee at that meeting would usher in a period of confrontation. The programme of work for COPUOS showed an absence of any commitment to the principle of consensus and would not, therefore lead to any significant progress. The same delegation which had so brazenly attempted to manipulate the debate on the issues discussed in COPUOS for the sole purpose of spreading propaganda must bear the responsibility for that turn of events. The United States had based its decision to join COPUOS to a large degree on the firm commitment of that body to the principle of consensus. Most of the achievements of COPUOS could be attributed to that commitment. Unfortunately, his delegation was not optimistic about the future of that Committee." The United States delegate went on to criticize the Group of 77 for being unwilling to consider the concerns of the United States despite the United States' record of having freely shared its resources and knowledge with the countries represented by the Group of 77 for over 25 years. Accordingly, "In view of the foregoing, his Government would have to re-examine its decision to participate in the work of COPUOS." *Id.* at 20–21.

39. I Manual of Remote Sensing 519, Colwell, ed., (American Society of Photogrammetry 1983).

40. Department of the Interior, United States Geological Survey, Reports: Summary of Worldwide Landsat Data Demand for Calendar Year 1982 (November 17, 1983), for Calendar Year 1981 (October 28, 1982), for Calendar Years 1979–80 (Revised June 1, 1981). At U.S.G.S., contact Ms. Geny Austin, (605) 594-6142.

41. Sheffield, Man on Earth (Sidgwick and Jackson Limited 1983). This book contains sixty-eight spectacular color satellite images taken from a height of 570 miles by the *Landsat* spacecraft. The photographs were produced by the Earth Satellite Corporation, a privately-owned company that provides data collected by *Landsat* to twenty-four national governments and hundreds of private clients.

42. White House Press Office, Press Release, January 3, 1984. Commerce Business Daily notice published Sept. 10, 1983 as amended Sept. 15, 1983, states, in part, "It is the policy of this administration to seek commercialization of governmental activities which are not uniquely governmental in nature since private enterprise is the primary source of our national economic strength. . . . it is the current policy of the administration to seek prompt commercialization of land satellite remote sensing. . . ." On Dec. 29, 1983, the Commerce Business Daily announced that a request for proposal (RFP) for the transfer of the United States land remote sensing program to the private sector would be released on Jan. 3, 1984. The notice solicited requests for the RFP from private firms.

will provide its customers with ten-meter ground-resolution images of the Earth.[43]

E. Materials Processing

NASA has contracted with a wide variety of customers for transportation of satellites and materials-processing experiments on board the Space Shuttle. James Beggs, NASA Administrator, has stated that NASA, which has a $7.49 billion fiscal 1985 budget and over 24,000 employees, presently is negotiating with twenty companies regarding the development of commercial applications for materials processing in space.[44] Topics include metal formation, electroplating, catalysts, glass alloys, and long-term storage of blood. This is in addition to the agreements NASA has already signed with 3M Company for organic crystallization and Johnson & Johnson Company for biological extraction of living cells in space. As these initial efforts evolve into profitable businesses in space, private companies will finance and build "space factories." Space Industries of Houston has signed a "memorandum of understanding" with NASA to privately develop a commercial space factory which will work with NASA's space station now under development at the Johnson Space Center.[45] These commercial space industrial facilities will operate for profit in synergistic cooperation with NASA's space operations center. Administrator Beggs predicts that the cost of Space Shuttle operations will be offset by commercial revenues beginning in 1988 or 1989.[46]

F. Working Relationships Between NASA and Private Organizations

To facilitate development of private industry in space, NASA has developed three basic types of working relationships with private organizations. These three are intended to provide the flexibility needed to meet a wide range of needs from large organizations with strong research departments to small entrepreneurial firms that want to develop a product for the market. They also provide for incremental increases in understanding and commitment by the parties. In all cases, the government does not fund any of the work done by the firm, but rather each party funds its own activities separately. The three types of working relationships are described below.

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43. Le Satellite Spot, Notice 9, Les Enjeux de L'Espace, Supplement Aux Cahiers Francais No. 206–207, Mai–Septembre 1982.

44. *See* Beggs, Aviation Week & Space Technology, June 25, 1984, at 40 and 65.

45. Aviation Week & Space Technology, June 25, 1984 at 116; M. Simon, Report—Financial Assessment of the Space Operations Center as a Private Business Venture (Stanford University, November 1981).

46. *See* Beggs, *supra* note 44.

The Joint Endeavor Agreement (JEA) is a cooperative arrangement in which private participants and NASA share common program objectives, program responsibilities, and financial risk. The objective of a JEA is to encourage early space ventures and demonstrate the usefulness of space technology to meet marketplace needs. A JEA is a legal agreement between equal partners, and is not a procurement action; no funds are exchanged between NASA and the industrial partner. A private participant selects an experiment and/or technology demonstration for a joint endeavor which complies with materials processing systems (MPS) program objectives, conducts the necessary ground investigation, and develops flight hardware at company expense. As incentive for this investment, NASA agrees to provide free Space Shuttle flights for projects which meet certain basic criteria, such as technical merit, contribution to innovation, and acceptable business arrangements. As further incentive, the participant is allowed to retain certain proprietary rights to the results, particularly the non-patentable information that yields a competitive edge in marketing products. However, NASA receives sufficient data to evaluate the significance of the results, and requires that any promising technologies be applied commercially on a timely basis, or published.

For companies interested in applying microgravity technology but not ready to commit to a specific space flight experiment or venture, NASA has developed Technical Exchange Agreements (TEA). Under a TEA, NASA and a company agree to exchange technical information and cooperate in the conduct and analysis of ground-based research programs. In this agreement, a firm can become familiar with microgravity technology and its applicability to the company product line at minimal expense. Under a TEA, the private company funds its own participation and derives direct access to and results from NASA facilities and research, with NASA gaining the support and expertise of the private company's industrial research capability.

In an Industrial Guest Investigators (IGI) agreement, NASA and industry share sufficient mutual scientific interest that a company arranges for one of its scientists to collaborate (at company expense) with a NASA-sponsored principal investigator on a space flight MPS experiment. Once the parties agree to the contribution to be made to the objectives of the experiment, the private company's scientist becomes a member of the investigation team, thus adding industrial expertise and insight to the experiment.

G. Private Business Offices to Provide Services

On October 26, 1984, a Texas savings and loan institution filed an application with the Texas Savings and Loan Department, a state regulatory

agency, to open a full-service branch on the moon.[47] The application requested that a ten- to fifteen-year lead time be granted since that length of time would be required to comply with NASA planning, design, and development requirements. The new office would be located at the lunar base that may be developed by the United States at Cayley Crater, near the Sea of Tranquility.[48] Current information about space commercial development within the next fifteen years convinced the savings association that there was an excellent commercial opportunity in space for financial services.[49] As a result of developments like those just described, it is reasonable to expect that goods made in and services provided from space will form a growing, and eventually indispensable, part of the United States economy.

H. A Lunar Base

Industrial growth in space is occurring. The Space Shuttle, even if privately operated, will most probably be hard pressed to meet the demand for transport of goods and people to space. Fortunately, this bottleneck can be avoided by gathering some resources (in fact up to 90 percent of the materials used in most structures) from mining the moon. Lunar resources are more cost-effective than earth-launched resources for large-scale operations in space.[50] Specifically, the availability in orbit of liquid oxygen derived from lunar rocks will allow a four Space Shuttle fleet to carry the same payload as eight present Space Shuttle flights, by providing a "filling station in the sky," allowing refueling of spacecraft in orbit.[51] A separate study confirms the reasonableness of expecting a United States lunar base with fifty people, producing liquid oxygen, before the year 2000.[52] NASA has studied a proposed lunar base at Cayley Crater (4°N, 15°E lunar) in great detail: the base would have 150 people, 40 support crew and would be operational 2000–2010.[53]

47. Application of Lamar Savings Ass'n to the Texas Savings and Loan Department, Oct. 26, 1984 (copy in the author's files).

48. Detailed NASA Space Study SP-413: Space Settlements, A Design Study 106–10 (1977).

49. Lamar Savings Ass'n, Press Release, October 26, 1984 (copy in the author's files).

50. "A Cost Benefit Analysis of Space Manufacturing Facilities," M. Hopkins, Department of Economics, Harvard University, p. 305, Proceedings of Third Princeton/AIAA Conference, May 1977.

51. "Lunar Oxygen Impact Upon STS Effectiveness," Eagle Engineering Report to NASA, May 1983. The real timeline for this lunar base is 1990–2010. *See* Executive Summary Final Report, Space Industrialization NASA Contract NAS 8 32198, at 24 (April 1978).

52. Caltech Space Settlement Conference Proceedings, July 1978, California Institute of Technology.

53. Detailed NASA Space Study SP-413: Space Settlements, A Design Study, 106–110, (1977).

I. Space 2020 A.D.

A report commissioned by the Office of Technology Assessment predicts that additional NASA funding of only $3 billion per year would allow the United States to occupy (and use for productive purposes) the entire inner solar system, including the asteroids, within only 25 years. That projection uses only currently known technology. It does not include the "bootstrapping" effects of government "roadbuilding" activities, such as the permanently manned space station recently ordered by President Reagan, on private industry. Thus it must be viewed as a conservative prediction. The author would hope that at least the following activities will occur by 2020.

By 2020, outer space will be a major focus for restless people in a technical society. The existence of a frontier is necessary to provide an adequate challenge to individuals who possess initiative and entrepreneurship. It will also accommodate those individuals, families, or groups who wish to progress faster or achieve more—who like competition and growth. Early in the twenty-first century, space activities will play important, and perhaps central, psychological, material and cultural roles in making earth a better and more interesting place. As United States society becomes post-industrial and the majority of the human race enters the technological age, the earth will provide a base from which human beings will move outward into the solar system and eventually into interstellar space. It is likely that the openness, opportunities and challenges of outer space will exert a profound and sustained influence on the societies of earth.

If we take up the challenge, the following major systems and activities could be in place and operating by 2020 A.D.

1. *Transportation*

Space transportation will be routine and inexpensive via common carriers from the Earth's surface to low-earth orbit. Beyond low-earth orbit, mature, second-generation nuclear/electric and solar-sail constant boost spacecraft will provide private and public transportation. These spacecraft will operate routinely on schedules within the inner solar system, i.e., from the orbit of Mercury to the asteroids. The majority of commerce in the inner solar system should be privately owned and will operate for profit. Commercial space lines will begin operating no later than 2000 A.D. Beyond the asteroids, publicly owned spacecraft, primarily on missions of exploration, will predominate; but some private spacecraft, owned by "world" corporations (i.e., corporations that do not reside primarily within the jurisdiction of any individual nation-state), will be exploring resources for future harvest.

2. *Cis-Lunar Space*

As a direct consequence of cheap, routine transportation from the earth's surface to low-earth orbit, a collection of mature business operations will be

in place and operating in low-earth and geosynchronous orbit and on the moon. These industries will include: energy, communication/information, and materials manufacturing. Cis-lunar space will be a zone of economic influence for the earth because industrial operations there will be essential to the earth's economy. Specifically, a significant fraction of the gross world product will be derived from these space-based activities. Although some of the routine business operations in low-earth and geosynchronous orbit will be government monopolies operated by socialist or communist states, the large majority of such enterprises will be conducted by world corporations. The majority of these operations will be financed by private capital and virtually all of them, public or private, will be profitable.

3. *Inner Solar System*

As a consequence of the development of advanced space transports toward the end of this century, the entire inner solar system from the orbit of Mercury to the asteroids will be undergoing active development by 2020 A.D. as an important resource for the human race. The earliest development will take place on the moon and on earth-crossing asteroids during the late 1980s and early 1990s. By the mid-1990s, availability of lunar and asteroidal materials will bootstrap resource-recovery operations in cis-lunar space. The asteroid belt should be rapidly developed by the use of chemical vehicles and automated exploration and processing stations. By the turn of the century, world corporations will have developed space operations to a degree that would have been very unexpected in the 1980s. Once profit, i.e., new real wealth, begins to flow back to the earth, investment in space operations will accelerate as individuals and corporations seek to earn a real return on investment greater than is possible in the highly regulated post-industrial condition existing on earth. With the development of advanced spacecraft between 1995 and 2010, the great fortunes of the next century will be made on the moon and in the asteroid belt. By 2020, most important aspects of space development will be independent of earth for raw materials. The earth will remain the major market for space resources and the main source of capital for space ventures through 2100.

4. *Outer Solar System*

Development of advanced spacecraft and robotics will make possible the automated and manned exploration of the resources of the outer solar sytem to and including the Oort Cloud. These operations will primarily be conducted by governments, but some resource mapping and exploration will be done by privately owned space corporations, many of which will have been chartered and developed in space during the expansion of 2010–2020.

5. *Interstellar Activities*

Prior to 2020 several governments will launch unmanned, fusion-

powered, staged interstellar probes to Bernard's Star, Alpha Centauri and the other nearer stars.

III. Legal Structure

Space law can be analyzed in terms of three components: an international juridical framework, national legal regulations, and the political policies of the relevant administration. The following discussion examines that legal regime, emphasizing the law as it affects United States persons.

A. International Custom and Treaties

The international legal framework is comprised of customary international law and treaties. Customary law is made by the actions of states, where such actions are taken in the belief that they are required or permitted by international law; customary law may be ratified by states' acquiescence. For example, a satellite is customarily considered to be in outer space, and thus not to be intruding on the airspace of any subjacent state, when it is in orbit. There is, however, no formal agreement between states that defines the lower boundary of "outer space."[54] The U.S.S.R. has proposed a limit of 110 kilometers (about 70 miles) with a right to overfly other states at lower altitudes on the way to or from this altitude.[55] Conversely, several equatorial nations claim to own those portions of the geosynchronous orbital arc, over 22,000 miles above the Earth's surface and used commercially by communications satellites, superjacent to their territory.[56] As human ex-

54. The definition/delimitation of outer space and the controversy engendered by that subject and the use of geostationary orbit positions are discussed in C. Christol, The Modern International Law of Outer Space, ch. 10 (1982). For a discussion of the law that will apply to activities conducted on the Space Shuttle, *see generally* Gorove, Space Shuttle and the Law (1980); 13 Akron L. R. 593–758 (1980) and 2 Hous. J. Int'l L. 1–260 (1979). *See also* Committee on Commerce, Science and Transportation, United States Senate, 98th. Cong., 1st Sess., Policy and Legal Issues Involved in the Commercialization of Space (Comm. Print 1983).

55. In a paper delivered by G. P. Zhukov at the Twenty-Third Colloquium on the Law of Outer Space held by the International Institute of Space Law of the International Astronautical Federation in Tokyo in 1980, the Soviets stated their position that the region above 100–110 kilometers altitude above sea level on earth is outer space. The various arguments for alternative definitions were discussed, but Zhukov was adamant on the point that the upper altitude limit of state sovereignty must not depend upon factual capacity of states to exercise an effective control on their air space up to that altitude. Zhukov stated that the delimitation between air space (which is subject to state sovereignty through the Chicago Convention and Transit Agreement) and outer space is closely connected with the legal regime of outer space. Geostationary satellites' orbital space is an inseparable part of outer space as a whole and its general legal regime is applicable to this part of space. G. Zhukov, Colloquium On The Law Of Outer Space, 221 (1980).

56. The Bogota Declaration, signed Dec. 3, 1976, states, in part as follows:

"Equatorial countries declare that the geostationary synchronous orbit is a physical fact linked to the reality of our planet because its existence depends exclusively on its relation to

perience in space increases beyond the tightly ground-controlled activities of the past, customary international maritime law developed in the courts of admiralty by trading nations over thousands of years will most probably dominate the law of space commerce.[57] Customary international law's main benefit is the ability to flexibly evolve to meet changed circumstances. Its principle detriment is a lack of precision. Absent a long history of jurisprudence, such as exists in admiralty, customary law may be less predictable than a treaty.

Treaties are either bilateral or multilateral. NASA has negotiated bilateral treaties with many nations to share the benefits of its research in space science and technology.[58] Most multilateral treaties relating to space were developed in COPUOS.[59] This committee is now dominated by the less-

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gravitational phenomena generated by the earth, and that is why it must not be considered part of the outer space. Therefore, the segments of geostationary synchronous orbit are part of the territory over which Equatorial states exercise their national sovereignty. The geostationary orbit is a scarce natural resource, whose importance and value increase rapidly together with the development of space technology and with the growing need for communication; therefore, the Equatorial countries meeting in Bogota have decided to proclaim and defend on behalf of their peoples, the existence of their sovereignty over this natural resource. The geostationary orbit represents a unique facility that it alone can offer for telecommunication services and other uses which require geostationary satellites."

The Declaration goes on to contend that geostationary orbit is not part of "the common heritage of mankind;" that devices placed in geostationary orbit require prior authorization from the country over which they will be located and that existent geostationary satellites are not condoned unless expressly authorized by the country exercising sovereignty over the affected segment of geostationary orbit. The 1967 Treaty on Principles is disclaimed as the final answer to the problems of the use of outer space and the lack of a valid definition of "outer space" is pointed to us as support for the theory that geostationary synchronous orbit is not in outer space, and hence not subject to the Treaty. THE BOGOTA DECLARATION, Dec. 3, 1976, as cited in CHRISTOL, *supra* note 54, at 891.

57. The similarity between astronauts and seamen is one often drawn to substantiate the desirability of deriving space law from the law of the sea. *See* DeSaussure, *Astronauts and Seamen—A Legal Comparison*, 10 J. SPACE L. 165 (1982).

58. *See, e.g.*, the "Memorandum of Understanding Between the National Remote Sensing Agency (NRSA), Government of India and the United States Aeronautics and Space Administration (NASA)", COMMITTEE ON COMMERCE, SCIENCE AND TRANSPORTATION, UNITED STATES SENATE, SPACE LAW 593 (1978).

59. In the past the major space states, particularly the United States and the U.S.S.R., have very substantially influenced the development of international space law at the United Nations. In 1958, the General Assembly established an Ad Hoc Committee on the Peaceful Uses of Outer Space consisting of 18 members of which three were within the Soviet bloc, namely, the U.S.S.R., Czechoslovakia, and Poland. The other members of the committee were Argentina, Australia, Belgium, Brazil, Canada, France, India, Iran, Italy, Japan, Mexico, Sweden, the United Arab Republic, the United Kingdom and the United States. The Soviets considered the committee to be "one-sided and heavily weighted in favor of the Western powers." Consequently, the three socialist states refused to participate in the meetings of the committee. Joining the boycott were India and the UAR who considered that the committee could not usefully serve its purpose in the absence of the U.S.S.R.

Through General Assembly Resolution 1472 (XIV) of December 12, 1959, COPUOS was established. To the Ad Hoc committee members were added Albania, Bulgaria, Hungary, and Romania of the socialist bloc and also Austria and Lebanon. In this manner the 18-member Ad

developed nations belonging to the "Group of 77" at the United Nations.[60] This group, which now numbers 122 states, advocates the development of a "new international economic order" that would redistribute the earth's wealth from the relatively rich "north" to the poorer "south."[61] The UNISPACE 82 conference held in Vienna provided an interesting example of how these 122 states hope to benefit from space activities.[62]

Since becoming a permanent body of the U.N. General Asembly in 1959, COPUOS has promulgated a general Outer Space Treaty, i.e., the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Jan. 27, 1967) (Outer Space Treaty)[63] and several treaties of more specific character that give substance to various provisions of the Outer Space Treaty. These latter treaties include an Agreement on the Rescue and Return of Astronauts (1968),[64] a Convention on International Liability for Registration of Objects Launched into Outer Space (1973),[65] and an Agreement Governing

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Hoc committee was enlarged in COPUOS to 24 members. The socialist bloc obtained 7 out of the 24 members.

The committee was again enlarged in 1961 by adding Chad, Mongolia, Morocco, and Sierra Leone. The 28 became 37 on December 18, 1973 with the adoption of General Assembly Resolution 3182 (XXVIII), and grew in 1977 to 47 with the adoption of General Assembly Resolution 32/196B. Two facts stand out in the augmentations of membership. First, the space-resource states were joined by representatives of the less developed countries. Second, the equatorial states received strong representation. With the admission of Nauru to the United Nations in 1976 there were 9 equatorial states as members. Of these, five, namely Brazil, Colombia, Ecuador, Indonesia, and Kenya are committee members. Congo, Nauru, Uranda, and Zaire have not been appointed to the committee. Since geostationary space objects find an orbital position above the Equator to be congenial, the named states have a particular interest in this subject. C. CHRISTOL, SATELLITE POWER SYSTEM (SPS INTERNATIONAL AGREEMENTS, 4–5 (1978). Now the members of COPUOS number 53. *See* C. CHRISTOL, THE MODERN INTERNATIONAL LAW OF OUTER SPACE, app. 12 (1982). For a discussion of decisionmaking in COPUOS, *see supra* note 38.

60. For an excellent history of treaties developed by COPUOS, *see* C. CHRISTOL, THE MODERN INTERNATIONAL LAW OF OUTER SPACE (1982).

61. Congress of the United States, Office of Technology Assessment, UNISPACE/82: A Technical Memorandum, March, 1983.

62. *Id.*

63. 18 UST 2410, TIAS 6347, 610 UNTS 205, entered into force October 10, 1967.

64. 19 UST 7570, TIAS 6599, 672 UNTS 119, entered into force December 3, 1968.

65. 24 UST 2389, TIAS 7762, entered into force for the United States October 9, 1973.

The Convention establishes a standard of unlimited "absolute liability," requiring a launching state to pay compensation for damage caused by its space object on the earth's surface or to an aircraft in flight. If the damage is done in space or to another spacecraft, the launching state is liable only if the damage is "due to its fault or the fault of persons for whom it is responsible." The convention also establishes rules distributing liability among states engaged in joint space ventures. Generally, each state is jointly and severally liable for the entire amount. A one-year statute of limitations for presenting a claim runs from the time of the damage or such time as the damage should have been discovered had the damaged state exercised due diligence. Finally, the convention outlines the procedure for presenting a claim and authorized a claim commission. Only a nation may bring a claim under this convention. Canada recovered several million dollars through the 1972 convention for damage incurred due to the crash of the Soviet *Cosmos*

the Activities of States on the Moon and Other Celestial Bodies (1976).[66] As of late 1982, only 84 of the world's approximately 150 states had acceded to the Outer Space Treaty. Successively fewer have ratified each of COPUOS's subsequent offerings: Rescue and Return, 77; Liability, 63; Registrations, 31; and Moon, 11. It is questionable whether the substance of these treaties properly can be considered part of customary international law, i.e., applicable to states that are not parties to the treaties, because, *inter alia*, less than a majority of states have chosen to become party to them. The United States and the U.S.S.R. have ratified all these treaties except the Moon Treaty. It is likely that the United States will never ratify the Moon Treaty because of the chilling effect its provisions could have on the development of space resources by free enterprise.[67]

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954 nuclear-powered spy satellite in Canada. No claims were paid by the United States when the 85-ton *Skylab* orbital station crashed back to earth.

The 1976 registration convention provides a mechanism for registering a space object on a national register. This is important for business because the national registration of a space object, such as a space factory, determines which nation's law applies to the object. If a space factory is enrolled on the United States' registry, then United States laws and courts have jurisdiction over the factory and all events that transpire aboard it. Specifically, such a space object should be subject to United States patent, antitrust and tax law as well as all other federal statutes.

66. 28 UST 695, TIAS 8480, entered into force September 15, 1976.

67. Moon Treaty, Hearings held before the Subcommittee on Science, Technology & Space of the Senate Committee on Commerce, Science & Transportation, 96th Cong. 2d. Sess., July 29 & 31, 1980. The 1967 Treaty of Principles consists of 17 articles making the following major points:(1) The exploration and use of outer space should be for the benefit of all mankind and all states, regardless of the level of their economic or scientific development; (2) Outer space, the moon, and other celestial bodies are not subject to any claim of national appropriation by any means, including occupation; (3) Nuclear weapons and weapons of mass destruction should not be stationed in outer space, on the moon or other celestial bodies; (4) Astronauts are envoys of mankind and are due all assistance in emergencies. States must return astronauts who accidentally land in their territory; (5) States bear international responsibility for national activities in space, whether these activities are done by governmental or nongovernmental entities. . . . Actions of non-governmental entities in outer space require authorization and continuing supervision by the state; (6) States are responsible for damage done by their spacecraft orbits component parts. The launching state, if different, is jointly liable; (7) State jurisdiction and control over spacecraft and personnel continues into space. Ownership is not affected by travel into space or subsequent return to the earth; (8) States should confer before doing anything in space that would harm the earth or interfere with the actions of another state in space; (9) All installations and equipment in space should be open to inspection on grounds of reciprocity and reasonable notice.

Undefined phrases in the Treaty give it a comfortable looseness that may be an advantage as it evolves to meet the needs of future space activities. Terms such as "outer space," "weapons of mass destruction," and many others were not defined by the Treaty, and no interpretation of their meanings has been agreed on in the decade since the Treaty's promulgation. Judicial interpretation may define these terms with precision when the need for clarification becomes pressing, and future treaties may provide better definitions. Much careful legal analysis certainly will be needed over the next few decades to develop the issues affected by these definitions.

The Treaty on Principles' greatest limitation is that it was written and adopted through consensus by a multinational committee. Thus it was intellectually forged out of high ideals rather than being pragmatically developed from previous experience. Additional problems

A number of issues are pending before COPUOS and its legal subcommittee. They include problems of substance, such as weapons in space, information transfer by DBS, and high-resolution remote sensing. In view of the present large size of COPUOS and its recent abandonment of consensus procedures in favor of confrontation, it is virtually certain that COPUOS will continue to decline in importance as a source of space law. As of November 1, 1984, the United States had withdrawn its delegates from several meetings of the technical subcommittees of COPUOS. Virtually all of COPUOS's meaningful work is done in these subcommittees.[68] It is the author's opinion that COPUOS is no longer capable of operating by consensus. Thus COPUOS has lost its pragmatic ability to function as a future source of law for United States commercial space activities. To the extent that the legal concepts developed by COPUOS in the past are binding in United States courts or are persuasive to the Untied States Congress and the Executive Branch, however, they may be implemented in United States domestic legislation or regulations or otherwise affect the way United States persons do business in space.

B. National Law and Regulation

National legal regulation of business activities in the United States begins with the Constitution, which comprises a contract among the people of the United States to establish and limit their government. Article VI provides that the Constitution, the laws made in pursuance thereof and all treaties made under the authority of the United States, are the supreme law of the land. Article VIII of the Outer Space Treaty provides that the state of registry shall retain jurisdiction and control over space objects and their personnel while in outer space or on a celestial body. Since jurisdiction is the authority of a sovereign power to govern, it is clear that United States law governs and controls activities conducted on space objects and personnel enrolled on the registry maintained by the United States Department of State under the provisions of the Registration Convention.

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arise as a result of the Treaty's provision regarding use, occupation and national appropriation, which attempts to fundamentally reverse traditional international law. Historically, occupation has typically equaled national appropriation. In fact, eight equatorial nations, including Brazil, have claimed control of the part of space used by communications satellites over their territory as a natural resource. Despite these difficulties, the Treaty of Principles is more concrete than the customary international law from which it developed, and it has served as a touchstone for the development of more specific treaties.

The United States' responsibility for "authorization" and "continuing supervision" mandated by the 1967 Treaty of Principles is codified in a federal statute, the National Aeronautics and Space Act of 1958 and is implemented by NASA through administrative rules and regulations.

68. Author's conversation with Neil Holsenball, General Counsel, NASA, in Washington, D.C., October 29–31, 1984.

The Outer Space Treaty requires that the United States government provide authorization and continuing supervision of space activities undertaken by businesses under United States jurisdiction. It is the right of the United States to determine, by means of its national laws and regulations, the nature and extent of this authorization and supervision. Federal statutes are of equal authority with treaty law. If there is a conflict between a statute and a treaty, the later-promulgated instrument controls.[69] Thus federal statutes and the regulations made under them control the activities of United States business in space as positive law, even to the extent of revoking any portion of an earlier international treaty that conflicts with the national law. Amendment X to the Constitution provides that the powers not delegated to the United States by the Constitution, nor prohibited by it to the states, are reserved to the states or to the people. Thus, in addition to treaties, federal statutes, and the regulations made under them, the laws of the several states governing the regulation of business also help determine how the United States authorizes and supervises private space activities.

The experiences of the first private company in the United States to build and launch a space vehicle, Space Services Incorporated of America (SSIA), provide an interesting example of how these laws work. SSIA was incorporated under the laws of the State of Texas in 1980. SSIA's charter provided that the company could engage in all lawful business for which corporations could be incorporated under the Texas Business Corporation Act.[70] One of SSIA's first acts was to research existing federal and state laws to determine if it could build and launch a private space vehicle.[71] In August 1981, the company's first rocket, the *Percheron*, exploded during test firing. In September 1982, SSIA's second launch attempt was successful: the *Conestoga I* rocket flew to an altitude of over 190 miles and landed in the international waters of the Gulf of Mexico, over 300 miles from its launch site on the Texas coast.

For the anticipated *Percheron* launch in August 1981, SSIA requested and obtained a waiver of Federal Aviation Administration (FAA) regulations controlling the launch of unmanned rockets. Because the anticipated launch

69. Congress may by statute "abrogate, repeal, supersede, or render ineffectual," "modify," or "suspend" the provisions of a treaty, even though such a subsequent statute may be regarded as a violation of the treaty. The courts must construe the statute "according to its manifest intent." If the conflict is clear and the legislation is the later in date, the statute must be recognized by the courts "regardless of political consequences." Dula, *Regulation of Private Commercial Space Activities*, PROCEEDINGS OF THE TWENTY-FOURTH COLLOQUIUM ON THE LAW OF OUTER SPACE 25, 29 (1981) (citing treaties), 87 C.J.S. 926; Petition of Georga Kopoulos, 81 F. Supp. 411, *pet. dism*, C. A., Moser v. U. S., 71 S. Ct. 553, 351 U.S. 41, 95 L. Ed. 729; U. S. v. Bell, 248 F. 992; Chae Chan Ping v. U. S., 9 S. Ct. 623, 130 U. S. 581, 32 L. Ed. 1068, 87 C. J. S. 943; and Fong Yue Ting v. U.S., 13 S. Ct. 1016, 149 U. S. 698, 37 L. Ed. 905, 87 C. J. S. 944).

70. Art 2.01(A) TEXAS BUSINESS CORPORATION ACT.

71. *See* Dula, *Regulation of Private Commercial Space Activities*, 23 JURIMETRICS J. 156 (1983), for the publication of that research.

was the first such activity reviewed by the FAA, the FAA required that the rocket land within the territorial waters of the United States.

For the *Conestoga I* rocket launch in September 1982, SSIA requested on March 16, 1982,[72] and on September 1, 1982 received, an exemption from the FAA regulations permitting a sub-orbital launch with a "splash-down" in the international waters of the Gulf of Mexico.[73] The exemption was granted after interagency consultation and coordination and after public comments were solicited in two *Federal Register* notices.[74] The FAA also issued an order designating temporary restricted airspace, and promulgated appropriate notices to airmen concerning the launch. While NASA did not exercise any regulatory authority over the launch, NASA did agree to provide a *Minuteman I* M56A-1 rocket motor which powered the *Conestoga I* rocket. As part of the process of deciding whether and how to permit the use of the M56A-1 rocket motor, NASA carefully reviewed the technical and safety aspects of the proposed *Conestoga I* launch. In addition, the agreement with NASA for the use of the rocket motors included provisions on insurance and indemnification of the United States, its agencies, employees and contractors.

Because the various treaties discussed above imposed obligations on the federal government, but not directly on SSIA, the State Department exercised its responsibilities under the treaties described above by requiring SSIA to obtain an export license. The State Department exercised this authority, however, not on treaty grounds, but under the Department's statutory authority for control and licensing of arms exports contained in the Arms Export Control Act.[75] On April 16, 1982, SSIA requested "any authorization necessary" from the State Department for the *Conestoga I* launch.[76] On September 7, 1982, the State Department issued a letter

72. Author's files, as Space Services Incorporated of America aerospace counsel.

73. *Id.*

74. 47 Fed. Reg. 16,243 (Apr. 15, 1983); 47 Fed. Red. 32,229 (July 26, 1982).

75. The State Department's statutory authority for control and licensing of arms exports is contained in the Arms Export Control Act, *as amended,* 22 U.S.C. § 2278. Pursuant to statute, the State Department has issued the United States munitions list which contains a list of designated arms, ammunition and implements of war which includes rockets and launch vehicles. 22 C. F. R. § 121.01. Category IV of the U. S. munitions list reads as follows:

Category IV—Launch Vehicles, Guided Missiles, Ballistic Missiles, Rockets, Torpedoes, Bombs and Mines.

(a) Rockets (except meteorological sounding rockets), bombs, grenades, torpedoes, depth charges, land and naval mines, and demolition blocks and blasting caps (see 121.05).

(b) Launch vehicles, guided missiles, and ballistic missiles, tactical and strategic.

(c) Apparatus, devices, and materials for the handling, control, activation, detection, protection, discharge, or detonation of the articles in paragraphs (a) and (b) of this category (see 121.06).

(d) All specifically designed components, parts, accessories, attachments, and associated equipment for the articles in this category.

Id. See also id., Categories V(a), VIII, XI, and XII.

76. Author's files, as Space Services Incorporated of America aerospace counsel.

granting approval for the launch by means of an export license issued under the Arms Control Act. This one-time license was subject to very strict limitations.[77] Because the *Contestoga I* was to be launched only 48 hours later, SSIA decided to accept the State Department's authorization even though there were substantial questions as to whether there was any rational legal basis for imposing an export licensing requirement on private rocket launches from a United States site. SSIA also requested and received an experimental radio license from the Federal Communications Commission (FCC) granting the right to use frequencies on a non-exclusive basis for essential communications. Thus private commercial launching became an appropriate subject for federal regulation under President Reagan's space policy.

The most recent addition to the federal legal regulatory scheme is the Commercial Space Launch Act of 1984,[78] which was signed by President Reagan on October 30, 1984 and which enacted into law some aspects of his evolving space policy. The Act designated the Department of Transportation (DOT) as the lead agency for private commercial launches. The Act requires any person engaged in non-government launch operations in the United States to obtain a license pursuant to the terms and conditions, rules and requirements established by the Secretary of Transportation in consultation with other federal agencies. Certain United States citizens, as

77. On September 7, 1982, the State Department issued a letter approving the launch under the Arms Control Act, subject to the following conditions and limitations:

1. This authorization is confined to the proposed prototype launch only. Subsequent launches of this type will require a separate review and approval.
2. The authorization is based on the understanding that [SSIA] has agreed to comply with certain safety requirements imposed by NASA and the FAA on the Conestoga launch.
3. This authorization is subject to the understanding that [SSIA] has obtained insurance in the amount of $100 million for any damages or expenses that might arise in connection with the Conestoga launching, including any payments for which the United States may be responsible under any treaty.

Letter from the United States State Department to Space Services Incorporated of America (Sept. 7, 1982) (on file with the author). 18 [Fed. Reg.] Weekly Compilation of Presidential Documents 869, 872 (1982).

78. Pub. L. No. 98-575 (1984). S. 2931, the "Commercial Space Launch Act", was introduced by Senators Trible, Gorton, Heflin, Inouye, Riegle, Hollings, Kasten, Matsunaga, Stevens, Packwood, Ford and Kassebaum on August 9, 1984. S. 2931 was the subject of a hearing before the Committee's Subcommittee on Science, Technology, and Space on September 6, 1984. Testifying at this hearing were the Director of the Office of Commercial Space Transportation of DOT, representatives of NASA, and members of the commercial space launch industry. On October 2, 1984, the Committee ordered reported H. R. 3942 (the House companion bill, which had been referred to the committee on June 7, 1984). The reported bill is an amendment in the nature of a substitute and is compromise legislation developed by the Committee and the House Committee on Science and Technology. On October 18, 1984 the Commercial Space Launch Act (H. R. 3942) was transmitted to the President for his signature. According to the Committee Report on the Act, it promotes commercial space activity by giving the Secretary of Transportation the exclusive authority to issue licenses for commercial space launches and launch operations and by encouraging the use of government launch services and the sale of excess launch property at reasonable prices.

defined in section 4 of the Act, engaged in non-government launch operations outside the United States would require a license pursuant to the terms and conditions of section 6(a) of the Act. Government launch activities are exempt from the provisions of the Act.

In creating a one-stop licensing process within DOT for commercial space launch activities, the Act does not abrogate or repeal any existing federal law or requirement. The Act does instruct the Secretary of Transportation to consult with the other federal agencies whose existing authority applies to launch or launch-operation activities and to establish procedures that expedite the processing of applications for commercial launch and launch operation licenses. At the same time, the consultation requirement will permit the Secretary and the involved federal agencies, to the extent permitted by law, to revise and review their regulations and procedures to eliminate unnecessary regulatory obstacles to the development of commercial launch operations and to ensure that those regulations and procedures found essential are administered as efficiently as possible. The Act is consistent with Executive Order No. 12,465, discussed below, on this matter.

Nothing in the Act is meant to affect existing payload licensing authority, in particular the authority of the FCC under the Communications Act of 1934 or the authority of the Secretary of Commerce under the Land Remote Sensing Commercialization Act of 1984. Pursuant to the Act, the Secretary of Transportation may neither require a recertification process nor review the action of another agency to issue a payload license, authorization, or permit. The Act does address payloads to the extent that an applicant must be able to identify the payload and have obtained the necessary payload license to obtain a launch license. In the case of a payload where a license, authorization or permit is not required, the Secretary is granted a broader authority to ensure that the payload does not jeopardize public health and safety, safety of property, or any national security interests or foreign policy interests.

The Act authorizes the Secretary of Transportation to issue or transfer a license for launch activities to the extent such activities are consistent with the public health and safety, safety of property, and national security and foreign policy interests and to the extent the necessary payload licenses, authorizations or permits have been obtained. The Secretary may waive the application of any requirement within section 8 for a license if the Secretary determines that such waiver is in the public interest and will not jeopardize the public health and safety, safety of property, or any national security interest or foreign policy interest. To ensure a stable regulatory environment and to prevent unnecessary regulatory delays, the Act instructs the Secretary to make a determination on any license application not later than 180 days after receipt of such application. To ensure adherence to this standard, the Secretary is instructed to notify any application of any pending

issues after 120 days. This requirement should permit an adequate opportunity for any applicant to provide the necessary information or documentation to resolve any outstanding issues.

The Act authorizes the Secretary of Transportation to suspend, revoke or terminate any license and/or launch activity immediately, unless otherwise specified, if the Secretary finds that the licensee has substantially failed to comply with any requirement of the Act, license, or any regulation or if such action is required to protect public health and safety, safety of property, or national security interests or foreign policy interests. To assist in determining compliance with the license, the Secretary is permitted to place federal officers, employees, or other individuals, including contractor personnel, at any launch site, production facility or assembly site used by a contractor of the licensee.

The Act furthur promotes commercial space launch activities by authorizing the Secretary of Transportation to facilitate and encourage the acquisition of government launch property and government launch services by the private sector. The Act establishes a minimum level of liability insurance, to be determined by the Secretary in consultation with the Attorney General, as a requirement for a license and authorizes the Secretary to enforce the Act. The Secretary's enforcement authority may be delegated by the Secretary to any officer or employee of DOT or, with the approval of the head of another agency, of any officer or employee of such agency. A broader consultation requirement is established in section 20 where the Secretary is instructed to consult with the State Department, Department of Defense and other appropriate federal agencies in order to carry out the provision of the Act. Section 21 recognizes the need to preempt state laws, rules, regulations, standards, or orders "inconsistent" with the Act, and section 22 establishes the reporting requirements. The Act authorizes appropriations of $4 million for fiscal 1985.

C. Administration Policy

On July 4, 1982, at the landing of the Space Shuttle *Columbia*, President Reagan announced a national space policy to set the direction of United States space activities during the 1980s.[79] This policy announcement was the result of a government interagency review begun in August 1981. The policy provides that the United States government is to encourage domestic commercial exploitation of space capabilities, technology and systems for national economic benefit. On May 16, 1983 the National Security Council issued the Reagan Administration's policy on commercialization of expendable launch vehicles (ELVs).[80] This policy fully endorses and facilitates the

79. 18 [Fed. Reg.] Weekly Compilation of Presidential Documents 869, 872 (1982).
80. Aviation Week & Space Technology, June 25, 1984, at 16.

commercialization of ELVs. It provides that the government will regulate private ELV operations only to the extent required to meet national and international obligations and to maintain public safety. The policy even encourages private ELV operators to use government launch facilities.

To implement these policy decisions, in November 1983, the President designated the Department of Transportation (DOT) as the federal government's lead agency for commercial launch activities.[81] This decision was followed by the formal signing in February 1984 of Executive Order No. 12,465, which directed DOT to act as the focal point within the federal government for private-sector space-launch contacts and to facilitate the process for commercial launch operators of identifying and satisfying the related requirements and regulations of other federal agencies concerning commercial space activities.[82] Even more significantly, on October 30, 1984, President Reagan signed the Commercial Space Launch Act, described above.[83]

On January 25, 1984, President Reagan, in his State of the Union message, overrode strong opposition from some of his economic and military advisors to announce plans to construct a civilian permanently manned space station by 1994.[84] Reagan's speech also strongly encouraged private space industrial activities and commercial launch services. Thus, federal government agencies in the United States have clearly been told to permit and encourage commercial space activities. President Reagan's policy was elaborated upon at a White House ceremony on July 20, 1984 celebrating the 15th anniversary of the lunar landing of *Apollo 11*, and the following federal goals were described: (1) eliminate provisions in the tax codes and regulations that discriminate against commercial space ventures;[85] (2) update laws and regulations predating space operations to accommo-

81. 20 [Fed. Reg.] WEEKLY COMPILATION OF PRESIDENTIAL DOCUMENTS 90 (1984).

82. *Id.* at 263.

83. *See supra* text accompanying note 78. Pub. L. No. 98–575, Oct. 31, 1984; Senate Committee on Commerce, Science & Transportation, Report 98–656, 98th Cong. 2d Sess., Oct. 3, 1984; House Committee on Science & Technology, Report 98–816, 98th Cong. 2d Sess., May 31, 1984.

84. President Reagan overrode strong opposition to his support of a permanently manned space station from Secretary of Defense Caspar W. Weinberger and staff who felt that the project would drain development funding in general and dilute some space shuttle resources important to Defense Department space operations. By rejecting this opposition and developing the space station for civil space objectives, the White House believes it was able to make a statement on the peaceful uses of space. Additional opposition came from Office of Management and Budget Director David Stockman, who argued against the space station development as one additional program that would increase the national deficit. Reagan told Stockman that it was a good thing he was not there when King Ferdinand and Queen Isabella were considering whether or not to fund Christopher Columbus. AVIATION WEEK & SPACE TECHNOLOGY, January 30, 1984, at 16.

85. AVIATION WEEK & SPACE TECHNOLOGY, 16, June 30, 1984. A "Tax Status of Space Act" was introduced in Congress to give space business legal status similar to business done on the earth's surface. Houston Chronicle, Aug. 12, 1984, § 1, at 19.

date the commercial use of space, including streamlining regulatory decisions affecting future space projects; (3) expand industry's role in setting the nations' research agenda, through advisory committees, to expand research and development in areas that have commercial applications and will result in development of marketable commercial space products and services; and (4) take steps to assure companies and potential investors of policy consistency to encourage the long-term commitment required for most space projects. These economic initiatives were designed to place industrial research and manufacturing in space and the development of space-based services on an equal footing with terrestrial businesses.[86]

Under the new policy, the administration is committed to take steps, including legislative proposals, to assure that the encouragement of private investment in space is a long-term, consistent United States policy. The new policy grew out of a comprehensive study by the National Academy of Public Administration (NAPA), which recommended that the following policies and initiatives be adopted by NASA to encourage space business: (1) declare and institutionalize a major commitment to the commercialization of space technology; (2) assist industry in pursuing opportunities for profitable investment in space; (3) offer NASA facilities and services for use by private companies under conditions that encourage commercial development; (4) continue publicly funded research and development including study of long-range opportunities; and (5) reduce the risks and restrictions that impede commercial exploitation of space technologies.[87] The NAPA report provides a comprehensive and clear set of guidelines that appear to be acceptable to NASA. Since May 1983, when the report was submitted, NASA has implemented several of its key provisions. This action is particularly encouraging because NASA must really alter its way of doing business to implement these changes. If all agencies of the federal government implement President Reagan's space policies as effectively as NASA, it is probable that significant new business activities will take root and flourish in space.

IV. Conclusions

Harsh regulation could stop development of space by United States business. Free enterprise does not move where there is no possibility of profit. While space is the "common heritage of all mankind" in a philosophical sense, for business to operate in space the resources actually reduced to possession and processed by private industry must belong to the

86. *Id.*

87. NATIONAL ACADEMY OF PUBLIC ADMINISTRATION, ENCOURAGING BUSINESS VENTURES IN SPACE TECHNOLOGIES (1983).

entrepreneur who had the vision and took the risks. The United States government must not allow treaties declaring space to be mankind's "common heritage" to prevent the development of these resources.

We can draw several conclusions. First, United States space activities must be controlled by definite United States law, not by vague international treaties. This is critically important to allow United States investors to assess the risk of investing in space ventures. Second, the United States law governing space businesses must be very flexible and must evolve in response to real business needs. And third, United States private space activities must be granted exemptions from some regulations (e.g., those concerning occupational safety and health, environmental protection, and perhaps even securities) on a case-by-case basis until these agencies develop regulations for space operations.

In the United States, we can point to several historic examples of joint endeavors by government and business successfully developing new frontiers: (1) the subsidy of the railroads by land grants in the mid-1800s, which opened the western United States to settlement and industry; (2) the development of the United States air transportation industry by air mail subsidies, technology transfer from military aircraft programs and operating subsidies for the military reserve air transport fleet; and (3) direct payment for construction of the federal interstate highway system. In each of these cases, and in many more, the initial cooperation between government and business returned benefits to the United States economy that rapidly repaid the initial subsidy or investment and went on to create new jobs and new real wealth for the people of the United States.

The resources available in space are so immense that it may be desirable to give business an incentive to help with the great risks involved in building space industry. For example, Congress could take the following steps: (1) Legislate a direct tax credit for capital expenditures made in space manufacturing, much like the present tax credit for solar energy. (2) Declare that business done and sale of products made in space would be tax exempt until 2020, after which normal tax rates would apply. Today space is an "underdeveloped area." Many nations that seek industry agree to waive taxes on new industry for some period. (3) Arrange for government guaranteed loans for, or even establish a fund to make direct investment in, selected new space industries in return for a share of future earnings. When the loans were repaid, the royalty income would establish a permanent investment fund.

All of these ideas and examples have one common touchstone—government and industry must work together as friendly, flexible partners, to develop the frontier of space. In 1982, the U.S.S.R. launched more than 110 satellites; the United States launched less than 20. While it is true that private companies in the United States are working to commercialize ex-

pendable launch vehicles and build private space stations, this work can only succeed in a vigorous business-government partnership.

If we work together, we, all the people of earth, and our children will have the material wealth and spiritual challenge of many worlds. The choice we face, as the historian H. G. Wells foresaw, is "the universe or nothing."