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96th Congress
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COMMITTEE PRINT

AGREEMENT GOVERNING THE ACTIVITIES OF STATES ON THE MOON AND OTHER CELESTIAL BODIES

PREPARED AT THE REQUEST OF

HON. HOWARD W. CANNON, *Chairman*

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

UNITED STATES SENATE

AUGUST 1980

PART 3

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LETTER OF SUBMITTAL

CONGRESS OF THE UNITED STATES,
OFFICE OF TECHNOLOGY ASSESSMENT,
Washington, D.C., August 13, 1980.

Hon. HOWARD W. CANNON,
Chairman, Committee on Commerce, Science, and Transportation,
U.S. Senate, Washington, D.C.

DEAR SENATOR CANNON: Enclosed is a page proof copy of the OTA study of the United Nations Moon Treaty requested in the letter from you and Senator Stevenson to Congressman Udall dated November 30, 1979. The study, in the form of a staff paper, is not being released publicly by OTA, although drafts of the work at different stages were externally reviewed by nongovernment and government experts. The study was not reviewed or approved by the Technology Assessment Board.

The study presents: (1) a survey of the current and foreseeable state of technologies related to exploitation of nonterrestrial resources; (2) a recapitulation of recent relevant developments in plans to use, and the regime to regulate, resources of the deep seabed; (3) an analysis of parallel developments in the use of and regulation of space; (4) an article-by-article review of the Moon Treaty and a summary of explicit and implied constraints on U.S. activities; and (5) a brief discussion of alternative legislative options available to the Congress.

I understand that Messrs. Gehrig and Beasley of the Commerce Committee staff are arranging for publication of this study as a Committee print in your series of hearings and documents concerning the Moon Treaty. A camera-ready master copy of the completed, proofed text has been delivered to Mr. Beasley.

We hope this study is responsive to the Committee's need. If we may be of any further help, please let me know.

Sincerely,

JOHN H. GIBBONS.

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1. OVERVIEW

During the 22d session of the U.N. Committee on the Peaceful Uses of Outer Space, held in New York from June 18 to July 3, 1979, the Committee decided to submit to the General Assembly of the United Nations for consideration, final adoption and opening for signature, the draft Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (hereinafter referred to as the Moon Treaty), the text of which is presented in its entirety in annex A.

On November 30, 1979, Senator Howard W. Cannon, Chairman of the Senate Committee on Commerce, Science, and Transportation, and Senator Adlai E. Stevenson, Chairman of the Subcommittee on Science, Technology, and Space, jointly wrote to Congressman Morris K. Udall, Chairman of the Technology Assessment Board, noting that the U.N. Committee on Peaceful Uses of Outer Space had recommended the draft agreement to the U.N. General Assembly, and forwarded to Mr. Udall a copy of the text of the draft agreement. The letter continued:

> This Agreement is a treaty; therefore, if signed by the United States, it will be sent to the Senate for advice and consent to ratification. It is being argued that the Agreement, if ratified, could inhibit, or even prohibit, U.S. private industry from developing and exploiting extraterrestrial materials.
>
> To reach its decision with respect to ratification, the United States Senate must have an objective analysis of the implications of this Agreement. It is therefore requested that the Office of Technology Assessment undertake a small-scale assessment of the impact the Agreement would have on the capability of the United States to exploit extraterrestrial materials. In light of the expectation that the Treaty might reach the Senate for ratification early next year, it would be helpful if the study were made available within the next few months.

Pursuant to this request the Director of OTA arranged for the requested, small-scale assessment to be conducted by existing OTA staff within available resources and drawing upon available literature, U.S. governmental specialists, and other available sources. Work began in January 1980.

The scope of this assessment was limited to: 1) an introductory discussion of the state of the art and technology related to exploitation of extraterrestrial materials; 2) a brief survey of the progress in the related negotiations on the law of the sea; 3) a recapitulation of recent developments in commercial activities in space and developments in space law; 4) a description of the basic criticisms which have been publicly raised about the treaty; and 5) a review of the text of the Moon Treaty. Analysis of the treaty was generally restricted to identification of explicit or implied constraints found in the language of the treaty and did not extend to analysis of the broader complex of related economic and political issues surrounding the treaty. As a re-

sult, this analysis has certain obvious limitations. The broader analysis expected to be done by the Congressional Research Service should supplement this study in important ways. A summary of current and possible congressional actions is also presented.

Using Space and the Space Environment

There are many aspects of the space environment (elaborated at p. 12) that can be exploited. All of these characteristics can be exploited in low and geosynchronous Earth orbit employing materials produced on or from the Earth's surface or subsurface. Employing materials available on Earth, and using these various aspects of the space environment, space use and commercial exploitation in Earth orbit are proceeding today. The Moon Treaty would have no impact on such activities.

Contemplating expansion of man's activities to areas beyond the orbits of the Earth presumes the availability of certain technological capabilities that do not now exist and there are no current U.S. programs for development of some of the needed capabilities to permit exploitation of space beyond Earth orbit.

Long-range planning officials at the National Aeronautics and Space Administration (NASA) generally agree that development of technological capabilities needed to pursue nonterrestrial materials (NTM) use will not occur in the near future on a priority basis unless a major space system commitment, justifying NTM use, is undertaken. Such a commitment could be creation of a solar power satellite demonstration system with public, private, or joint financing. Planning specialists outside NASA, however, disagree with this conclusion and have identified smaller scale scenarios in which NTM exploitation becomes cost competitive with the use of materials produced on Earth and launched to Earth orbit. NTM use may become a viable option, these specialists contend, whenever man's requirements for materials to support his activities in space rise to a level which cannot be economically fulfilled by the Shuttle Orbiter. Relevant technologies for NTM use will be pursued and even developed on Earth on a nonpriority basis. There are some programs funded and some under study that will expand the existing technology base toward a greater capability eventually to exploit NTM.

NASA officials believe that, even assuming an ambitious future program of space applications, using lunar resources would not appear to be justified unless a program of the dimension of a solar power satellite (SPS) system were involved; and even then only if a decision were made *not* to use terrestrial resources for the first series of perhaps 5 to 10 satellites. Such a decision is considered by some experts as highly improbable. SPS is a concept for collecting solar energy in space, converting it to electricity, and transmitting it to Earth via microwave beams. Located in geosynchronous orbit, SPSs may be able to provide large amounts of renewable energy to Earth with acceptable environmental impacts. SPSs (5,000 to 10,000 MW) would be large—50 to 100 km^2 in area and 50,000 to 100,000 tons in mass. Their large mass makes SPSs candidates for use of lunar materials,

but almost certainly only after a definite commitment has been made to a full-scale production program of perhaps two satellites per year for 10 or more years.

Others are not persuaded that the SPS concept is a prerequisite to economic use of lunar material. One recently published study documents the potential for economic use of lunar materials at a program scale between 100 and 1,000 times smaller than SPS. Studies sponsored by the Space Studies Institute (SSI) have taken an alternate technological approach and arrived at the same conclusion. These studies suggest that cost-competitive utilization of lunar resources is by no means tied to program commitments on the scale of SPS. Any large-scale industrialization of space will require substantial materials availability. If these requirements are met from Earth resources, it will be necessary to develop expensive new transportation systems capable of delivering payload into space at a lower cost per pound than the Shuttle Orbiter. In comparison to the capital costs of designing, constructing, and employing such new launch vehicles, development costs for NTM exploitation are argued to be competitive. Accordingly, these studies postulate scenarios in which lunar resource retrieval substitutes economically for a new Earth-to-Earth-orbit transportation system. It is not clear at present how much support for these views exists within the aerospace community.

A brief review of study efforts NASA has sponsored to investigate lunar resources use clearly suggests that the resources of the Moon do provide technological opportunities for conducting large-scale, in-space operations. Those who have conducted research in the area believe that to ensure that such resources may be used in the future, a unified program of laboratory research, process experiments, and studies of manufacturing and processing operations would be required—probably not a large program, but one receiving continual, reliable support, emphasizing fundamentals, and constructively involving the academic community and nonaerospace industry interests in a share of the effort.

As to the timing of extraterrestrial resources exploitation, only a major program commitment of dimensions comparable to the Apollo or Space Shuttle programs could result in experimental operations on the Moon within a decade of commitment. Under present funding levels, significant lunar materials experimentation by the United States is not likely before the year 2000, and if a production decision were then made, probably at least another 5 to 10 years would be required to begin production. In general, the Nation appears to have in hand the technological know-how to begin a development program for extraterrestrial resources use. The pacing factor will be the timing of a program commitment of sufficient funds in the order of billions of dollars. There do not now appear to be any insurmountable technological impediments to extraterrestrial resources exploitation.

Analysis of Issues–Identification of Constraints

An informal working paper prepared by the State Department summarizes the administration's view of what the United States

gains from the Moon Treaty. An analytical, point-by-point response prepared by the L-5 Society* is coupled with the State Department paper in annex D to this report.

Emergence of the Moon Treaty from years of negotiation in the U.N. Committee on the Peaceful Uses of Outer Space, places it earlier in time of completion than the Law of the Sea Treaty, but it is still largely an international treaty contemporary with the emerging legal regime being negotiated in the Third U.N. Conference on the Law of the Sea (UNCLOS III). Some critics of the Moon Treaty point to concepts and provisions closely paralleling concepts and provisions in the early history of negotiation of the draft treaty on the law of the sea, now believed to be nearing completion. Consequently, to place in context a current evaluation of the Moon Treaty, it is necessary to review some aspects of the history and current status of the law of the sea negotiations (pp. 295-307). In addition, in the following section (pp. 307-311), recent precedents of relevance in the evolving body of space law are reviewed. Together, these recently emerging bodies of law are seen to have relevance to the Moon Treaty, its interpretation, and its possible effects.

UNCLOS III is developing a composite convention of more than 400 articles, including tens of articles in specialized and detailed annexes. New institutions are being proposed and detailed regulations are being laid down through a negotiating procedure that has operated (at least until mid-1980) on a consensus basis. Nations are negotiating to accommodate their individual interests and their shared interests in a single instrument of a scope and detail unprecedented in the history of international law. Hundreds of years of international and maritime law and practice are being codified in the same instrument with totally new legal concepts. An extremely complex and disparate set of interests are being dealt with simultaneously.

The consensus approach to these UNCLOS III negotiations, which address the entire scope of the convention as a single package, means that vital security interests, commercial interests, environmental protection, conservation, dispute settlement procedures, scientific interests, and general maritime interests, all are being interwoven and traded off. These negotiations are now in their seventh consecutive year and many believe that the final treaty text is virtually completed. It remains to be seen whether or not commercial exploitation of deep seabed resources is nearing realization. At a minimum, it is anticipated that broad consensus on the package will mean a wide acceptance of solutions to long-contested ocean law issues.

Although the U.S. Government role in funding R&D in both military and civil programs has been the single most important impetus to development of new space technology for transportation, space science, research, exploration, and applications, there has been, and con-

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*The L-5 Society is a nonprofit association of some 3,500 private citizens who are devoted to the advancement of mankind's full utilization of the potential of space. Members reside in every State in the United States and a number of foreign countries.

tinues to be, an active presence by private enterprise in the development, ownership, and operation of space systems. Between 1960 and 1980, global commercial investments in space systems have exceeded $3 billion. These investments have been commercially attractive, despite high risks involved in the early developmental period, and early investments have been returned with a profit.

Thus, there is a substantial and growing presence of U.S. industry and foreign industry, as well as governments, in the space arena. Even during the early, high-risk, and developmental years, before most of the current space law was written, hundreds of millions of dollars were invested in commercial space ventures. Capital has been available to fund single programs requiring hundreds of millions of dollars of prerevenue investment, and new entities continue to emerge seeking to enter the commercial arena in space. Early entry into space was under different circumstances and in a different environment from that which prevails today. Recently, even traditionally technical bodies like the International Telecommunication Union (ITU) have begun to feel the influence of the "North/South debate," involving developed country interests juxtaposed and in conflict with developing country interests.

As experience was gained and technical and economic feasibility of various new space applications were being demonstrated, the evolving body of space law to govern space activities began to expand. Commercial and governmental R&D occurred in parallel with the gradual creation of the relevant law and regulations applicable to space activities. Organizations with long histories, like ITU and the Intergovernmental Maritime Consultative Organization (IMCO) adjusted their traditional roles and rules and began to accommodate the need for new institutional entities and new regulations to deal with the emerging, expanding body of space activities.

The body of extant space law is extensive, diverse, dynamic, and expanding. It involves, and its formulation directly involves, nations in all parts of the world and at all levels of technical and economic development. The work of the 47-nation U.N. Committee on the Peaceful Uses of Outer Space has been central in forming the core space treaties, but, as shown herein, an extensive body of practical cooperative and commercial law relating to space activities has also been created by states outside the more formal proceedings of the United Nations.

This long history of international cooperation in the space field will be an important counterweight to any influence which the deep seabed experience at the LOS Conference will have on the elaboration of a future detailed regime for nonterrestrial resources. It should, however, be recognized that in recent years, some of the same North-South issues found in the LOS context have become more prominent in international negotiations related to space. In particular, several of the recent World Administrative Radio Conferences of ITU have involved increasing Third World demands for more equitable allocation of radio frequencies and more technical assistance.

Issues Raised in Opposition to the Moon Treaty

The principal reasons that have been presented in opposition to U.S. signature and ratification of the Moon Treaty are that it would:

- create a moratorium on commercial exploitation of the resources of the Moon and other celestial bodies, until a second, much more comprehensive treaty for regulating resource activities is concluded;
- establish guiding principles for the negotiation of this second treaty which are completely antithetical to the commercial development of outer space resources by private enterprise; and
- thereby give other countries tremendous political control over the timing and direction of expanding commercial uses of outer space, as well as the question whether to permit such uses.

Aside from the textual interpretation of article 11 of the Moon Treaty and related provisions (discussed *infra* at pp. 331-339), these arguments concerning the treaty's imposition of a *de facto* moratorium draw heavily on the experience of the seabed mining industry.

While the incomplete UNCLOS III negotiations have been in progress for the last 6½ years, several hundred million dollars have been invested by commercial entities in the development of technology and the study of the nature, location of, and best means for processing deep seabed resources. Major consortia have been formed within this same period, and plans apparently exist today within at least some companies to proceed with programs for deep seabed resources exploitation. Nevertheless, seabed mining industry spokesmen indicate that eventual full-scale deep-sea mining operations by U.S. companies may never occur because the draft treaty texts nearing completion in the LOS Conference require further improvements and refinements before they can serve as a basis for private investment acceptable to U.S. industry. Evidencing the debilitating effect which the uncertain international political situation has had on ocean mining programs, three of the four consortia with major U.S. participation have announced severe cutbacks in their expenditures during the past 2 years, including disbanding technical teams and closing facilities. Although the United States has just enacted domestic legislation to establish an interim regime for deep-sea mining pending entry into force of an LOS convention (Public Law 96-283), even this law, at the insistence of the administration, imposes a temporary moratorium on commercial exploitation activities until January 1988.

On the one hand, it can be seen that industrial seabed developments continued during the 1970's in the face of an explicit U.N. moratorium resolution and a contested formulation of the nature and content of the regulatory regime to be applied at some future time. Consistent with past experience in early space commercial exploitation, industry was apparently prepared to take risks and to invest capital when the benefits to be obtained seemed substantial, even though there existed risk and doubt about emerging law.

On the other hand, apparently no major U.S. seabed mining company presently contemplates making the large-scale investment in actual recovery facilities so long as the extent to which that invest-

ment will be respected under the future LOS regime, remains in doubt. Even after 10 years of delay, because of the politics involved, the U.S. Government appears unprepared to exercise the unilateral right of seabed exploitation it consistently has claimed to have. The new law effectively postponed that action for at least 8 more years. Investments in seabed mining R&D began at a time when the companies could not predict that the common heritage regime ultimately espoused by the United States would contain the burdensome provisions now criticized by industry. Today, aerospace and related companies know how the Third World interpreted the common heritage and supporting principles in the deep seabed context, and they see how much of that interpretation U.S. negotiators are apparently prepared to accept.

It is neither the purpose nor the intent of this review of the positions stated on the Moon Treaty to seek to resolve them. It is clear that there are deeply held convictions on both sides of the argument, and it is probably the most difficult kind of an argument to resolve, being focused on speculation about possible future events and the likely consequences that will flow from U.S. signature and ratification of the treaty in the near future.

Constraints on U.S. Capability to Exploit Extraterrestrial Resources

The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (full text at annex A), opened for signature on December 18, 1979, is, in substantial part, a reiteration and elaboration of earlier treaties drawing primarily on the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies of 1967.

The new agreement restates and extends some constraints on the freedom of states to use the Moon and other celestial bodies; it is interpreted by some to imply constraints on resource exploitation in the immediate future; and in providing for the future creation of a regime to govern the exploitation of resources on the Moon and other celestial bodies, the agreement creates the possibility of additional constraints being established at a future time.

In *article 11* there is a commitment to "undertake to establish" an international regime, including appropriate procedures to govern the exploitation of resources. There is disagreement over whether or not this language includes a commitment to "conclude" a new treaty as a result of that undertaking. To the extent that constraints are found in article 11, they are implied in the undertaking to establish a regime consistent with general and vaguely worded purposes stated in that article. Additional constraints have been read into the text based on parallelisms with LOS resolutions and some others are justified by assumptions about the future behavior of states. There is no clear justification in the U.N. space committee's record of negotiation of article 11, or any other article of the agreement, that can be seen to impose a *de jure* moratorium on exploitation. There is explicit reference in article 11 to article 6(2), wherein the agreement provides that

states parties may use minerals and other substances in support of scientific investigative missions.

Current and Possible Congressional Actions

Congress is currently:

- without an institutional position although certain members oppose signature of the treaty; and
- convening hearings to establish a clear, reliable record concerning the treaty.

Actions available to Congress in the near term include:

- soliciting submission to Congress of the report of the interagency task force in the executive branch currently reviewing the treaty and its implications; and
- planning and convening a congressionally hosted panel series or comprehensive review conference on the treaty, if deemed necessary to supplement currently planned hearings.

Longer term actions available to Congress include:

- withdrawing the informal advice against signature and preparing for treaty hearings for purposes of providing advice and consent to ratification;
- developing appropriate reservations, understandings, or declarations to be incorporated in any eventual instrument of ratification submitted by the United States;
- considering what, if any, legislation may be appropriate to meet U.S. industrial needs concerning possible future exploitation of extraterrestrial resources;
- studying the possibility of the State Department taking an initiative to place before the U.N. Outer Space Committee a proposal to develop an early protocol to the Moon Treaty on matters of definition of terms and clarification of vagueries and ambiguities in the text; and/or
- maintaining a firm position in opposition to signature by the administration, based on a determination that the Moon Treaty is unacceptable to the people and the Government of the United States.

These possible future actions are elaborated and explained in chapter 6, pp. 346-350.

2. INTRODUCTION: WHY THIS STUDY WAS UNDERTAKEN

During the 22d session of the U.N. Committee on the Peaceful Uses of Outer Space, held in New York from June 18 to July 3, 1979, the Committee decided to submit to the General Assembly of the United Nations for consideration, final adoption and opening for signature, the draft Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (hereinafter referred to as the Moon Treaty), the text of which is presented in its entirety in annex A.

In the months following completion of the Committee's work on the draft agreement a number of critical articles appeared in newspapers and magazines expressing concern and alarm about the implications for the United States of the draft agreement. Correspondence on the matter was exchanged between a number of Congressmen, Senators, and senior officials, including the President and cabinet members of the U.S. Government.

On September 6, 1979, the Subcommittee on Space Science and Applications of the House Committee on Science and Technology held hearings on International Space Activities, which included a review of the activities of international organizations and the effects of their actions on future space activities. One issue addressed during the hearings that highlighted substantial controversy was the matter of U.S. signature and ratification of the proposed Moon Treaty.

On November 30, 1979, Senator Howard W. Cannon, Chairman of the Senate Committee on Commerce, Science, and Transportation, and Senator Adlai E. Stevenson, Chairman of the Subcommittee on Science, Technology, and Space, jointly wrote to Congressman Morris K. Udall, Chairman of the Technology Assessment Board, noting that the U.N. Committee on Peaceful Uses of Outer Space had recommended the draft agreement to the U.N. General Assembly, and forwarded to Mr. Udall a copy of the text of the draft agreement. The letter continued:

> This Agreement is a treaty; therefore, if signed by the United States, it will be sent to the Senate for advice and consent to ratification. It is being argued that the Agreement, if ratified, could inhibit, or even prohibit, U.S. private industry from developing and exploiting extraterrestrial materials.
>
> To reach its decision with respect to ratification, the United States Senate must have an objective analysis of the implications of this Agreement. It is therefore requested that the Office of Technology Assessment undertake a small-scale assessment of the impact the Agreement would have on the capability of the United States to exploit extraterrestrial materials. In light of the expectation that the Treaty might reach the Senate for ratification early next year, it would be helpful if the study were made available within the next few months.

Pursuant to this request the Director of OTA arranged for the requested, small-scale assessment to be conducted by existing OTA

staff within available resources and drawing on available literature, U.S. governmental specialists, and other available sources. Work began in January 1980.

In addition to this study, three other reports have been requested by the Senate Committee on Commerce, Science, and Transportation: 1) a committee print of the text of the "Moon Treaty," as approved by the U.N. General Assembly, and other relevant treaties and agreements; 2) an analytical report, to be prepared by Mrs. Eilene Galloway, a private consultant, to include an historical summary of the negotiations in the United Nations leading to the "Moon Treaty," a comparative analysis of space treaties now in force, and a statement of the issues and questions raised by that analysis; and 3) an interdisciplinary study of the "Moon Treaty" by the Congressional Research Service (CRS) of the Library of Congress, that will consider the various technological, foreign affairs, and international law issues.

OTA was invited to prepare an objective analysis pursuant to its statutory role in support of Congress, which is set forth in the Technology Assessment Act of 1972. The Act provides that, among other things:

> The basic function of the Office shall be to provide early indications of the probable beneficial and adverse impacts of the applications of technology and to develop other coordinate information which may assist the Congress. In carrying out such function, the Office shall:
>
> (1) identify existing or probable impacts of technology or technological programs;
>
> (2) where possible, ascertain cause-and-effect relationships;
>
> (3) identify alternative technological methods of implementing specific programs;
>
> (4) identify alternative programs for achieving requisite goals;
>
> (5) make estimates and comparisons of the impacts of alternative methods and programs;
>
> (6) present findings of completed analyses to the appropriate legislative authorities;
>
> (7) identify areas where additional research or data collection is required to provide adequate support for the assessments and estimates described in paragraph (1) through (5) of this subsection; and
>
> (8) undertake such additional associated activities as the appropriate authorities specified under subsection (d) may direct.
>
> [sec. 3(c), Public Law 92-484, 86 Stat. 797]

It must be noted that for assessment of projects or programs that have not yet been undertaken or fully developed, there inevitably must be a certain amount of prediction and speculation. Considering the work in progress outside of OTA, the scope of this assessment was limited to: 1) an introductory discussion of the state of the art and technology related to exploitation of extraterrestrial materials; 2) a brief survey of the progress in the related negotiations on the law of the sea; 3) a recapitulation of recent developments in commercial activities in space and developments in space law; 4) a description of the basic criticisms which have been publicly raised about the treaty; and 5) a review of the text of the Moon Treaty. Analysis of the treaty was generally restricted to identification of explicit or implied constraints found in the language of the treaty and did not extend to a full analysis of the broader complex of related economic and political issues surrounding the treaty. As a result, this analysis has certain obvious limitations. The broader analysis expected to be done by CRS should supplement this study in important ways.

3. METHODOLOGY OF THE STUDY AND ACKNOWLEDGMENTS

Time constraints compelled OTA staff to use as the main source of material for this study the body of extant relevant literature. A literature review was conducted and the source materials used are available for reference at OTA. In addition, to the extent time permitted, interviews were held with selected specialists involved in space program management and planning, and others. Relevant contributed articles, papers, and correspondence were also examined and are referenced. A list of experts consulted is at annex B.

When a preliminary draft of portions of the assessment report was prepared, the draft working paper was circulated to a number of persons inside and outside the Government along with an invitation to participate in a workshop to review and discuss the draft, convened at OTA on March 31, 1980. (A list of participants is attached at annex C.) Following the workshop, the draft working paper was revised taking into account the contributions, suggestions, and revisions discussed at the workshop, as well as comments and contributions from other sources, and a draft final report was prepared for submission to the Senate Committee on Commerce, Science, and Transportation, as requested. That draft was circulated for comment and this report is the final product of that process.

While the assistance and contributions of all who cooperated in this study are gratefully acknowledged, the responsibility for both the form and content of this assessment must rest with OTA.

The principal author and project leader for this study was Stephen E. Doyle. Significant contributions are also acknowledged from Harry Almond, James R. Arnold, Marjorie A. Browne, Victor D. Comras, Raymond Crowell, Eilene Galloway, Jerry Grey, Noel Hinners, Lloyd E. Jones, Lee Kimball, Wladimir Naleszkiewicz, Leigh Ratiner, Herbert Reis, S. R. Sadin, John R. Sevier, Zalman Shavell, David B. S. Smith, Jean Smith, Ray Williamson, and Rebecca Wright. In addition, reviewing the history of the law of the sea negotiations was greatly assisted by a series of articles in recent volumes of the *American Journal of International Law* authored or coauthored by Bernard H. Oxman.

4. TECHNOLOGIES AND POSSIBILITIES FOR THE EXPLOITATION OF EXTRATERRESTRIAL RESOURCES

Using Space and the Space Environment

There are many *aspects of the space environment* that can be exploited, or used, including, but not limited to:

- broad visibility of and from large portions of the Earth's surface,
- near zero-g environment (free of gravity),
- near vacuum environment,
- characteristics of orbital mechanics relating to ground track patterns and periodicity of satellites,
- nearly continuous solar energy radiation,
- continuity and stability of certain orbits, and
- scientific, particularly astronomical, research without the "atmospheric filter."

All of these characteristics can be exploited in low and geosynchronous Earth orbit employing materials produced on or from the Earth's surface or subsurface. Employing materials available on Earth, and using these various aspects of the space environment, space use and commercial exploitation are proceeding in Earth orbit today.

Nations currently use space systems for:

- communications relay and broadcasting to supplement terrestrial civil and military systems for telephone, telegraph, television, data communications, facsimile services, and other, more specialized communication services;
- collecting meteorological data including space-made images of weather patterns, satellite relay of data collected at terrestrial or near-surface locations, and selected phenomena measurements, such as temperatures, precipitation levels, and sea states;
- remotely sensing characteristics and conditions of the Earth's surface and materials on the Earth's surface, including, *inter alia*, crops, geological materials, water, land characteristics, soil moistures, and pollution sources;
- navigation for civil and military users;
- surveillance in support of national defense programs;
- scientific research and exploration;
- working laboratories for tests such as selected materials processing experiments; and
- in almost all of the foregoing cases, capturing, converting, and using solar energy to support system operations in space.

Contemplating expansion of man's activities to areas beyond the orbits of the Earth presumes the availability of certain technological

capabilities that do not now exist and there are no current U.S. programs for development of some of the needed capabilities to permit exploitation of space beyond Earth orbit.

Long-range planning officials at the National Aeronautics and Space Administration (NASA) generally agree that development of technological capabilities needed to pursue nonterrestrial materials (NTM) use will not occur in the near future on a priority basis unless a major space system commitment, justifying NTM use, is undertaken. Such a commitment could be creation of a solar power satellite demonstration system with public, private, or joint financing. Absent such a system commitment of some billions of dollars dimension (perhaps even tens of billions of dollars), officials at NASA do not see major technological programs for NTM exploitation occurring in the foreseeable future, *i.e.*, within the next decade or two.

Planning specialists outside NASA, however, disagree with this conclusion and have identified smaller scale scenarios in which NTM exploitation becomes cost competitive with the use of materials produced on Earth and launched to Earth orbit. NTM use may become a viable option, these specialists contend, whenever man's requirements for materials to support his activities in space rise to a level which cannot be economically fulfilled by the Shuttle Orbiter.

It is important to distinguish between (1) development programs now in being for materials processing in space of selected materials available on Earth to be lifted into space for processing, and (2) the matter of collecting resource materials in space for processing in space. The former are not affected by any aspect of the Moon Treaty, the latter may be, as discussed in chapter 5.

Relevant technologies for NTM use will be pursued and even developed on Earth on a nonpriority basis. There are some programs funded and some under study that will expand the existing technology base toward a greater capability eventually to exploit NTM. The principal elements of the required technology base are:

- Earth-to-space and orbit-to-orbit transportation capabilities more cost effective and more versatile than present systems;
- materials collection and processing systems, both man-operated and automated;
- space-based power supply capabilities increasing by orders of magnitude the power supplies produced up to this time; and
- long-duration stay-time life support systems, including an expendable resources resupply capability.

Improved transportation systems will be required not only to move people and materials from Earth to low Earth orbits (LEOs) (up to 500 miles) and to ferry people and materials from LEOs to high Earth orbits and geosynchronous orbits (up to in excess of 20,000 miles), but also, to transport people and materials to locations beyond Earth orbit or to positions on other celestial bodies. The NASA Shuttle Orbiter under current development has an operational ceiling of about 600 miles. It will be able to lift up to 60,000 lb into LEO, the total payload per launch depending on the desired stay-time on orbit and the inclination to the equator of the intended mission orbit.

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Recent studies funded by NASA are beginning to suggest that there exist a variety of materials-processing techniques that might make NTM exploitation in space economically competitive with, or more attractive than, using feedstocks on the Earth's surface to create materials that then require transport to Earth orbit for end use. These studies also show that some of the needed technologies for NTM processing are needed and appropriate for improved productivity with less environmental impact in Earth-based processing systems. Thus, advancing the state of the art for space processing of NTM will also advance the state of the art of current terrestrial processing systems. NASA's recent, relevant studies are summarized below.

Power supplies in space, up to this time, have produced a few kilowatts of power. To support long stay-time, manned operational space stations in Earth orbit, it is estimated that power supplies of hundreds of kilowatts would be required, and if full-scale production facilities are to be: 1) constructed for manufacturing purposes, 2) manned, and 3) operated, eventually megawatts (millions of watts) of power will be required.

To house and maintain man in space for durations of greater than a few months, entirely new structures and life support systems will have to be developed.

Generally, these requirements do not involve insurmountable technical problems, but they do require a good deal of new applied engineering, using and building on what is now known and is being learned.

If the United States proceeds on a course intended to explore and develop the technological base needed for a fully deployed solar power satellite system, the development of technologies in that context will contribute to the technology base for eventual NTM exploitation. Many relevant items are required for activities independent of NTM exploitation *viz.:*

- the Shuttle and Shuttle-derived cargo vehicles,
- interorbit cargo and ferry vehicles,
- crew quarters and life support technologies, and
- satellite and space station construction and assembly equipment.

There are other categories of technology, the development of which would contribute to NTM exploitation, *viz.:*

- advanced propulsion technology to move materials into and through space,
- lunar lander for people and material transport of substantial capacity, and
- processing technologies capable of operation in the space environment, regardless of the source of the materials processed.

Recent Studies of Extraterrestrial Resources Use

NASA's program offices continually fund research and planning studies of future mission possibilities. Recently, two NASA experts reviewed the studies of *lunar resource utilization* (LRU) that have

been done for NASA's Office of Aeronautics and Space Technology.[1] The following information is a condensed version of that review.

In the NASA-funded studies, three objectives received paramount attention:

1. determine what general type of applications would justify use of lunar materials,
2. identify research and technology needs for use of lunar materials, and
3. assess the concept of constructing spacecraft from lunar materials.

Restating and briefly elaborating the first objective: "What type of applications would warrant the investment in research, development, and equipment required to realize the goal of using lunar materials?" NASA officials believe that, even assuming an ambitious future U.S. space applications program, using lunar resources would not appear to be justified unless a program of the dimension of a solar power satellite (SPS) system were involved. SPS is a concept for collecting solar energy in space, converting it to electricity, and transmitting it to Earth via microwave beams. Located in geosynchronous orbit, SPSs may be able to provide large amounts of renewable energy to Earth with acceptable environmental impacts. SPSs would be large—50 or more square kilometers in area and 50,000 or more tons in mass. (See figure 1.) Their large mass makes SPSs candidates for use of lunar materials.

But there are no mines, refineries, factories, or launch systems on the Moon. They must be created through research and investment before the benefits of LRU could be realized. Because the front-end investments are expected to be large, NASA officials conclude that only something as large as SPS appears to offer the return required to justify the start-up cost.

Others are not persuaded that the SPS concept is a prerequisite to economic use of lunar material. One recently published study[2] documents the potential for economic use of lunar materials at a program scale between 100 and 1,000 times smaller than SPS. Studies sponsored by the Space Studies Institute have taken an alternate technological approach and arrived at the same conclusion. These studies suggest that cost-competitive utilization of lunar resources is by no means tied to program commitments on the scale of SPS. Any large-scale industrialization of space will require substantial materials availability. If these requirements are met from Earth resources, it will be necessary to develop expensive new transportation systems capable of delivering payload into space at a lower cost per pound than the Shuttle Orbiter. In comparison to the capital costs of designing, constructing, and deploying such new launch vehicles, development costs for NTM exploitation appear to be competitive. Accord-

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[1]F. C. Schwenk, and S. R. Sadin, "Technological Opportunities for Lunar Resource Utilization: A NASA Study Program," mimeo. draft, to be published (1980).

[2]G. Driggers, "Is Lunar Material Use Practical in a Non-SPS Scenario?," a paper presented at the Fourth Princeton/AIAA Conference on Space Manufacturing Facilities, May 14-17, 1979, Princeton, N.J.

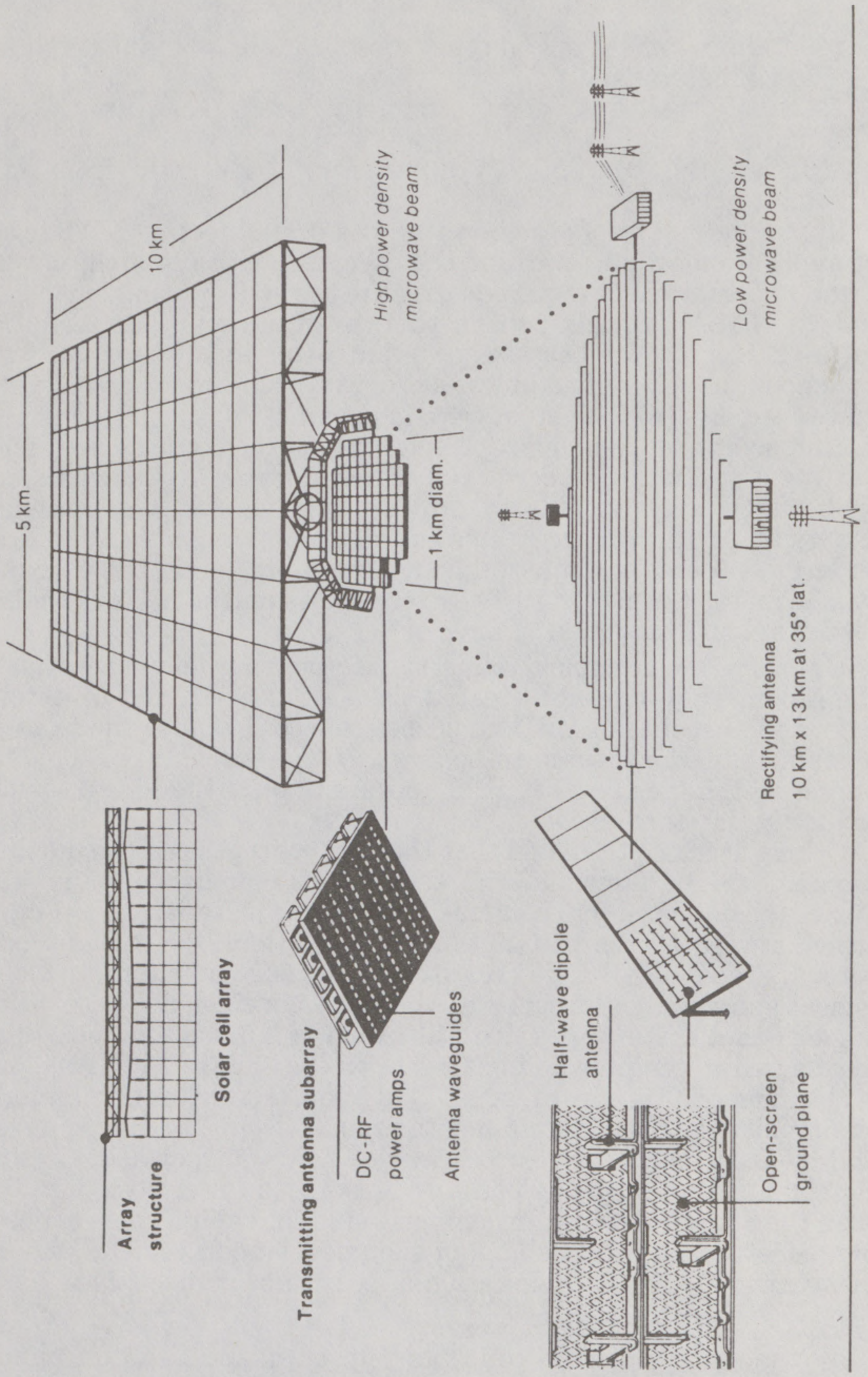


FIGURE 1.—NASA/DOE SOLAR POWER SATELLITE REFERENCE SYSTEM

SOURCE: U.S. Department of Energy.

ingly, these studies postulate scenarios in which lunar resource retrieval substitutes economically for a new Earth-to-Earth-orbit transportation system.

Why the interest in lunar resources for SPS or for any space system? The major reasons would be to provide energy to Earth at low cost or to avoid problems created by using only Earth's resources. Transportation of mass from Earth into orbit represents one of the major costs of doing business in space, even with major advancements in propulsion capabilities and reductions in costs. The energy required for moving mass from the Moon is at least 12 times lower than from Earth.

Relevant NASA studies extended from 1975 through 1979. In 5 years, the modest amount of slightly over $1 million was expended. The studies took several forms. There was a succession of summer studies and workshops conducted to consider overall LRU systems. The initial summer study had a program focus on space settlements. Subsequent summer studies focused on space industrialization, SPS, and, most recently, on research and technology needs.

Another NASA-funded activity was a multiphased study by the Lunar and Planetary Institute (LPI) in Houston, Tex., which produced the following:

- the *Lunar Materials Handbook,* and
- preliminary definitions of
  —process concepts,
  —mining concepts, and
  —preliminary refining (beneficiation) concepts.

The *Lunar Materials Handbook* is a detailed compilation of resources available on the Moon and describes the physical and chemical properties of the known resources. An LPI workshop also produced a report on the likely sites for obtaining desired materials. The essential conclusions are:

- the lunar regolith (surface rock and soil) is a good target resource. It is ubiquitous, locally homogeneous, and regionally heterogeneous. The materials of interest include anorthite (aluminum silicate), ilmenite ($FeTiO_3$), and glasses;
- Apollo's 14, 16, and 17 landing sites are good topographically;
- much material in the soil is fine; the average grain size is 30 to 70 microns, with 85 to 90 percent of the material by weight having a particle size less than 1 mm;
- major elements discovered, present in amounts greater than 1 percent, are oxygen, silicon, aluminum, calcium, iron, and magnesium;
- minor elements, with abundances in the range of 0.1 to 1 percent, are chromium, manganese, sodium, potassium, sulfur, and phosphorus; and
- trace amounts (less than 0.1 percent) of hydrogen, helium, carbon, and nitrogen are present.

For mining, preferred concepts rely on adaptations of mundane construction equipment—scrapers, front-end loaders, trucks adapted for the lunar surface—and remote control. Materials handling on the Moon required to build one or two SPSs per year is quite modest com-

pared to mining and construction operations on Earth. For example, the fueling of ten 1,000-MW (million watt) coal-fired powerplants requires the mining of 50 million *tons* of coal each year. Building one 10,000-MW SPS is estimated to require one-time mining of about 500,000 tons of lunar soil (100 times less).

Studies and experiments also have been conducted in the areas of processing and refining lunar materials. Beneficiation, or enhancing of ores, is essential to limit the amount of materials handled in processing plants. On the Moon, the goal is to concentrate soil grains that are largely anorthites, which contain the desired elements. Low-energy-consuming processes are desired. The options are physical, magnetic, and electrostatic separations.

Magnetic separation appears capable of removing free-iron particles from lunar soils (0.1 percent by weight), and providing feedstock for producing clear glasses. Electrostatic methods have ideal characteristics for lunar materials separation enhancement. A facility for electrostatic separation should be low in mass and provide the widest range of control and selection of species to be separated. Lunar soils and the lunar environment are well suited to electrostatic separation methods. (In Canada, 6 million tons per year of hematite ore are processed by electrostatic separation to reduce the silica content. Thus, there is useful experience on Earth to be applied on the Moon.)

Processes for making glasses and ceramics on the Moon have also been studied. Glasses and basalts are naturally occurring and samples of glass, fiberglass, and ceramics have been made from oxide compositions identical to those returned by Apollos 11, 12, and 16.

From the lunar soil, as found, the following products could be made: glass fibers, glass containers, foamed glass, glass sheets, and cast basalts and ceramics for building blocks and electrical insulators. From the anorthite ($CaAl_2SiO_2$) obtained from electrostatic separation, clear glasses could be produced. Silica, alumina, and magnesia derived from chemical processes would allow fabrication of refractory bricks and crucibles for use in high-temperature (1,700° C) industrial processes and permit the manufacture of high-quality electro-optical components, e.g., wave guides. (See table 1 for a listing of useful products from lunar resources prepared during the study for NASA.)

Chemical processing was also studied in a preliminary fashion to define a plant that could provide silicon and aluminum for a reference solar power satellite, to suggest a "proof-of-concept" processing system which could be developed and tested on Earth, and to guide future research in chemical processing. Although limited funds have been expended, chemists have generated large amounts of information on chemical reactions, process variables, reagent needs, and flow diagrams.

Two approaches appear favored at this time: carbochlorination and acid leach. Both can provide pure silica and various metals and metal oxides for further processing by more or less conventional means. Important aspects of these processes are the recovery and reuse of reactants: carbon, chlorine, water, and hydrofluoric acid.

A study being prepared for release in mid-1980 at LPI in Houston, Tex., integrating a comprehensive examination of technologies known and needed, some preliminary comparative economic analysis, information about lunar materials now known, and possible exploitation of lunar resources, has presented in a working draft findings summarized in table 1. This information should be verified against the final, published report, which is expected to postdate completion of this OTA study.[3]

TABLE 1.—USEFUL PRODUCTS FROM LUNAR SOURCES

STRUCTURAL MATERIALS
- Metals—Steels, aluminum, magnesium, titanium
- Alloys—70 alloys of the above metals requiring little or no Earth-inputs of alloying agents
- Reinforced metals—aluminum, magnesium reinforced with silica, steel, or alumina
- Glasses, fused silica
- Ceramics, alumina, magnesia, silica, compounds
- Hydraulic cements (need water)

THERMAL MATERIALS
- Refractories plus chromia, titania, titanium silicide
- Same as ceramics above plus castables, ramming cements, insulation, fiberglass, fibrous, or powdered ceramics

ELECTRICAL MATERIALS
- Conductors—aluminum, iron, resistance alloys (FeCrAl)
- Electrodes—graphite, Fe_3O_4
- Magnetic materials, iron alloys, magnetic ceramics
- Insulation, glass, ceramics

FIBROUS MATERIALS
- Glass, silica (for apparel, paper, filters, etc.)

PLASTICS, ELASTOMERS, AND SEALANTS
- Soluble silicates, silicone resins (contain some C)

ADHESIVES AND COATINGS
- Anodized aluminum, magnesium, titanium, electroplating (Cr)
- Sputtered coatings, etc.

LUBRICANTS, HEAT-TRANSFER FLUIDS
- Sulfides, SO_2, He

INDUSTRIAL CHEMICALS AND FLUIDS
- Detergents, cleansers, solvents, acids, bases H_2SO_4, H_3PO_4, CaO, NaOH, O_2 propulsion

BIOSUPPORT
- Oxygen (breathing), 16/18 of water by mass
  - SiO_2—soil component (includes many trace nutrients)
- Constituent elements of life-forms: O, Ca, C, Fe, Mg, K, P, N, Na, H, and others

SOURCE: MIT, Space Systems Laboratory.

To summarize some of the principal findings in the latest LPI studies concerning basic motivation for use of lunar materials to support space missions and future space industry:

- the Moon is a large, accessible source of useful material;
- we have good working knowledge about the Moon and how to operate there with tens of people;
- we have detailed knowledge of several particular, attractive sites from Apollo;
- studies indicate relatively low unit cost for production of materials on the Moon should be achievable;
- most of the methods and devices to be used on the Moon can be fully proven prior to return to the Moon;
- returned lunar samples can be used in demonstrations of processing equipment;
- many technologies developed for use on Earth could, with modest adjustment, be applicable to initial small-scale operations on the the Moon to produce feedstock and needed devices;

[3]*Extraterrestrial Materials Processing and Construction*, NSR 09-051-001, Mod. No. 24, a study by the Lunar and Planetary Institute, Dr. David Criswell, Program Director.

- support industries required on Earth for large space programs can be considerably smaller for a given level of effort if the center of industrialization is shifted to the Moon;
- a new (heretofore nonexistent) collaboration between the space sector of the industry and materials mining and processing industries would be mutually supportive and could produce important serendipitous results;
- parallel, independent studies in other institutions (Massachusetts Institute of Technology (MIT), General Dynamics) corroborate that in-space use of lunar feedstocks for multiple uses is possible and practicable, even if the "means of manufacture" are brought entirely from Earth;
- preliminary consideration of the state-of-the-art in robotics and automated systems is encouraging and adds to the attractiveness of lunar-processed materials; and
- there are at least three alternative chemical processing schemes that are attractive for use on the Moon and relatively modest studies on Earth could verify these alternatives in 2 to 3 years.

Other institutions that have studied the matter in detail have essentially come to the conclusion reflected in the LPI study, *viz.*, "One fact stands out clearly in considering the development of processing technologies to use lunar materials. It is completely reasonable to start immediately on ground-based experimental and development programs which would result in demonstration systems. Rapid progress can be expected."[4]

This OTA survey of the attitudes of informed engineers and scientists toward the state-of-the-art and the prospects for lunar materials exploitation, must be viewed in the perspective of the overall national space program and its current state of economics and priorities. The LPI study authors, apparently sensitive to the need to put their work into the context of broader national needs and comparative commitments, present as a part of their report some "broad conclusions," including:

1. Time and expenses necessary to develop moderate sized production processes on earth which could be transferred to the moon should be significantly less expensive than the development of major spacecraft systems such as the space shuttle or very large boosters.
2. There are many direct applications of the processes, technologies and basic knowledge which will be developed in lunar processing to the processing on earth of common and low grade terrestrial resources. The lunar related research and development should directly speed up technology areas of vital importance to the industrial health of the United States.
3. It is reasonable to start systems studies of the operation of feedstock industries in space both to understand more fully the constraints and advantages of lunar based industries and to place the use of lunar materials into the planning strategies of the space community.
4. Many members of the industrial materials community consider the prospects of developing lunar and space based industries worthy of consideration and professionally extremely interesting."[5]

To gain further insight into the impact of lunar resources exploitation on the SPS concept, a NASA contracted study was conducted by

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[4]Ibid., at p. 11
[5]Ibid., at pp. 20-21

the General Dynamics Corp.[6] In this study, the SPS design was specified as the Department of Energy/NASA "baseline." The SPS concept was not redefined to use optimally lunar resources, the study was thus constrained to the use of terrestrially produced equipment designs. With this constraint, the use of lunar resources could supplant 90 percent of the payload lifted from Earth. Nevertheless, because of the high estimated costs of lunar operations and systems, a clear-cut economic advantage for lunar resource utilization was not shown until a number of power satellites ranging from 5 to 20 were constructed. This is the basic reason why planning experts believe NTM will not be used until SPS is well into a full production phase. The contractor also observed that fabrication of components in space should cost less than those made on Earth because, assumedly, the mining, processing, fabrication, and assembly were accomplished by a single enterprise. This "no middleman" advantage was not applied to the terrestrial SPS costing.

Also recently, a study was done by MIT's Space Systems Laboratory (SSL) entitled "Extraterrestrial Processing and Manufacturing of Large Space Systems,"[7] or, more simply, a study of a space-based manufacturing facility. This SSL study identified equipment and processes suitable for manufacture of a wide variety of products in space. To focus the research effort, the MIT study group produced a preliminary design of a case example: a space manufacturing facility (SMF) designed and sized to produce a 10-GW SPS per year. This "reference SMF" would produce solar cells, structural members and joints, electrical distribution systems, microwave transmitting tubes, and waveguides and radiating elements. To perform these jobs, the SMF takes elements from the Moon *and*, from Earth, selected essential components and supplies as shown in table 2.

TABLE 2.—SMF INPUTS AND OUTPUTS

SPACE MANUFACTURING FACILITY INPUTS	
From the Moon	*From the Earth*
Aluminum	Kapton tape
Iron	Klystron parts
Silicon	DC-DC converter parts
Silica	Lubricants
Magnesium	Machinery spare parts
Oxygen	Consumables
	Dopants
SPACE MANUFACTURING FACILITY OUTPUTS	
Solar cells	
Structural members	
Joints	
Joint clusters	
DC-DC converters	
DC-DC converter radiators	
Waveguides	
Klystron assemblies	
Insulation fittings	
Busbar strips	
Electric wires and cables	

SOURCE: MIT, Space Systems Laboratory.

[6] *Lunar Resources Utilization for Space Construction*, General Dynamics Convair Div., NASA contract NAS9-15560, 1979.

[7] *Extraterrestrial Processing and Manufacturing of Large Space Systems*, MIT, Space Systems Laboratory, NASA contract NAS8-32925, NASA contractual report CR-161293, September 1979.

The SSL study was not a full-fledged evaluation of the realm of space manufacturing. To provide an optimal design, the study would have had to consider related operational characteristics of factory management, transportation costs (an essential element), and labor productivity in space.

A major focus of the study was to devise a method of manufacturing solar cells in space. After considering many approaches, a direct vaporization process was selected. This is important because this in-space fabrication technique could also be useful for Earth-supplied raw materials. An in-space fabrication process could begin with terrestrial materials and make the transition to lunar materials should it prove to be an effective, economical way of producing solar cells. But little data exist for this process.

The SSL group also examined continuous casting of aluminum, glass foaming in space, and other required processes. For each machine of the SMF, the MIT group prepared a specification sheet and a costing sheet to provide a baseline of information for further work and defined an extensive list of suggested shuttle experiments in space manufacturing shown in table 3. One senior aerospace official, reviewing this OTA report in draft, noted that these MIT proposed processes are highly interesting but that they are still too speculative and unresearched to warrant major industrial commitment to financing of experiments or development. The SSL group arrived at the following conclusions:

- SMF appears technically feasible;
- SMF is
  —versatile (could make a variety of products),
  —flexible (production rate can be varied), and
  —productive;
- specialized space-only processes were suggested;
- to gain economic advantage, designs should be tailored for SMF;
- SMF capital investment is approximately $12 billion for SPS (does not include factories and mines on the Moon);
- more study needed to define optimal SMF; and
- technology demonstration is required; modest cost space experiments may be needed.

TABLE 3.—REPRESENTATIVE SUGGESTED SHUTTLE EXPERIMENTS
(BASED ON THE REFERENCE SMF DESIGN)

Zone refining
Direct vaporization of Si, Al, SiO_2
Direct vaporization through shadow masks and mask cleanup
Recrystallization of silicon
Prototype of integrated solar cell production line
Powder mixing in vacuum and zero-g
Glass foaming furnace
Metal solidification experiments
Prototype induction furnace and casting machinery
Sheet metal production and machining
Glass fiber extrusion
Space welding and cutting techniques
Klystron assembly equipment
Prototype repair devices and techniques
Prototype internal transport systems
Free-flying teleoperators

SOURCE: MIT, Space Systems Laboratory.

Economics of the MIT-Designed Space Manufacturing Facility

Because there are few reliable numbers that anyone can produce to exhibit costs associated with an SMF, it was particularly useful to have from the MIT study results a report on comparative SMF costs and sensitivities even though they must be considered approximate and subject to revision. The MIT report's economic section is quoted and paraphrased below to give some measure of a quantitative nature to the matters being reviewed.

As noted above, for each machine of the SMF the study group prepared a specification sheet. Costing sheets (see figure 2) were then developed from the specification sheets. The procurement costs, duty cycles, repair labor, and replacement parts requirements were defined through literature search and consultation with experts in industry and academia. R&D costs were estimated according to a high, medium, or low technology rating on the components as shown in table 4 (in dollars per kilogram).

The data from the costing sheets adds up to some 3,000 numbers impacting overall SMF cost. This data was input to a line-item costing computer program which calculated nonrecurring and recurring costs of the SMF, including computations of personnel totals, logis-

FIGURE 2.—SMF COSTING SHEET

Name of Machine: ALUMINUM ALLOYING FURNACE

Operators/machine 0 (people)

Number of machines 3

During normal operation:

Earth inputs 0 (kg/hr)

Earth input costs 0 ($/kg)

Component	Number/machine	Mass (kg)	Power (kW)	Procurement cost ($ 10³)	Duty cycle (%)	Repair labor (crew hrs/repair hr)	Replacement parts (kg/year)	Technology level	R&D costs (K$ 10³)
Casing	1	150	0	300	95	2	150	H	300
Coils	1	60	1,150	30	95	1	0	M	30
Radiator & Piping	1	1,000	10	500	99	1	10	M	500
Controller	1	5	.1	10	99	1	0	H	10

SOURCE: *Extraterrestrial Processing and Manufacturing of Large Space Systems*, MIT, Space Systems Laboratory, NASA contract NAS8-32925, NASA contractual report CR-161293, September 1979.

TABLE 4.—COSTING BASELINE (DOLLARS PER KILOGRAM)

	R&D	Procurement
Low	$ 500	$ 50
Medium	5,000	500
High	20,000	2,000
Ultra-high	100,000	10,000

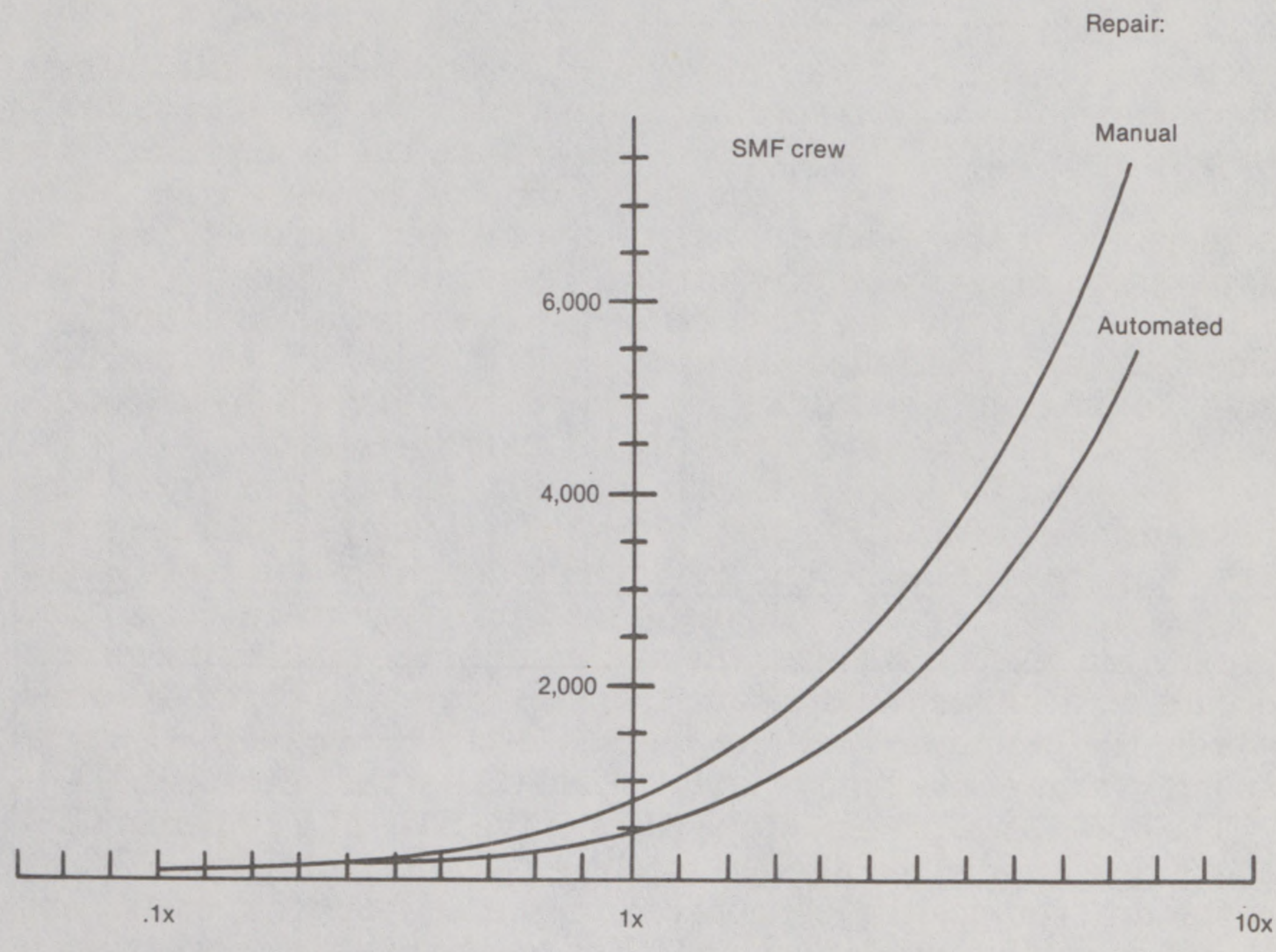
SOURCE: MIT, Space Systems Laboratory.

tics, power, and consumables requirements, mass totals, transportation requirements, and their associated costs.

The study group then used the line-item costing computer program to investigate the sensitivity of the results to certain parameters. One parameter of interest is human productivity. Since most of the production personnel at the highly automated SMF are doing maintenance and repair (rather than machine operation), the number of people required onsite is strongly affected by the reliability of the machinery. This parameter, machine reliability, turns out to be a strong driver of SMF costs as well.

The effect of machine reliability on SMF population is shown in figure 3. It was assumed that: lunar oxygen is available at the SMF; personnel require high-thrust chemical propulsion and fast trajec-

FIGURE 3.—SMF CREW SIZE V. EQUIPMENT RELIABILITY



SOURCE: *Extraterrestrial Processing and Manufacturing of Large Space Systems*, MIT, Space Systems Laboratory, NASA contract NAS8-32925, NASA contractual report CR-161293, September 1979.

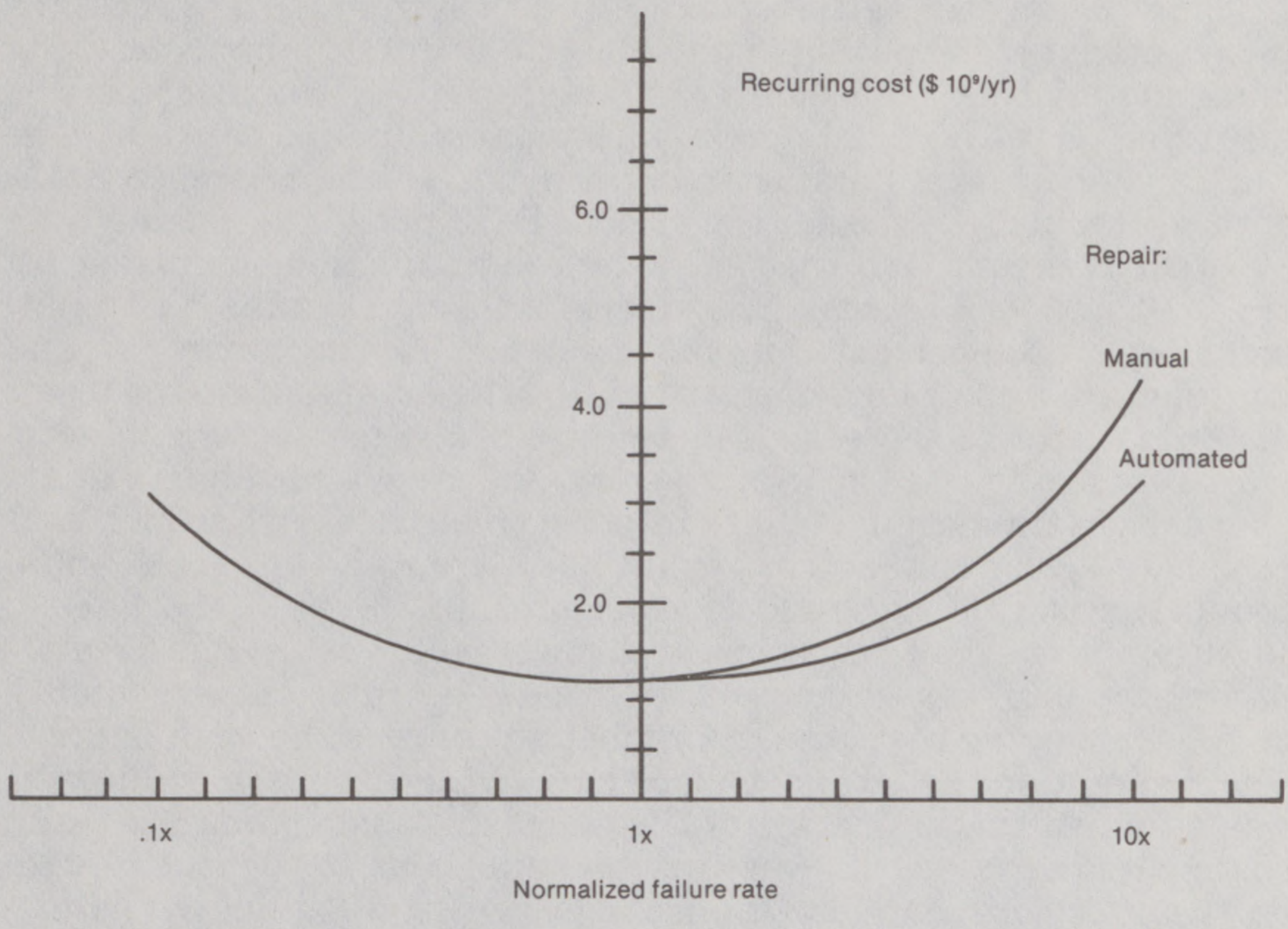
tories between Earth and the SMF (presumed to be in geosynchronous orbit); logistics and materials are carried from Earth to LEO by Shuttle-derivative vehicles, and then from LEO to the SMF by low-thrust high-specific-impulse electromagnetic propulsion using lunar material as propellant. The failure rate of the machinery is displayed on the horizontal axis, with more failures to the right. The "1x" value for this parameter corresponds to the reference SMF, with a set of duty cycles for the various SMF machines ranging from 80 to 99.9 percent, and with the solar-cell production equipment between 95 and 99.9 percent. The vertical axis displays the SMF crew, including a 100-percent support crew factor. The "manual" and "automated" repair lines correspond to different options in the repair of components in the solar cell factory. The other factories are repaired manually. As the graph shows, the crew size climbs rapidly above a certain machine failure rate. The reference SMF, which uses automated solar cell factory repair, has a crew of 440 people, and a productivity of 150 kg/production-person-hour.

Although the crew size drops with lower failure rates, this does not necessarily imply lower costs as well. The effect of machine reliability on SMF *recurring* cost (or SPS production costs) is shown in figure 4. The assumptions listed above also apply to this graph. In addition, it was assumed that 5 percent of the machinery mass was required in spare parts each year (20-year machine life). Due to the lack of data on the effect of reliability on machinery costs, a log-linear relationship between machine duty cycle and machine R&D procurement costs was assumed. In other words, a machine with 99-percent duty cycle would cost 10 times more in R&D and procurement than a similar machine with 90-percent duty cycle. The graph in figure 4 rises to the right (higher machine failure rate) due to increased crew costs for repair. The right-hand side of figure 4, however, rises due to higher cost of spare parts for the more reliable machinery and the assumption of a constant spare parts requirement (rotable spares). Therefore, the recurring costs of the SMF exhibit a minimum, coincidentally near the reliability of the reference SMF. The "manual" and "automated" repair lines are defined as in figure 3. Thus the reference SMF has a recurring cost of $1.2 billion per year.

The *nonrecurring* costs display a similar relationship to machine reliability as the recurring costs, with the low-failure end of the curve raised up by R&D costs and the high-failure end of the curve raised by procurement costs of the many machines required to meet fixed production levels. However, the minimum in the nonrecurring costs occurs at a higher failure rate than the recurring costs. In other words, the minimum costs for initially establishing the SMF correspond to a lower machine reliability than that of the reference SMF.

The *overall* net-present-value costs of the SMF at a 10-percent discount rate are plotted against machine reliability in figure 5. These costs are composites of nonrecurring and recurring costs, and therefore exhibit similar behavior. The low-failure end of the curve is raised by the R&D costs of reliable machines; the high-failure end of the curve is raised by the repair crew costs. The reference SMF has an overall discounted cost of $22 billion, of which $11.6 billion are

FIGURE 4.—COST OF SPS PRODUCTION (SMF RECURRING COSTS ONLY) V. EQUIPMENT RELIABILITY



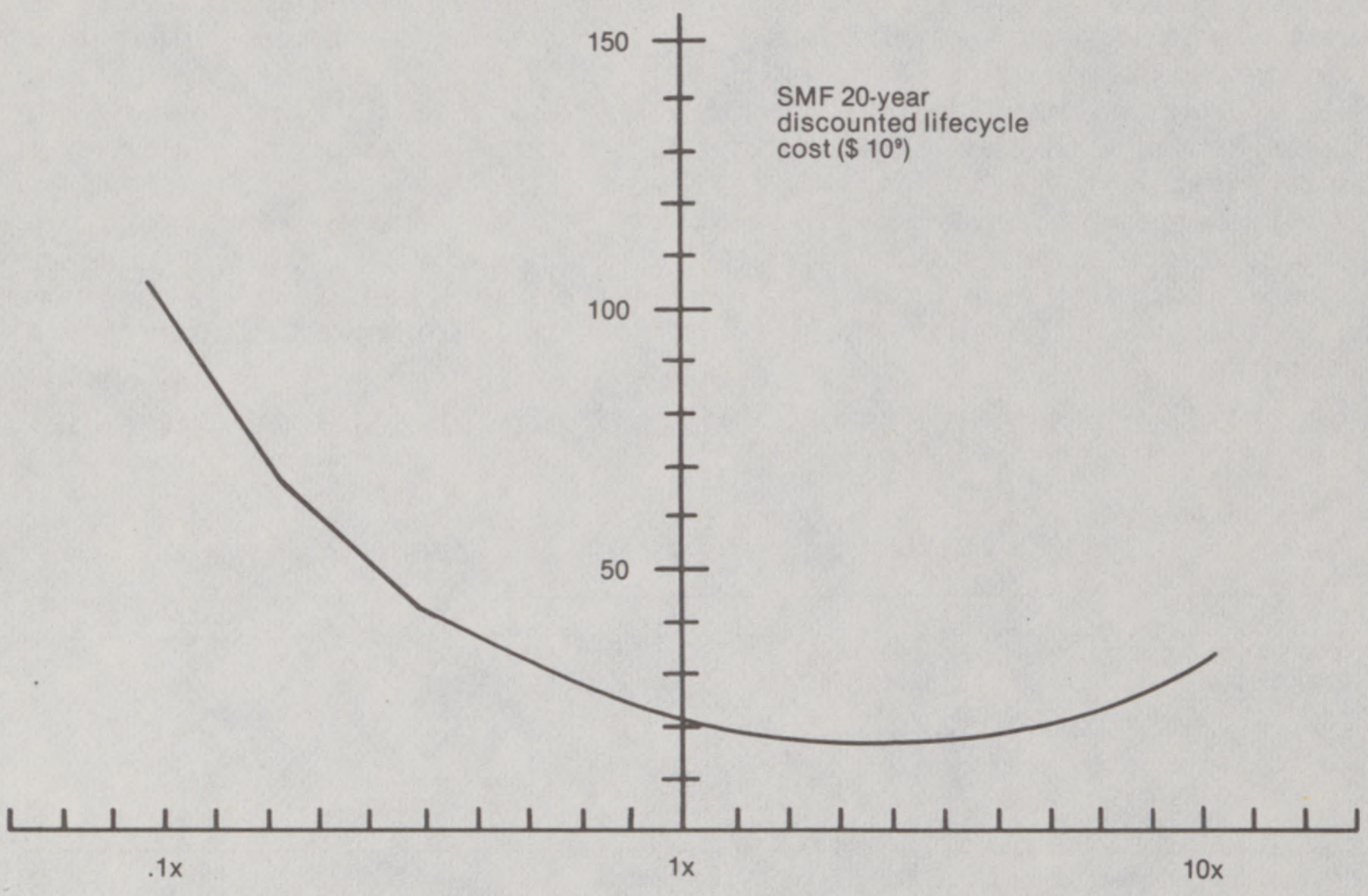
SOURCE: *Extraterrestrial Processing and Manufacturing of Large Space Systems*, MIT, Space Systems Laboratory, NASA contract NAS8-32925, NASA contractual report CR-161293, September 1979.

nonrecurring costs and $10.4 billion are the net-present-value of recurring costs of $1.2 billion per year for 20 years.

An interesting result of this analysis is that the minimum overall discounted cost occurs at roughly twice the failure rate of the reference SMF. Thus, the SMF design developed by the study appears slightly overengineered, with some adverse cost results.

The MIT report noted that although several man-years (and computer-days) of effort could be spent in further variation of parameters studies, two basic conclusions come out of this costing analysis. The first is that the total SMF system costs, derived from the best estimates of machine characteristics as presented in the reference SMF design, are $11.6 billion for nonrecurring, and $1.2 billion per year for recurring costs. These costs are competitve with ground-based production of the same product, one SPS per year. The second is that, based on an assumed relation between nonrecurring parts costs and reliability, optimum failure rates exist which result in minimum nonrecurring and recurring costs. However, these minima generally do not occur at the same failure rate. A further tradeoff study between initial and yearly costs is necessary. Again, it must be emphasized that these are SMF-incurred costs and do not include either the lunar base or terrestrial facilities such as the rectenna and distribution systems, as well as operating costs for these facilities.

FIGURE 5.—SMF PROGRAM COST V. EQUIPMENT RELIABILITY



SOURCE: *Extraterrestrial Processing and Manufacturing of Large Space Systems*, MIT, Space Systems Laboratory, NASA contract NAS8-32925, NASA contractual report CR-161293, September 1979.

The executive summary of the economic section of the MIT report concludes with these observations:

Finally, it must be emphasized that cost estimates of future, and speculative, space systems must inevitably be based on a high degree of uncertainty. In this section the SSL study group has attempted to demonstrate the effects of varying one of the parameters which has the greatest degree of uncertainty: failure rate of equipment and hence machine duty cycle. It is of course possible to conduct similar parameter variation analyses with other of the many sensitive parameters of the system, such as transportation costs, productivity of labor in space, and . . . many [other] factors . . . ; however the above example is sufficiently illustrative of the sensitivity of costs to the assumptions used in this analysis.

OTA wishes to inject at this point that the present value cost estimates shown above are only economic comparison tools and cannot be read as actual costs or expenditures required for the defined SMF and SPS. The system would be built and deployed over time (20 years), and the economic factor variations, up or down, involved in passage of time can have a major impact on *actual* cost incurred.

Another area of uncertainty involves the cost of developing the specialized equipment for the SMF. This cost is covered partly by the R&D costing baseline of Table 4 and partly by an additional process development and systems integration cost assigned to each of the sixty processes which make up the SMF. These costs were assigned even to a well established process on the assumption that space rating would add new operational constraints requiring further development. The cost for each process is listed in the Appendix and varies from $\$10 \times 10^6$ [million] to $\$100 \times 10^6$ [million] depending on complexity and maturity of the process. The lower amount was applied to well developed systems, the upper limit to new and novel space oriented concepts.

As mentioned previously the costs presented here are based on extensive discussions with organizations well acquainted with the terrestrial application of most of the processes used. However, in the final analysis, translation of this collective experience to an operating system in space is a highly subjective process. Different experiences and different view points will result in different estimates as to the baseline costs. It is hoped that the degree of detail used in defining the SMF and its many subsystems as well as the flexibility built in to the costing algorithms will allow readers to arrive at their own conclusions as to the system cost.

The costs presented here should be considered as first estimates only, based on the best available information and on as detailed a component breakdown as time permitted. As such they indicate that the proposed concept is an attractive choice for the manufacture of SPS, and probably other space hardware, worthy of further investigation.

In addition to the foregoing, SSL staff provided the following summary table.

TABLE 5.—REFERENCE SMF COST SUMMARY (ALL COSTS IN 1979 $)

	Billion dollars
Nonrecurring costs (costs of establishing the system)	$11.6
Recurring costs per year	1.2/year
Net present value cost of SMF (Assuming 10% discount rate, 20-year operation, one 10-GW SPS per year production: does *not* include lunar operations, lunar materials transportation, SPS components transportation, and assembly)	22.0
Net present value cost of SPS manufacture (SMF operations only, one 10-GW SPS per year for 20 years, 10% discount rate; does *not* include lunar operations, lunar materials transportation, SPS components transportation, and assembly)	1.1

SOURCE: MIT, Space Systems Laboratory.

In a recently completed review of new studies and information available to date, NASA has produced an overall estimate of a total SPS cost structure. Figure 6 shows an estimate of total SPS system costs.

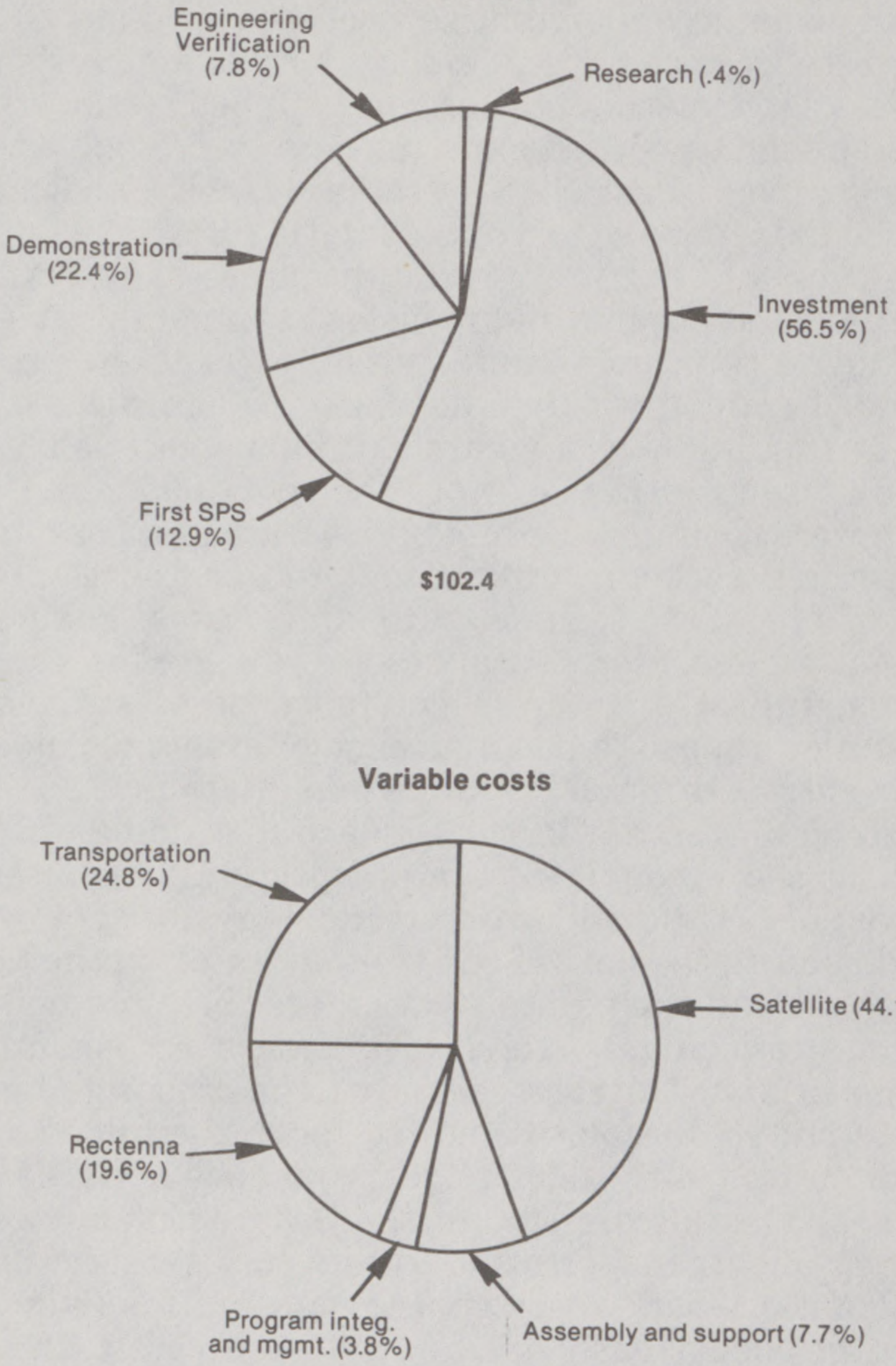
There are, in addition, some advanced concepts beyond those just reviewed. Professor O'Neill at Princeton, for instance, has urged an approach in which lunar materials themselves are used in building the equipment for mining, refining, and manufacturing thereby reducing further the amount of material to be carried from Earth into space. This notion was explored to some extent in the summer workshop conducted by the NASA Advisory Council. There, self-replication of machines on the Moon was postulated as an approach to make the initial investment in space manufacturing as low as possible. These ideas are to be explored further in NASA-sponsored workshops planned for the future.

Dr. David Criswell at LPI, and others, have proposed the building of solar powerplants on the lunar surface rather than in geosynchronous orbit about Earth. Energy would be transmitted to Earth via microwaves or lasers. The design of this concept must contend with problems caused by the vast distance for transmission, synchronization with receivers on Earth, and the Moon's own day-night cycle.

Summary

This brief review of study efforts NASA has sponsored to investigate LRU clearly suggests that the resources of the Moon do pro-

FIGURE 6.—TOTAL SOLAR POWER SATELLITE PROGRAM COSTS
(dollars in billions)



SOURCE: *Extraterrestrial Processing and Manufacturing of Large Space Systems*, MIT, Space Systems Laboratory, NASA contract NAS8-32925, NASA contractual report CR-161293, September 1979.

vide technological opportunities for conducting large-scale, in-space operations on the scale of an SPS program. Those who have conducted research in the area believe that to ensure that such resources may be used in the future, a unified program of laboratory research, process experiments, and studies of manufacturing and processing operations would be required—probably not a large program, but one receiving continual, reliable support, emphasizing fundamentals, and constructively involving the academic community and nonaerospace industry interests in a share of the effort.

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The Moon offers future opportunities for supplying resources. Experts agree that the supply of energy to Earth currently appears to be a likely justification for an LRU program development that would provide an adequate return on investment. Some contend that LRU will present economic opportunities even sooner than SPS. Before use of lunar resources can occur, a considerable amount and variety of study, research, experimentation, and applied engineering are required to establish the needed expertise and to provide a technology base for development. Past NASA studies identify what needs to be done to realize the technological opportunities in LRU.

As to the timing of extraterrestrial resources exploitation, only a major program commitment of dimensions comparable to the Apollo or Space Shuttle programs could possibly result in experimental operations on the Moon within a decade of commitment. Otherwise, under present funding levels, significant lunar materials experimentation would not appear likely before the year 2000, and if a production decision were then made, probably at least another 5 to 10 years would be required to begin production. In general, the Nation appears to have in hand the technological know-how to begin a development program for extraterrestrial resources use. The pacing factor will be the timing of a program commitment of sufficient funds. There do not now appear to be any insurmountable technological impediments to extraterrestrial resources exploitation.

The preceding discussion serves to place the timing of U.S. action with respect to the Moon Treaty in perspective. It is clear that the state of the art of NTM exploitation technology does not demand immediate decisions on the part of the United States on the Moon Treaty. The Congress and the administration are therefore under no timing constraints immediately to resolve the issues which have been raised in connection with this treaty. But, the prospects for NTM exploitation are not so speculative nor so far in the future as to make the potential impact of the Moon Treaty on such activities an irrelevancy. Thus, the recent decision of the Senate Committee on Commerce, Science, and Transportation to convene oversight hearings on the question of the Moon Treaty appears timely. It does appear desirable for foreign policy reasons, as well, to proceed in an active and orderly examination of the implications and consequences of the United States becoming a party to this treaty.

5. ANALYSIS OF ISSUES—IDENTIFICATION OF CONTRAINTS

Recent Developments in the Law of the Sea

Emergence of the Moon Treaty from years of negotiation in the U.N. Committee on the Peaceful Uses of Outer Space places it earlier in time of completion, but it is still largely an international treaty contemporary with the emerging legal regime being negotiated in the Third U.N. Conference on the Law of the Sea. Some critics of the Moon Treaty point to concepts and provisions closely paralleling concepts and provisions in the early history of negotiation of the draft treaty on the law of the sea, now believed to be nearing completion. Consequently, to place in context a current evaluation of the Moon Treaty, it is necessary to review some aspects of the history and current status of the law of the sea negotiations. In addition, in the following section, recent precedents of relevance in the evolving body of space law are reviewed. Together, these recently emerging bodies of law will be seen to have relevance to the Moon Treaty, its interpretation, and its possible effects.

During 1978, when a number of bills relating to the Law of the Sea and exploitation of resources of the deep seabed were pending before Congress, The Library of Congress' Congressional Research Service (CRS) compiled a special report on "Deep Seabed Minerals: Resources, Diplomacy, and Strategic Interest" for the Subcommittee on International Organizations of the House Committee on International Relations.[1]

The study, contributed to by several area experts in CRS, contains a summary history of the U.N. Law of the Sea Conferences since the late 1950's, and provides an excellent synopsis of developments up to its publication in 1978. The following materials in this section draw substantially from the sections of that report dealing with the U.N. history, but with supplementary information added, as needed, to bring the account of developments up to the present (May 1980).

Seabed Mining Technologies and Industry Development

Substantial industrial and consequential governmental interest in deep seabed resources was stimulated by interest in a sample of nodules of relatively high cobalt content found near Tahiti during 1957. Dr. J. L. Mero recognized the commercial potential of deep seabed mineral nodules and in 1959 he wrote "A Preliminary Report on the Economics of Mining and Processing Deep-Sea Manganese Nod-

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[1] "Deep Seabed Minerals: Resources, Diplomacy, and Strategic Interest," (Washington, D.C.: 95th Cong., 2d sess., Subcommittee on International Organizations of the House Committee on International Relations, Mar. 1, 1978), committee print, 123 pp.

ules.''[2] The report was distributed widely to industry, and by 1962 U.S. firms were funding exploratory and experimental ocean mining projects.

CRS characterizes the period from 1962 to 1968 as the seabed mineral resources R&D period, during which efforts were directed primarily to collecting data on nodules, designing possible mining systems, economic feasibility studies, and bench-scale processing testing on small batches of nodules collected by dredge. Reportedly, expenditures in this period were in the range of $10 million to $20 million.

According to CRS, the period from 1969 to 1974 could be characterized as a period of preliminary engineering development of deep seabed mining systems. A relatively small number of companies independently carried out multimillion-dollar R&D programs which enabled them to assume leading roles in subsequently developed ocean mining consortia. From 1969 to 1974, it is estimated that between $50 million and $100 million was spent by firms on exploration, processing, and mining technology, some firms publicizing major advances.[3]

But beginning in 1974, a major change took place in organizational arrangements. Companies began proving the technical and economic feasibility of ocean mining through trial mining operations of equipment ranging from one-fifth to full scale, and construction and demonstration of processing plants. Expenses were increasing and international agreement had not been reached on the relevant law to apply to seabed exploitation. Consequently, a number of international seabed mining consortia were formed.

The major reasons identified by CRS for the emergence of joint ventures were: 1) inability and unwillingness of individual companies to meet the high capital requirements, and 2) uncertainty surrounding the international negotiations for a regulatory regime. CRS opined that in the absence of an agreed treaty on exploitation a broader measure of support could be gained from consortia participants representing several countries. The consortia, identified in table 6, also shared risk, shared capital, and pooled diverse capabilities.

It is anticipated that several existing consortia could be ready to begin commercial seabed exploitation by the late 1980's. It remains to be shown that the developmental seabed mining technologies can be scaled up and deployed for full commercial operation, but there is another retarding factor: there is industrial concern about committing the much higher level of capital funds needed for commercial operations in the continuing unsettled international status of the governing regime to control seabed resources exploitation. U.S. mining interests have actively sought congressional action in this situation to ameliorate, by domestic law guarantees, the risks associated with going into full-scale commercial operation before a regulatory

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[2]Published by the Institute of Marine Resources, University of Southern California, Jan. 1, 1959, 96 pp.

[3]''Deep Seabed Minerals,'' op. cit., at 13-14.

TABLE 6.—OCEAN MINING CONSORTIA AND JOINT VENTURES IN 1978

Name/companies	Percent ownership	Country
Kennecott Consortium		
Kennecott Copper Corp.	50	United States
British Petroleum Co.	10	United Kingdom
Rio Tinto Zinc Corp. Ltd.	10	United Kingdom
Consolidated Gold Fields, Ltd.	10	United Kingdom
Noranda Mines, Ltd.	10	Canada
Mitsubishi Corp.	10	Japan
Ocean Management, Inc.		
Inco Ltd.	25	Canada
Arbeitsgemeinshaft Meerestechnische gewinnbare Rohstoffe (AMR)	25	West Germany
Sedco, Inc.	25	United States
Deep Ocean Mining Co. (DOMCO)	25	Japan
Ocean Mining Assoc.		
(service contractor—Deepsea Ventures, Inc.)		
U.S. Steel Corp.	33⅓	United States
Union Miniere, S.A.	33⅓	Belgium
Sun Oil Co.	33⅓	United States
Ocean Mineral Co.		
Lockheed Missiles & Space Co.	unk	United States
Standard Oil of Indianna.	unk	United States
Royal Dutch Shell	unk	Holland
Bos Kalis Westminster	unk	Holland
French Assoc. for Nodule Exploration		
Centre National p. l'Exploitation des Ocean (CNEXO)	unk	France
Commissariat a l'Energie Atomique	unk	France
Bureau de Recherche Geologiques et Minieres (BRGM)	unk	France
Societe Metallurgique Nouvelle/Societe le Nickel (SMN/SLN)	unk	France
Chantiers de France Dunkerque	unk	France
Continuous Line Bucket (CLB) Group		
About 20 companies in the six listed countries, for development of a mining system, but not for commercialization	unk	Australia
	unk	Canada
	unk	France
	unk	West Germany
	unk	Japan
	unk	United States

SOURCE: "Deep Seabed Minerals: Resources, Diplomacy, and Strategic Interest," (Washington, D.C.: 95th Cong. 2d sess., Subcommittee on International Organizations of the House Committee on International Relations, Mar. 1, 1978), committee print, p. 15.

regime is defined and agreed upon. In the absence of a formalized domestic legal regime, industry believes it would be impossible to raise the necessary capital to proceed. Recently Congress enacted domestic legislation (Public Law 96-283) on seabed mining that does not contain firm guarantees that a future Law of the Sea Treaty will not cause investment losses, but it does provide some assurance that the U.S. Government is sensitive to the problem. It remains to be seen whether or not this legislation will provide sufficient incentive for large-scale ocean mining investments while the law of the sea issues remain unresolved.

The Developing Seabed Regime

The first U.N. Conference on the Law of the Sea was convened in Geneva, Switzerland, in February 1958, after 7 years of study within the U.N. International Law Commission on various aspects of the law of the sea. The final acts of that conference, signed by 86 countries' representatives, included four conventions:

1. on the territorial sea and the contiguous zone,
2. on the high seas,
3. on fisheries and preservation of biological resources, and
4. on the continental shelf.

Article 2 of the 1958 Convention on the High Seas treats the matter of resources of the high seas and their exploration and exploitation as follows:

> The high seas being open to all nations, no state may validly purport to subject any part of them to its sovereignty. Freedom of the high seas is exercised under the conditions laid down by these articles and by the other rules of international law. It comprises, *inter alia*, both for coastal and noncoastal states:
> (1) Freedom of navigation;
> (2) Freedom of fishing;
> (3) Freedom to lay submarine cables and pipelines;
> (4) Freedom to fly over the high seas.
> These freedoms and others which are recognized by the general principles of international law, shall be exercised by all States with reasonable regard to the interests of other States in their exercise of the freedom of the high seas.[4]

The 1958 Conference did not reach agreement on the question of the breadth of the territorial sea and fishing zone limits. A second conference was scheduled by the U.N. General Assembly to deal with the unresolved questions.

The Second U.N. Conference on the Law of the Sea met in Geneva, Switzerland, in 1960. In a final vote on a compromise proposal to define the territorial sea as 6 miles wide, with an additional 6-mile fishing zone, the Conference failed by one vote of attaining the required two-thirds majority of those present and voting. Failure to resolve the territorial sea limit issue resulted in unilateral national extensions of jurisdictional claims (see table 7).

TABLE 7.—TERRITORIAL SEA CLAIMS BY COUNTRIES OVER TIME

Territorial claim in nautical miles	Number of countries in: 1958	1968	1977
3	22 (U.S.)	30 (U.S.)	28 (U.S.)
6	12	16	8
12	11	31	59
200	1	4	10

SOURCE: "Deep Seabed Minerals: Resources, Diplomacy, and Strategic Interest," (Washington, D.C., 95th Cong. 2d sess., Subcommittee on International Organizations of the House Committee on International Relations, Mar. 1, 1978), committee print, p. 19.

No major additional agreements were attempted during the early 1960's. In August 1967, the U.N Representative of Malta called for U.N. preparation of a declaration and treaty that would reserve the seabed and ocean floor as the common heritage of mankind, and establish a system in which all countries, rich and poor, landlocked and maritime, would benefit from the resources lying on and under the ocean floor. Malta's ambassador recalled the colonial scramble for territory in the 19th century and urged action to prevent a recurrence.

The U.N. General Assembly responded by creating an ad hoc committee of 35 nations to study the question of the reservation exclusively for peaceful purposes of the seabed and ocean floor, and the subsoil, underlying the seas beyond the limits of national jurisdiction, and the uses of their resources in the interests of mankind.[5] The committee met three times in 1968 and reported to the 1968 U.N.

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[4]Ibid. at 19.
[5]A/RES/2340 (XXII), Dec. 18, 1967.

General Assembly stressing the need for more study. The 1968 U.N. General Assembly transformed the ad hoc committee into a standing committee of 42 members to study issues regarding the problem of international cooperation in the exploration and use of the international seabed area and its resources.

The Committee on the Peaceful Uses of the Seabed and the Ocean Floor Beyond the Limits of National Jurisdiction (the Seabed Committee) addressed specific functions allocated to it by the General Assembly in four sessions during 1969 and two sessions during 1970. During the 1969 session, the Assembly adopted the so-called "moratorium resolution,"[6] in which the General Assembly declared exploitation of the resources of the seabed area beyond national jurisdiction should be carried out under an international regime, including appropriate international machinery, and declared that "pending the establishment of the aforementioned international regime:

> (a) States and persons, physical or juridical, are bound to refrain from all activities of exploitation of the resources of the sea-bed and ocean floor, and the subsoil thereof, beyond the limits of national jurisdiction;
>
> (b) No claim to any part of that area or its resources shall be recognized.

The widely split vote (68-28-28) on the moratorium led to active and continual debate about the nature of the resolution and its implications for international law. Some governments consider it a binding declaration of international law, others (United States) consider it an expression of the view of some states that should be taken into account but that does not have the binding effect of a treaty.

The General Assembly followed in 1970 with a resolution adopting a "Declaration of Principles Governing the Seabed and the Ocean Floor, and the Subsoil Thereof, Beyond the Limits of National Jurisdiction." The vote was 108 (United States) in favor, 0 against, 14 abstentions. The 15-point declaration recognized that the:

> sea-bed and ocean floor, and the subsoil thereof, beyond the limits of national jurisdiction . . ., as well as the resources of the area, are the common heritage of mankind.[7]

Controversy over whether the declaration should contain an explicit moratorium on deep seabed exploitation resulted in compromise langauge designed to paper over the differences of view. Paragraph 3 of the declaration provided that "No State or person, natural or juridical, shall claim, exercise or acquire rights with respect to the area or its resources incompatible with the international regime to be established and the principles of this Declaration." Paragraph 4 states that "All activities regarding the exploration and exploitation of the resources of the Area and other related activities shall be governed by the international regime to be established." In explaining the U.S. vote in support of the resolution in the first committee, the U.S. Representative noted how these ambiguities successfully bridged the gap between those states which had endorsed and those which had rejected the 1969 Moratorium Resolution. In the following decade, the Declaration of Principles became the principal source for Third World

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[6]A/RES/2574D (XXIV), Dec. 15, 1969, adopted by a vote of 62 in favor, 28 (U.S.) against, 28 abstentions.

[7]A/RES/2749 (XXV), Dec. 17, 1970.

arguments that unilateral deepsea exploitation prior to the entry into force of a new law of the sea convention is illegal. Those concerned about the Moon Treaty believe this history is relevant because the ambiguities found in the Declaration bear striking similarities to those found in article 11 of the Moon Treaty.

The Seabed Committee had noted to the General Assembly the limitations of its mandate and pointed out that to develop proposals in the international areas beyond national jurisdiction, a number of associated questions would have to be dealt with and resolved. The U.N. General Assembly then decided to convene, in 1973, a third conference on the law of the sea. The General Assembly enlarged the Seabed Committee to 86 members and charged the Committee to prepare for the conference. This resolution, adopted by a vote of 108 (United States) in favor, 7 (U.S.S.R.) against, and 6 abstentions, provided that the conference would:

> deal with the establishment of an equitable international regime—including an international machinery—for the area and the resources of the seabed and the ocean floor, and the subsoil thereof, beyond the limits of national jurisdiction, a precise definition of the area, and a broad range of related issues, including those concerning the regimes of the high seas, the continental shelf, the territorial sea (including the question of its breadth and the question of international straits) and contiguous zone, fishing and conservation of the living resources of the high seas (including the question of the preferential rights of coastal States), the preservation of the marine environment (including, *inter alia*, the prevention of pollution) and scientific research.[8]

This resolution laid out an enormous range of work for the Seabed Committee and called explicitly for the creation of "international machinery" by the contemplated conference.

The Seabed Committee recognized in 1971 that its work would have to be different from the preparatory work for the First U.N. Conference on the Law of the Sea. From 1951, the U.N.'s International Law Commission, a select body of legal experts, spent 7 years drafting 73 articles which were the basis of the four conventions adopted at the 1958 Conference. The Seabed Committee was primarily a political body composed of national delegations of varying levels of knowledge and experience in international law and oceanography. During 1971 the Seabed Committee organized itself into three subcommittees with the following functions:

- *Subcommittee 1*—Development of treaty articles establishing an international regime and international machinery for the area and resources of the seabed . . ., and bearing in mind the 1970 Declaration of Principles adopted by the General Assembly;
- *Subcommittee 2*—Preparation of a comprehensive list of subjects and issues relating to the traditional law of the sea and draft treaty articles thereon;
- *Subcommittee 3*—Preparation of draft treaty articles on the preservation of the marine environment and scientific research. (In 1972, the issue of transfer of marine technology was added to those under consideration in Subcommittee 3.)

The Seabed Committee met in two lengthy sessions in each of the 3 years of its preparatory work. In 1973 Subcommittee 1 produced a

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[8]A/RES/2750 (XXV), Dec. 17, 1970.

collection of draft articles setting forth alternative texts for a regime and machinery for the international deep seabed area beyond national jurisdiction. The range of proposed texts showed many differing interpretations derived from the 1970 Declaration of Principles Governing the Seabed and Ocean Floor. Major divergences could be seen in articles concerning:

- the nature of the exploration and exploitation system for deep seabed area resources;
- functions and powers of the international authority; and
- nature of the decisionmaking process in the authority.

The Third U.N. Conference convened in December 1973 to begin work toward a new comprehensive treaty to be negotiated by 1975. In setting the dates to begin the Third Conference, the U.N. General Assembly dissolved the Seabed Committee.[9] The negotiations in the Third U.N. Conference have been many times longer and much more difficult than had been officially anticipated in 1973. Eight sessions of the conference have been held and a ninth is half over, as shown in table 8.

In a paper[10] recently prepared by Victor Comras of the Department of State summarizing the long negotiating history, he pointed out that the mandate of the Third U.N. Conference on the Law of the Sea (UNCLOS III) included virtually all the outstanding issues regarding maritime jurisdiction and ocean usage today. A selected list of substantive issues involved includes:

- establishment of an international regime for the deep seabed;
- high seas definitional and use questions;
- coastal state jurisdiction;
- navigation, passage, and overflight through straits and innocent passage;
- fishing and conservation of marine living resources;
- preservation of the marine environment, including prevention of pollution; and
- scientific research.

There are, in addition, many technical and procedural issues involving matters such as dispute settlement, convention final clauses, and the availability of and international access to marine technology. In establishing the Conference mandate, the U.N. General Assembly "underlined that a single comprehensive convention was necessary because of the interrelationships among all ocean uses and activities."[11]

After the period of informal negotiation in Geneva in early 1977, under the chairmanship of Minister Jens Evensen of Norway, and development of texts subsequently in the Sixth Session of the Third Conference (May 23–July 15, 1977), the conference leaders issued an Informal Composite Negotiating Text (ICNT) on July 20, 1977. U.S. reaction was immediate and unequivocal, as shown in the following

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[9]A/RES/3067 (XXVIII), Nov. 16, 1973.

[10]Overview of the history and substance of the UNCLOS III negotiations in an untitled, mimeographed draft provided by the author.

[11]Ibid.

TABLE 8.—SESSIONS OF THE THIRD U.N. CONFERENCE ON THE LAW OF THE SEA

Session	Dates	Place	Comment
1	Dec. 3-15, 1973	U.N. Headquarters, New York, N.Y.	Organizational session, set up committee structure, elected officers, failed to adopt rules of procedure.
2	June 20-Aug. 29, 1974	Caracas, Venezuela	Adopted ⅔ majority vote on substantive matters after all attempts at consensus fail. Began substantive work, reduced alternatives, produced no new texts.
3	March 17-May 9, 1975	Geneva, Switzerland	A negotiating session; few formal meetings, no general debate. Produced an informal Single Negotiating Text, not as agreed articles but indicating direction of negotiations.
4	March 15-May 7, 1976	U.N. Headquarters, New York, N.Y.	Produced a Revised Single Negotiating Text (RSNT) that was criticized by developing countries as favoring interests of developed countries.
5	Aug. 2-Sept. 17, 1976	U.N. Headquarters, New York, N.Y.	Group of 77 rejected the RSNT produced by Committee 1, although Committee 2 and 3 texts were clarified on many issues, and most of the issues relating to traditional LOS questions were essentially resolved. Progress in negotiation of the deep seabed regime was at an impasse. During the session, Secretary Kissinger made clear a U.S. commitment to provide financial assistance to the interstate mining entity, the Enterprise, and accept a review of the system of exploitation after 20 years.
Informal consultations	Feb. 28-March 11, 1977	Geneva, Switzerland	Norway's Minister Evensen chaired informal discussions seeking to end the impasse on regime negotiations. At the meetings' conclusion, Evensen drafted texts reflecting the discussion and views presented.
6	May 23-July6 15, 1977	U.N. Headquarters, New York, N.Y.	For the opening 3 weeks of the session, the Conference continued work on the Evenson texts and negotiations on the regime begun in Geneva. After the session ended, most of the work in Committees 2 and 3 was agreed. On July 20, 1977, a new Informal Composite Negotiating Text (ICNT) was issued, but this document was immediately denounced by the United States.
7	March 28-May 19, 1978	Geneva, Switzerland	The ICNT became a primary source of work and negotiation and principal issues remaining were largely those in the seabed regime area. Seven Negotiation Groups were created on so-called ''hard core issues,'' and a group of legal experts was established to work on dispute settlement provisions. At the end of this session, the Committee and Negotiating Group chairmen issued reports containing work results.
Resumed 7	Aug. 21-Sept. 15, 1978	U.N. Headquarters New York, N.Y.	Negotiations, primarily on the exploitation regime, continued.
8	March 19-April 27, 1979	Geneva, Switzerland	Negotiations continued with major work devoted to Committee 1 provisions concerning the seabed exploitation regime. At conclusion of this session (4/28/79), all work done to date was consolidated in ICNT/Rev. 1.
Resumed 8	July 16-Aug. 24, 1979	U.N. Headquarters New York, N.Y.	Essentially completed substantive negotiation on environmental provisions and marine technology transfer and reviewed many articles for acceptance. Group of legal experts was appointed to work on final clauses.
9	Feb. 27-April 4, 1980	U.N. Headquarters, New York, N.Y.	Negotiation continued, focused largely on the seabed mining regime and related technical issues. Substantially reduced the issues remaining to be resolved. Produced ICNT/Rev. 2 which is described by the conference chairman as a ''a *negotiating* text which provides . . . a substantially improved prospect of a consensus.'' Completed negotiations on marine scientific research.
Resumed 9	Planned: July 28-Aug. 29, 1980	Geneva, Switzerland	In July 1980, there was guarded optimism that this could be the final substantive negotiating session of the Conference begun in December 1973.

SOURCE: Office of Technology Assessment.

extracts from a statement by the head of the U.S. delegation, Ambassador Elliott Richardson, issued July 20, 1977.[12]

The Informal Composite Negotiating Text resulting from this session of the U.N. Law of the Sea Conference evidences real progress on vital issues relating to international security and freedom of navigation. At the same time it substantially sets back prospects for agreement on an international regime for the conduct of seabed mining. Both the substance of the text on this issue and the lack of fair and open processes in its final preparation require me to recommend that the United States undertake a most serious and searching review of both the substance and procedures of the conference.

It is with a sense of considerable frustration that I make this accounting, for true progress was made during the past session.

[There are presented then a series of paragraphs identifying essentially those matters on which Ambassador Richardson believed important progress was made.]

—Under the fair and judicious leadership of Minister Jens Evensen of Norway, a responsible and effective discussion of seabed issues took place. The discussion and the texts formulated by Minister Evensen offered real prospect that the impasse on seabed mining issues could be resolved on terms acceptable to both the developed and developing nations.

Regrettably, however, the new "composite" text concerning the system of exploitation and governance of the deep seabed area (Part 11) is now fundamentally unacceptable. It deviates markedly from the proposed compromise text which had been prepared on the basis of full, fair, and open discussion under Minister Evensen's leadership.

The Evensen text, although not without problems, was generally viewed as a useful basis for further negotiation. The newer [July 20, 1977] text—produced in private, never discussed with a representative group of concerned nations, and released only after this session of the conference terminated—cannot be viewed as a responsible substantive contribution to further negotiation. Indeed, the manner of its production—treating weeks of serious debate and responsible negotiation as essentially irrelevant—raises an equally serious procedural problem: whether the Law of the Sea Conference can be organized to treat deep seabed issues with the seriousness they, and the conference which depends upon their satisfactory resolution, demand.

Among the serious points of substantive difficulty in the latest deep seabeds text, and the system it would define, are the following:

—It would not give the reasonable assurance of access that is necessary if we and others could be expected to help finance the enterprise and to accept a "parallel system"* as a basis of compromise;

—It could be read to make technology transfer by contractors a condition of access to the deep seabed—subject, at least in part, to negotiation in the pursuit of a contract;

—It could be read to give the Seabed Authority [International Seabed Resource Authority] the power effectively to mandate joint ventures with the Authority as a condition for access;

—It fails to set clear and reasonable limits on the financial burdens to be borne by contractors; indeed, it simply combines a wide range of alternative financial burdens,

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[12]77 Dept. of State Buletin 389(1977).

*The "parallel system" represents a compromise between the initial position of Third World nations that a new interstate mining entity—the Enterprise—should be the sole seabed mining operator and the position of highly industrialized states that only states and their nationals should be granted seabed mining rights. Under the currently contemplated "parallel system," both the Enterprise and States and private companies may, in principle, engage in seabed mining, always subject to the prior approval and continuing supervision of the International Seabed Authority. Much of the detail of the seabed regime deals with the mechanisms, terms, and conditions of the process for ensuring that the Enterprise obtains the wherewithal to engage in seabed mining at least as successfully as private companies.

as if such a combination could be a compromise—when, in fact, it is likely to prove a compound burden sufficient to stifle seabed development;

—It would set an artificial limit on seabed production of minerals from nodules—which is not only objectionable in principle, it is also far more stringent than would be necessary to protect specific developing country producers from possible adverse effects and is incompatible with the basic economic interests of a developing world generally;

—It would give the Seabed Authority extremely broad new, open-ended power to regulate all other mineral production from the seabed "as appropriate;"

—It would appear, arguably, to give the Authority unacceptable new power to regulate scientific research in the area;

—It would fail adequately to protect minority interests in its system of governance and would, accordingly, threaten to allow the abuse of power by an anomalous "majority;"

—It would allow the distribution of benefits from seabed exploitation to peoples and countries not party to the convention;

—It would seriously prejudice the likely long-term character of the international regime, by requiring that—if agreement to the contrary is not reached within 25 years—the regime shall automatically be converted into a "unitary" system, ruling out direct access by contractors except to the extent that the Authority might seek their participation in joint ventures with it.

With this unfortunate, last-minute deviation from what had seemed to be an emerging direction of promise in the deep seabed negotiations, I am led now to recommend to the President of the United States that our government must review not only the balance among our substantive interest but also whether an agreement acceptable to all governments can best be achieved through the kind of negotiations which have thus far taken place.

In addition to such rejection of the July 20, 1977 text by the United States and other potential seabed mining countries, a change in government by elections in Sri Lanka resulted in the loss of the chairman of the Third Conference. Ambassador Hamilton Shirley Amerasinghe, who had chaired the ad hoc committee and the U.N. Seabed Committee and who was elected conference chairman in 1973, was not accredited by his government to the Seventh Session in 1978. As a result of his nonaccreditation, the question of the conference chairmanship occupied the Seventh Session for 3 weeks before it was resolved in favor of retaining the Sri Lankan Ambassador in the chairman's position. This decision was one of the few, if not the only one requiring a formal vote in the 7-year history of the conference.

The work products of the negotiating groups in the Seventh Session were consolidated, along with results of the Geneva part of the Eighth Session, into ICNT/Rev.1, issued April 28, 1979. Following the New York part of the Eighth Session, the reports of the various committee and negotiating group chairmen were consolidated and, with ICNT/Rev.1, served as working documents for the Ninth Session in New York in February, March, and April 1980. Following the New York part of the Ninth Session, a new consolidation, ICNT/Rev.2, dated April 11, 1980, was issued.

At the end of the first part of the Ninth Session in April 1980, Ambassador Richardson issued a statement which summarized the state of negotiations as follows:

> . . . it is now distinctly possible that our work can be completed next summer [1980] in Geneva.
>
> The largest tasks to be taken up in Geneva will concern the voting system for the Council of the International Seabed Authority and the completion of the final clauses of the Treaty. While the issue of boundary delimitation also remains open, it has been

exhaustively debated, and its final resolution will not require much additional time. Improvements are also needed in a number of other texts, but these too can be dealt with in the first two weeks at Geneva . . . .

The most concrete outcome of the negotiations here in New York is the second revision of the [ICNT]. If, as expected, the texts contained in the reports of the Chairmen are all—or almost all—incorporated in the second revision, the result will constitute a major step forward.

In the case of seabed mining, the most important improvements are the establishment of a floor under the production ceiling and the elimination of the moratorium. A generally satisfactory text on financial terms of contracts and financing the Enterprise has been substituted for the earlier text, and significant improvements have been made in the structure of the Enterprise. Although still defective, the provisions for technology transfer add up to a more workable system which will benefit both developed and developing countries. A considerable number of changes have been made which further spell out and clarify the system of exploitation under which both the Enterprise and private companies will operate.

As to voting in the Council, it remains an essential—in fact, vital—objective of the United States delegation to achieve a result capable of providing adequate protection for the major economic interests at stake . . . . The Conference has only one goal: to produce a Convention that commands a broadly based consensus among developed and developing countries.

UNCLOS III is thus developing a composite convention of more than 400 articles, including tens of articles in specialized and detailed annexes. New institutions are being proposed and detailed regulations are being laid down through a negotiating procedure that has operated (at least until mid-1980) on a consensus basis. Nations are negotiating to accommodate their individual interests and their shared interests in a single instrument of a scope and detail unprecedented in the history of international law. Hundreds of years of international and maritime law and practice are being codified in the same instrument with totally new legal concepts.

An extremely complex and disparate set of interests are being simultaneously dealt with, including definitions, the territorial sea and contiguous zone limits, innocent passage, passage through straits, exclusive economic zones, the continental shelf, the high seas, management and conservation of living resources of the high seas, enclosed and semienclosed seas, rights of landlocked states, the area beyond national jurisdiction and its resources, development of resources, settlement of disputes, protection and preservation of the marine environment, global and regional cooperation, technical assistance, monitoring and environmental assessment, reduction and control of pollution, enforcement and safeguards, ice-covered areas, responsibility and liability, sovereign immunity, marine scientific research, legal status of installations, regional scientific and technical centers, and a variety of specialized technical matters.

The consensus approach to these negotiations, which address the entire scope of the convention as a single package, means that vital security interests, commercial interests, environmental protection, conservation, dispute settlement procedures, scientific interests, and general maritime interests, all are being interwoven and traded off. These negotiations are now in their seventh consecutive year and many believe that the final treaty text is virtually completed. It remains to be seen whether or not commercial exploitation of deep seabed resources is nearing realization. At a minimum, it is anticipated

that broad consensus on the package will mean a wide acceptance of solutions to long-contested ocean law issues.

It is not the purpose of this study to analyze the desirability of the deep seabed regime and machinery emerging at the LOS Conference. We cannot predict what additional changes will be made to the treaty text before it is adopted, whether the United States will find it sufficiently acceptable to sign, or whether, in that event, the Senate will adjudge the overall treaty to be in the national interest and thus give its advice and consent to ratification. Those decisions will be made later within the framework of the wide range of maritime law interests affected by the LOS Treaty.

Some well-informed observers predict that any changes to the language of the deep seabed regime and machinery will be within a fairly narrow range of alternatives. Thus, the basic components of the system of exploitation and provisions for administration which the LOS participants have negotiated under the common heritage principle can be tentatively identified. Attempting to describe these components neutrally, they can be summarized as:

- A system in which States and private companies can obtain access to resources only through a complicated procedure for acquiring contracts from a new International Authority.
- As a condition of contracts, private companies must pay significant international taxes and agree to sell requested technology to an interstate public ocean mining competitor, the Enterprise.
- The system places private companies in competition with the Enterprise, at least in international markets, and the Enterprise enjoys certain preferential rights of access and initial financial subsidies.
- Seabed minerals production is to be restricted or controlled for the purpose of protecting developing country producers of the same minerals on land.
- While many operational decisions will be made by a Council in which developed countries may have some measure of enhanced influence, the role and policymaking powers of a one-nation-one-vote assembly are sufficiently broad to raise some concern about the stability of the system of governance.

This list of components includes some significant compromises of principle. It is these compromises which certain opponents of the Moon Treaty claim may be conceded by the United States in advance of a regime negotiation if it agrees that the common heritage and related principles apply to extraterrestrial resources.

The concern persists that the content of the detailed regime proposed to govern the exploitation of deep seabed resources will unduly influence the negotiations to establish the rules for the possible future regime for extraterrestrial resources. The assumptions about political and economic events which underlie this concern are explained in "The Moon Treaty" section, although no attempt is made to determine the validity of these assumptions. It is, of course, possible that a U.S. decision not to sign or ratify the Moon Treaty will have no impact on LOS influence over the lunar resources regime negotiation. The Moon Treaty exists and is open for signature. Several states

have already signed, although none have ratified (Chile on 1/3/80; France on 1/29/80; the Philippines on 4/23/80; Romania on 4/24/80; and Austria on 5/21/80).

It is equally possible that nonparticipation by the United States will deter other countries from bringing the Moon Treaty into force and this result would give the United States enhanced bargaining power in any subsequent negotiation. It is important to note that, as a matter of political practicality, other countries are unlikely to exclude the United States from followup negotiations and nothing in the Moon Treaty itself precludes states parties from inviting nonparties to participate in subsequent negotiations. Such a practice was followed, for example, when the Soviet Union joined the conference for negotiation of the INTELSAT definitive arrangements in 1969 although it never became a party to the interim arrangements of 1964.

Developments in Space Commercialization and Use

Stimulated by the U.S.S.R. launch of Sputnik-1 in 1957, the industrial base in the United States made a relatively rapid entry into productive space projects and programs. Military rocket development programs and a flexible industrial team were joined with congressional declaration of national goals and organizational structuring of NASA, in 1958, to commence the civil R&D program for space development. In fact, successful launches of the Department of Defense's Jupiter and Vanguard rockets, placing scientific and developmental payloads in orbit, preceded the creation of the National Aeronautics and Space Administration (NASA).

The Industry and the Technology

Among early developmental programs in the communication sector, in the early 1960's American Telephone and Telegraph (AT&T) funded the experimental Telstar Program, producing satellites launched by NASA for AT&T on a reimbursable basis. As the economic and technical feasibility of satellite communication was being demonstrated by NASA and industry in 1961 and 1962, Congress enacted the Communications Satellite Act of 1962, creating a chosen entity, in the form of a private corporation, to lead the United States in a global communication satellite development program. In 1964, under U.S. Government and Comsat leadership, a new international cooperative venture was undertaken to establish, on an interim basis, a global commercial communication satellite system, to be owned by user nations, but to be available for use by all countries on a nondiscriminatory basis. The new global organization, the International Telecommunication Satellite Organization (Intelsat), was established by agreements among member states, with an Operating Agreement among designated national telecommunication entities that contribute to, interconnect with, and derive resources from the global system. Intelsat's interim arrangements were reviewed and renegotiated from 1969 to 1971. In August 1971, the definitive arrangements for Intelsat were opened for signature. Today, 105 nations share, in direct proportion to their contribution to the system, in the ownership, operational management, and use of the system, and many

nonmember countries also use the system by making nondiscriminatory payments for use, but nonmembers do not share in the distribution of revenues among the owning and capital-funding states, nor do they share in rights to patents and data produced by Intelsat contracts. The fifth major generation of communication satellite technology in less than 20 years is now under construction for Intelsat. More than $1 billion have been invested in the space segment of Intelsat over its history by the member countries and their telecommunication entities. National investments in ground segment facilities (Earth stations and equipment) also exceed $1 billion.

Governmental cooperation in space application areas, particularly in meteorology and remote sensing, also developed during the 1960's and 1970's, in some cases under bilateral arrangements and in other cases through regional or global cooperative institutions. Exchanges or sharing of technology necessary to permit broad involvement has been generally accomplished on commercial bases or through cooperative ventures.

The U.S. rocket-producing industry grew, the satellite manufacturing industry grew, and a number of national and international communication satellite systems emerged. Many of these operational space systems are owned and operated today exclusively by commercial firms, e.g., Westar, Comstar, Telesat's Canadian Anik system, and RCA's Satcom system. Other commercial systems also are being built.

In addition to commercial use of space, there has been expanding governmental use for systems to meet varied needs including defense communications, meteorology, surveillance, and navigation; scientific research and exploration; and space tracking and data acquisition. A major new program for a Tracking and Data Relay Satellite System (TDRSS) will be deployed commercially in the early 1980's and will substantially reduce U.S. dependence on overseas tracking facilities. In addition to providing dedicated capacity to support NASA's tracking and data relay requirements, the Advanced Westar System of Western Union will also offer expanded commercial services to other users along with TDRSS.

Although the U.S. Government role in funding R&D in both military and civil programs has been the single most important impetus to development of new space technology for transportation, space science, research, exploration, and applications, there has been, and continues to be, an active presence by private enterprise in the development, ownership, and operation of space systems.

Legislation introduced in the 96th Congress proposes that a major area of space applications be opened up to expanded commercial participation, *viz.* remote sensing from space of the surface and resources of the Earth. In recent months NASA has announced a major new policy on shared-cost developmental programs with industry, and one important project is already being developed for demonstration of space processing capabilities using the U.S. Space Shuttle and Europe's Spacelab, now both nearing completion of their governmentally funded development.

Between 1960 and 1980, major worldwide commercial investments in space systems have exceeded $3 billion. These investments have been commercially attractive, despite high risks involved in the early developmental period, and early investments have been returned with a profit.

Thus, there is a substantial and growing presence of U.S. industry and foreign industry, as well as governments, in the space arena. Even during the early, high-risk, and developmental years, before most of the current space law was written, hundreds of millions of dollars were invested in commercial space ventures. Capital has been available to fund single programs requiring hundreds of millions of dollars of prerevenue investment, and new entities continue to emerge seeking to enter the commercial arena in space. Early entry into space was under different circumstances and in a different environment from that which prevails today. Recently even traditional technical bodies like the International Telecommunication Union (ITU) have begun to feel the influence of the "North/South debate," involving developed country interests juxtaposed and in conflict with developing country interests.

As experience was gained and technical and economic feasibility of various new space applications were being demonstrated, the evolving body of space law to govern space activities began to expand. Commercial and governmental R&D occurred in parallel with the gradual creation of the relevant law and regulations applicable to space activities. Organizations with long histories, like ITU and the Intergovernmental Maritime Consultative Organization (IMCO), adjusted their traditional roles and rules and began to accommodate the need for new institutional entities and new regulations to deal with the emerging, expanding body of space activities.

Developments in Space Law

The Moon Treaty, on which negotiations were concluded in July 1979, emerges as the fifth in a series of treaties dealing expressly with aspects of outer space activity, negotiated by members of the U.N. Committee on the Peaceful Uses of Outer Space and promulgated by the U.N. General Assembly. Four previous treaties were negotiated:

1. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, entered into force October 10, 1967;
2. Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched Into Outer Space, entered into force December 3, 1968;
3. Convention on International Liability for Damage Caused by Space Objects, entered into force for the United States October 9, 1973; and
4. Convention on the Registration of Objects Launched into Outer Space, entered into force September 15, 1976.

Of these, the 1967 Outer Space Treaty has provided the basic legal framework for all subsequent elaborations. In addition to these and the maritime law history recapped above, there are two other prior

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existing treaties from which precedent is drawn and which are relevant to an understanding of the Moon Treaty:

- The Antarctic Treaty, signed by 12 countries December 1, 1959; and the
- Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, entered into force October 10, 1963.

In addition to these treaties, other important multilateral agreements have been established and form a part of the body of space law:

- International Telecommunications Satellite Organization (Intelsat) Agreement with Annexes, August 20, 1971; and the related Operating Agreement;
- Convention for the Establishment of a European Space Agency (May 30, 1975);
- Agreement on the Establishment of the "INTERSPUTNIK" International System and Organization of Space Communications (November 15, 1971);
- Convention on the International Maritime Satellite Organization (INMARSAT) opened for signature September 3, 1976, and the related Operating Agreement;
- The Agreement of the Arab Corporation for Space Communications (April 14, 1976);
- Agreement on Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes (July 13, 1976);
- Agreement on the Constitution of a Provisional European Telecommunications Satellite Organization "Interim Eutelsat" (May 13, 1977); and the
- Convention on the Transfer and Use of Data of the Remote Sensing of the Earth From Outer Space (May 19, 1978).

Add to this list more than 200 bilateral and multilateral agreements on particular cooperative joint ventures for spaceflight projects, launch agreements, agreements for tracking stations, laser ranging stations, sounding rocket data collection programs, special studies of data from remote sensing satellites, including operation of remote sensing data receiving stations and processing facilities, and agreements for study of lunar sample materials.[13]

The body of extant space law is extensive, diverse, dynamic, and expanding. Its formulation directly involved nations in all parts of the world and at all levels of technical and economic development. The work of the 47-nation U.N. Committee on the Peaceful Uses of Outer Space has been central in forming the core space treaties, but, as shown above, an extensive body of practical cooperative and commercial law relating to space activities has also been created by states outside the more formal proceedings of the United Nations.

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[13]Texts of the major agreements listed above are collected in "Space Law: Selected Basic Documents," 2nd ed. (Washington, D.C.: 95th Cong., 2d sess., Senate Committee on Commerce, Science, and Transportation, December 1978), committee print. See also "A Review of NASA International Programs," as of Jan. 1, 1980, NASA Headquarters, Code LI, Washington, D.C.; and "United States International Space Programs" (Washington, D.C.: Senate Committee on Aeronautical and Space Sciences, July 30, 1965), Doc. No. 44.

This long history of international cooperation in the space field will be an important counterweight to any influence which the deep seabed experience at the LOS Conference will have over the elaboration of a future detailed regime for nonterrestrial resources. It should, however, be recognized that in recent years, some of the same North-South issues found in the LOS context have become more prominent in international negotiations related to space. In particular, several of the recent World Administrative Radio Conferences of ITU have involved increasing Third World demands for more equitable allocation of radio frequencies and more technical assistance.

The Moon Treaty

General Issues Raised

On the eve of the adoption of the Moon Treaty by the U.N. General Assembly, several Senators and Congressmen expressed concern about possible U.S. signature of the treaty. On September 28, 1979, Congressmen Don Fuqua and Larry Winn wrote to Assistant Secretary of State Thomas Pickering, noting that in hearings held September 6, 1979, by the Subcommittee on Space Science and Applications of the House Committee on Science and Technology, discussion of the Moon Treaty was one issue which raised substantial controversy. The letter noted that certain witnesses expressed the opinion that:

> . . . the "Common Heritage" concept and other provisions of the draft Agreement can have grave economic implications for the long-term economic security of the United States. Future programs of the United States government and those of private industry could be unduly inhibited in exploiting the potentials of the Moon and other celestial bodies . . . . [The letter then pointed out that] It is imperative that in any further U.N. action on this matter, sufficient clarification of meaning and intent of the draft Agreement be advanced to protect the interest of the United States.

Similarly, in a letter dated October 30, 1979, to the Secretary of State, Senators Frank Church and Jacob Javits expressed concerns. Because it elaborates a number of basic and complex issues, the letter is reproduced here in its entirety.

Dear Mr. Secretary:

We are concerned that the United States has apparently concurred in the decision of the UN Committee on the Peaceful Uses of Outer Space to approve the text of a draft treaty on the moon and other celestial bodies. There are several aspects of this draft agreement which could prove damaging to our national economic and security interests, and we urge you to instruct the United States Delegation to the 34th UNGA not to support the opening of this treaty for signature as presently drafted.

The provisions of the so-called "Moon Treaty" borrow heavily from the Third UN Law of the Sea Conference. Of particular significance is the provision (Article XI) declaring the moon and its resources, as well as all other celestial bodies in our solar system, to be the "common heritage of mankind." When the United States first agreed in a 1970 UN General Assembly resolution that deep seabed resources were the "common heritage of mankind," the phrase had no independent legal meaning. The United States position was that the phrase could only be given operative meaning through further negotiations on a legal regime for the exploitation of the seabed. Even then, developing countries claimed that "common heritage" was synonymous with "common property" so that the resources of the seabed could not be exploited by any one country or its nationals without the consent of the rest of the world.

After a decade of negotiation at the Law of the Sea Conference, the set of draft treaty articles now before the Conference sets forth an interpretation of the "common heritage" which does not conform to the national interests of the United States or of

other countries with free enterprise/free market economies, particularly as they relate to such matters as production limitations, technology transfer, dispute settlement and competition with the proposed international "Enterprise." Furthermore, the formula for control of the International Authority to regulate seabed mining does not provide adequate protection for developed countries in general and the United States in particular.

We realize that the United States has taken positions in opposition to most of the objectionable portions of this text, but we remain skeptical of further efforts to extend the concept of the common heritage when the understanding of this principle on the part of many countries of the world is so contrary to our own interests. In this regard, suggestions by some participants in the LOS negotiations that Antarctica also be declared the common heritage of mankind are indications of the general trend we are confronting in international forums.

Even if the United States eventually decides not to sign—or the Senate decides not to ratify—a Law of the Sea Treaty with objectionable provisions on the deep seabed, we are concerned that the LOS negotiations could create an irrebuttable precedent for the control of all resources in non-state areas. Furthermore, while the Law of the Sea Treaty may provide protection for a number of important national interests which are unrelated to resources, the same does not appear to be true of the draft moon treaty. Our basic freedoms in space, including on the moon and other celestial bodies, are already protected in the Outer Space Treaty of 1967. That document also prohibits territorial or sovereign claims in outer space. Any refinements to these principles contained in the draft moon agreement seems insignificant in comparison to the risk to our future economic interests contained in the treaty's provisions on resources.

We are concerned that the draft moon treaty could, over the long term, be harmful to our national security interests in two ways. First, it is impossible today to predict what future economic uses might be required of lunar and celestial resources. Yet, the treaty does not even define the term "natural resources," and the scope of the term as used is so broad as to permit arguments that it covers the atmosphere surrounding the moon and the planets, and even the sun's energy.

Second, the draft moon treaty's provisions on resources could disadvantage the United States to the benefit of the Soviet Union—which may be the reason the Soviets first proposed such a treaty on the moon. In this and similar forums, it has been the apparent objective of the Soviets to erect barriers to free enterprise development of important resources. While they were unable to achieve in the moon treaty the moratorium they initially sought on resource-related activities in outer space, they did achieve a deterrent almost as effective—a commitment to negotiate a subsequent resource regime that could serve as a practical moratorium on private investment in the interim period. (This *de facto* moratorium is probably inevitable, even if the United States successfully preserves its legal position that the draft moon treaty establishes no moratorium on commercial exploitation.) The end result is that the Soviets can move forward in the area of resource development at their own pace under the guise of scientific investigation, with no fear of significant competition from the West, which must rely on its industry to provide commercial initiative. Seen from a long-term geopolitical perspective, we believe this outcome could be damaging to fundamental American security requirements.

For all of the above reasons, we urge that the United States delegation take no action during this General Assembly to further commit the United States to the draft moon agreement. Indeed, we hope that the treaty will be returned to the Committee on the Peaceful Uses of Outer Space and not opened for state signature until revised.

The Secretary of State replied to this letter on November 28, 1979, in a letter addressed to Senator Church, Chairman of the Senate Foreign Relations Committee, and referred to remarks made by Ambassador Petree concerning the Moon Treaty at the United Nations. The full text of the Secretary's letter to Chairman Church follows, along with the relevant extracts from Ambassador Petree's statement.

Dear Mr. Chairman:

Thank you for your letter of October 30 regarding the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the "Moon Treaty") and the Law of the Sea ("LOS") Treaty.

Your letter arrived in the Department only a day before the General Assembly's Special Political Committee adopted by consensus a resolution commending the Moon Treaty and recommending that it be opened for signature. (The resolution was co-sponsored by 28 countries, including the United States, Australia, Belgium, Canada, France, the Netherlands, West Germany, the United Kingdom, Italy and Japan.) Under the circumstances, it was not possible to consider adequately the proposals in your letter prior to the Committee's action. We did take the opportunity offered by the debate on the resolution to place in the record our interpretation of various treaty provisions, including those to which you refer. (Our statement is enclosed for your information.) The resolution will next go to the General Assembly. As a practical matter there would be no support for returning the Treaty to the Outer Space Committee; it will inevitably be approved by the General Assembly.

Of course, our cosponsorship of the resolution and joining in consensus approval of the resolution does not entail legal obligations for the United States. Only ratification of the Treaty after the advice and consent of the Senate can impose binding obligations upon the United States. The Administration has not yet turned to questions relating to signature of the Treaty or its submission to the Senate. When we begin to consider such matters, we will give the most careful consideration to concerns which you and others have raised in regard to the Moon Treaty. I would, however, like to address myself to some of your points in a preliminary way.

In regard to the important matter of the exploitation of the natural resources of the moon and other celestial bodies, the Treaty contains no moratorium on exploitation and, in fact, has provisions designed to facilitate and encourage such exploitation. For example, Article XI(3) of the Moon Treaty makes clear that although the 1967 Outer Space Treaty provides that "Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means", this "non-appropriation" principle applies to the natural resources of celestial bodies only when such resources are "in place." Thus, Article 11(3) would permit ownership to be exercised by States or private entities over those natural resources which have been removed from their "place" on or below the surface of the moon or other celestial bodies. (Such removal is permitted by the article contained in the 1967 Outer Space Treaty which states, inter alia, that "Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States . . . .")

We also do not believe that the Treaty would benefit the Soviet Union to the disadvantage of the United States. While the Soviet Union first proposed a Moon Treaty, their draft text contained no detailed provisions concerning exploitation. It was, rather, characterized by the Soviets as a "navigation treaty." It was the United States which in 1972 first proposed detailed provisions concerning exploitation and the common heritage concept. (The 1967 Outer Space Treaty, which the United States has ratified with the Senate's advice and consent, already had provided that outer space was the "common province" of mankind and that "the exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development . . . ." (Article 1)). Until July of 1979, the Soviet Union maintained strong opposition to the common heritage concept, and it was essentially because of this opposition that the Treaty was not concluded several years ago. Likewise, the Soviets, as well as the United States, opposed the concept of a moratorium on exploitation of natural resources.

The State Department will, of course, continue to keep Congressional members and staff advised in regard to the status of the Moon Treaty, as we have since negotiations commenced in 1972. We have made special efforts at consultations over the course of the past year and a half.

As you note in your letter with respect to the LOS Treaty, the United States is opposed to several features of the negotiating text under consideration by the Third UN Conference on Law of the Sea. Our delegation will be making a major effort at the Conference session scheduled for February 27-April 3, 1980, to negotiate changes that will make the concept of the common heritage fully consistent with our objective of securing assured access to deep seabed mineral resources. I believe that the LOS treaty also offers prospective benefits with respect to a number of other important national interests.

The following comments are extracted from the Statement by Ambassador Richard W. Petree, U.S. Deputy Representative to the U.N. Security Council, in the U.N. General Assembly Special Political Committee on the Report of the U.N. Outer Space Committee and the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, November 1, 1979.

Mr. Chairman, I appreciate the opportunity to address this Committee regarding international cooperation in outer space activities and some of the matters under consideration by the United Nations Committee on the Peaceful Uses of Outer Space.

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Work of the Outer Space Committee

I now would like to comment on the work of the Outer Space Committee and its subcommittees during 1979.

We wish to commend and endorse the work of the Outer Space Committee and work of its Scientific and Technical and the Legal Subcommittees as reflected in their respective reports. The subcommittees have done particularly valuable work this year in carrying out their mandates from the parent Committee and from the General Assembly. I do not intend to discuss here all of the issues covered in these reports, as our views are on record in the debates which led to their adoption. However, we would like to make a few remarks in regard to the principal topics discussed.

Moon Treaty

After some seven years of effort, the Outer Space Committee has completed a draft of the Agreement Governing the Activities of States on the Moon and other Celestial Bodies (the "Moon Treaty"). The successful completion by the Committee on the Peaceful Uses of Outer Space of the Moon Treaty is a reaffirmation of the constructive spirit of the Outer Space Committee, which has now produced some five treaty texts since its inception—an enviable record. It is also a reaffirmation of the validity of the consensus procedures by which the Outer Space Committee operates. Consensus may not be the speediest method of work, but it is the method which best ensures that the results of the Outer Space Committee are meaningful.

It is a method especially appropriate to dealing with outer space, which the Outer Space Treaty declares to be the common province of mankind, and with Article 11 of the draft Moon Treaty, which declares that celestial bodies (other than the earth) and the natural resources of such celestial bodies are the common heritage of mankind.

The draft Moon Treaty is based to a considerable extent on the 1967 Outer Space Treaty. Indeed, the discussion in the Outer Space Committee confirmed the understanding that the Moon Treaty in no way derogates from or limits the provisions of the 1967 Outer Space Treaty.

Of course, the draft Moon Treaty also is, in its own right, a meaningful advance in the codification of international law dealing with outer space, containing obligations which are of both immediate and long-term application in regard to such matters as the safeguarding of human life on celestial bodies, the promotion of scientific investigation and the exchange of information relative to and derived from activities on celestial bodies, and the enhancement of opportunities and conditions for evaluation, research and exploitation of the natural resources of celestial bodies. We think it useful to address some of the especially significant provisions contained in the draft Moon Agreement, this "fifth star" in the constellation of outer space treaties.

There has been considerable discussion of Article 1 of the draft treaty. We accept the Outer Space Committee's conclusions as to this article—namely, first, that references to the moon are intended also to be references to other celestial bodies within our solar system other than the earth, secondly, that references to the moon's natural resources are intended to comprehend those natural resources to be found on these celestial bodies; and thirdly, that the trajectories and orbits referred to in Article 1, paragraph 2, do not include trajectories and orbits of space objects between the earth and earth orbit or in earth orbit only. In regard to the phrase "earth orbit only", the fact that a space object in earth orbit also is in orbit around the sun does not bring space objects which are only in earth orbit within the scope of this treaty.

In regard to Articles 2 and 3 of the draft treaty, we cannot fail to note the concerns expressed by members of the Outer Space Committee lest outer space become yet another area where man makes war. Article 2 reaffirms the application of the Charter

of the United Nations and of international law to outer space. While the Charter predates man's entry into space, its principles and provisions, including those relating to the permissible and impermissible uses of force, are as valid for outer space as they are for our seas, land or air. We welcome the international community's reaffirmation in the Moon Treaty of this essential point.

Article 3 contains a statement of the principle that the celestial bodies and those orbits around them and to them are only to be utilized for peaceful—i.e., non-aggressive—purposes. Paragraph 2 of Article 3 spells out in some detail some of the consequences to be drawn from Article 2. Specifically, paragraph two's purpose is to make clear that it is forbidden for a party to the Moon Treaty to engage in any threat or use of force on the moon or in other circumstances set forth in paragraph 2 if such acts would constitute a violation of the party's international obligations in regard to the threat or use of force.

Article 7 contains important protections for the environment of celestial bodies. We endorse the Committee's understanding that the language of this article is not intended to be read in such a way as would result in prohibiting the exploitation of natural resources to be found on celestial bodies but, rather, that any such exploitation is to be carried out in such a manner as to minimize, insofar as is possible, disruption of or adverse changes in the environment.

The common heritage concept, which was initially suggested by Argentina, but formally proposed by the United States in 1972, is set forth in Article 11, paragraph 1, which makes clear that its meaning, for purposes of the Moon Treaty, is to be found within the Moon Treaty itself. Likewise, its meaning in the Moon Treaty is without prejudice to its use or meaning in any other treaty. Article 11 also makes clear that the parties to the treaty undertake, as the exploitation of the natural resources of the celestial bodies other than the earth is about to become feasible, to enter into negotiations to establish a mutually acceptable international regime to govern the exploitation of those mineral and other substantive resources which may be found on the surface or subsurface of a celestial body. My Government will, when and if negotiations for such a regime are called for under Articles 11 and 18, make a good faith effort to see that such negotiations are successfully concluded. Each of the participants in a regime conference will, of course, have to evaluate any treaty that emerges from the conference in the light of its own national interests. For the United States, this would require a conclusion that the treaty is balanced and reasonable and would then, as a constitutional matter, require submission to the Senate for its advice and consent, just as we have sought and obtained advice and consent to United States ratification of the four outer space treaties now in force.

The draft treaty, as part of the compromise by many delegations, places no moratorium upon the exploitation of the natural resources on celestial bodies by States or their nationals, but does provide that any exploitation of the natural resources of celestial bodies be carried out in a manner compatible with the purposes specified in paragraph 7 of Article 11 and the provisions of paragraph 2 of Article 6. We view the purposes set forth in paragraph 7 as providing both a framework and an incentive for exploitation of the natural resources of celestial bodies. They constitute a framework because even exploitation which is undertaken by a State Party to the Treaty or its nationals outside of the context of any such regime, either because the exploitation occurs before a regime is negotiated or because a particular State may not participate in the international regime once it is established, will have to be compatible with those purposes set forth in Article 11, paragraph 7, of the Moon Treaty.

This same paragraph also is an incentive. By setting forth now the purposes governing exploitation of natural resources, uncertainty is decreased and both States and private entities may now find it possible to engage in the arduous and expensive efforts necessary if exploitation of the natural resources of the celestial bodies is ever to become a reality. Especially vital in this regard is the fact that Article 11 (7) (d) recognizes that an equitable sharing of the benefits derived from the natural resources of celestial bodies necessitates giving special consideration to those who have contributed directly to the exploration of the moon, as well as to the needs of developing countries and those who have indirectly contributed to the moon's exploration. This language also reflects the international cooperation that exists today in telecommunications and other practical applications of space, for example, Intelsat, Intersputnik and Inmarsat, where those States who have expended large resources, either public or private, to develop space systems to exploit these applications have equitably shared the benefits with the international community.

We also note that Article 11, paragraph 8, not only covers and sets the standards for the general right to exploit natural resources (in a manner compatible with Article 11 (7)) but also is intended to ensure that the unrestricted right to collect samples of natural resources is not infringed upon and that there is no limit upon the rights of States Parties to utilize in the course of scientific investigations, such quantities of those natural resources found on celestial bodies as are appropriate for the support of their missions.

Perceived Benefits of the Moon Treaty

In addition to the foregoing information submitted to the Senate Foreign Relations Committee, the Department of State prepared for and distributed to interested persons a short informal paper, dated October 17, 1979, entitled "Benefits to the United States of the Celestial Bodies Agreement." In a separate paper, the L-5 Society prepared a point-by-point review of the State Department's short paper on "Benefits." Attached to this report at annex D are the State Department's memorandum on benefits, and the L-5 Society's analysis of those stated benefits.

Some comment on the exchange reflected in the State Department informal working paper on "Benefits" and the L-5 Society analytical response is necessary.

The State Department paper fails to mention one addition to the body of explicit international law contained in the new treaty, which might have been listed in the first paragraph as a subset number four, as follows:

4. Confirming and expanding assurances of exclusively peaceful uses of CBs, *and prohibiting the threat or use of force or other hostile acts.*

This observation is based on the content of article II, expressly extending applicability of the U.N. Charter to CBs, and article III, paragraph 2, which is further discussed below. As presented in the excerpt of Ambassador Petree's statement printed above, the U.S. legal position appears to be that article II of the 1967 Outer Space Treaty already makes the U.N. Charter applicable to CBs and that the prohibitions on the threat or use of force or other hostile acts contained in article 3, paragraph 2 of the Moon Treaty only restates international obligations which flow from the Charter. In addition, two subitems could have been added to those listed under the heading: "2. Promoting exchange of scientific results of CB activities," as follows:

—requiring annual notification on the status and purposes of stations on CBs, and

—encouraging the widest possible cooperation and mutual assistance in all activities concerning exploration and use of CBs on bilateral or multilateral bases, or through international intergovernmental organizations.

Although the State Department paper notes the "Duty to notify of any placement of radioactive materials on a CB," it does not amplify what may be the more important aspects of that duty, namely, the duty to notify *in advance* of any placement of radioactive materials on a CB *and the purpose of such placements.*

In its response and analysis of the State Department paper, the L-5 Society fails to take note of an important point which relates to the heart of its argument, namely, the widely variable listing of countries that have signed and ratified the previous outer space treaties. The assumption is repeatedly stated throughout the L-5 Society analysis, that particular parts of the Moon Treaty merely restate existing international law already in the earlier treaties and, consequently, add very little to the body of extant international law.

As of December 1, 1978, signatures, ratifications, and accessions of the previous outer space treaties showed the following totals:

	Signatures	Ratifications (R)	Accessions (A)	Total R+A
1967 Outer Space Treaty	90*	56*	14	70
Rescue and Return Agreement	79*	51*	16	67
Liability Convention	71*	34	17	51
Registration Convention	27	18	5	23

*Plus the Ukranian SSR and Byelorussian SSR, which are not recognized as separate signatories by the United States.

Thus, fewer than half of the total number of sovereign governments in the world (approximately 160) have ratified or acceded to the 1967 Outer Space Treaty, and regressively lesser numbers have ratified or acceded to the subsequent U.N. space agreements and conventions. The fact is that today there is *not* widely accepted, codified, and agreed space law that *applies to all countries,* or even most countries, because more than half of the countries of the world have yet to ratify or accede to the prior existing space treaties. Important, space-active countries with launching capability that have not ratified or acceded to all the prior treaties include the People's Republic of China and Japan.

A benefit perceived but not articulated by the State Department may be that, because of its adoption of the common heritage principle, the Moon Treaty will be more widely accepted and ratified or acceded to than previous space treaties. If that is the case, it becomes very clear why the drafters chose to repeat so much of the text and so many of the principles of the prior treaties in this instrument; many countries which may not have ratified or acceded to the earlier treaties, if they intend to obtain the rights and benefits of the Moon Treaty concerning nonterrestrial resources by ratification or adherence, must also accept the restated basic principles drawn from the earlier treaties and included in the Moon Treaty.

To the extent that it is believed to be an important national interest of the United States to increase the total number of countries bound by certain of the principles found in the 1967 Outer Space Treaty, the assumptions repeatedly relied upon by the L-5 Society in its analysis—that little of import or consequence beyond the resource provisions of article 11 is newly added to the body of existing international law—would be subject to challenge on these grounds. The level of national interest in such an increase would depend on a number of factors, including the extent to which states not party to the earlier treaty have expressed legal positions concerning outer space activities different from its provisions; the extent to which such states, if any, have the capability or near-capability to engage in outer space

activities in contravention of the 1967 Outer Space Treaty, and the extent to which states with such capability have done so or are likely to do so. Among outstanding issues that remain under debate, for example, are the upper limit of national sovereignty, the status of the geostationary orbit, the construction and testing of antisatellite systems, and rights to conduct remote sensing and broadcasting by satellite. Presumably, the L-5 Society would argue that the 1967 Outer Space Treaty, even if it did not codify customary international law at the time of its conclusion, has, through the custom, practice, and acquiescence of the members of the international community come to embody the agreed and universally binding law of nations on the subjects no longer contested.

In any event, if the administration believes there to be an important national advantage in broad acceptance of the Moon Treaty for the reasons outlined here, it seems incumbent upon it to articulate this rationale. Thus far, support for the Moon Treaty has not been justified on the grounds that risk of some potential prejudice to future U.S. interests in resources is warranted by the present benefits to our security and related interests of increased adherence to the free exploration and use, nonappropriation, and exclusively peaceful purposes principles of the 1967 Outer Space Treaty.

There is one additional benefit that could accrue (i.e., cost that could be avoided) to the United States from signature and ratification of the Moon Treaty that is not mentioned by the State Department in the appended document. That is the foreign policy consistency and foreign goodwill and regard that will be assured. It will most certainly cost the U.S. Government some measure of goodwill and perceived consistency, reliability, and credibility if, after 7 years of active participation in proposing and negotiating fundamental elements of the text of this treaty, the United States walks away from it without signing. This issue arises in every major negotiation and is faced in each review for advice and consent to ratification. If, in fact, the treaty is contrary to U.S. interests, if it constrains U.S. freedom to exploit resources, the United States should not sign the agreement. It remains for Congress to determine a clear record of facts before such conclusions can be reached with confidence. Actions in process to this end and possible additional actions are discussed in the concluding chapter of this study.

Perceived Costs of the Moon Treaty

The substance of arguments presented on both sides in the papers in annex D, along with materials contained in preceding portions of this assessment, form the basis of the following review of issues raised concerning the Moon Treaty.

The principal reasons that have been presented in opposition to U.S. signature and ratification of the Moon Treaty are that it would:

—create a moratorium on commercial exploitation of the resources of the Moon and other celestial bodies, until a second, much more comprehensive treaty for regulating resource activities is concluded;

—establish guiding principles for the negotiation of this second treaty which are completely antithetical to the commercial development of outer space resources by private enterprise; and
—thereby give other countries tremendous political control over the timing and direction of expanding commercial uses of outer space, as well as the question whether to permit such uses.

These issues have been raised in various forums by many individuals, corporations, and groups. The serious concerns expressed by Senators Church and Javits in the letter to Secretary Vance printed on pages 311-312 have also been recorded by six other members of the Senate Foreign Relations Committee. Representative John Breaux (D-La.) has been very active in articulating the arguments for opposing U.S. signature and ratification of the Moon Treaty, and his effort has been supported by other colleagues in the House of Representatives. Other bodies which have expressed concerns about the implications of U.S. acceptance of the Moon Treaty include the Natural Resources Law Section of the American Bar Association, the National Association of Manufacturers, the National Ocean Industries Association, the Law of the Sea Committee of the American Branch of the International Law Association, the Aerospace Industries Association, and individual companies including United Technologies and Kennecott Copper Corp.

As an entity that devoted considerable time and effort to comparative analysis, review, and evaluation, the L-5 Society may be the best equipped among opponents of the treaty to highlight its shortcomings and explain its potential disadvantages. After an extended study and preparation of commentary on the treaty, testimony before the Congress, and analysis and commentary on the State Department's "Benefits" list, the L-5 Society reported:

> In short, our analysis of the Administration's justification for the moon treaty leads to the conclusion that the marginal advances which might be made in a few provisions are far outweighed by the enormous sacrifice that would be required of our Nation's future economic interests in space development.

To attempt to explain and analyze thoroughly all of the issues raised by the treaty's opponents in the literature which has been generated on this subject since September 1979 is a task too broad to be handled in the limited study. Instead, this section of the assessment sets out a summary description of the basic argumentation which has evolved with respect to two concerns—that the treaty creates a moratorium on the exploitation of extraterrestrial resources and that it prejudices the outcome of the second resource agreement, to the detriment of U.S. interests, by adopting principles already elaborated in the law of the sea negotiations.

First, the potential moratorium. A number of commentators have reviewed the text of the Moon Treaty and conclude that, read in its entirety, the treaty's language can be interpreted legally to imply a moratorium on nonterrestrial material exploitation for commercial purposes prior to the establishment of a new international regime

pursuant to a subsequent agreement.[14] These conclusions will be discussed in detail in the article-by-article review of the Moon Treaty appearing at pages 62-81. They are based exclusively on the text of the treaty itself and do not take into account the negotiating history, in which the issue of moratorium was explicitly debated, with language proposed that was rejected by the drafters.[15]

In addition to the legally interpreted implicit imposition of a moratorium in the text of the Moon Treaty, commentators have pointed to articulated Third World interpretations of the "common heritage" principle in the deep seabed context as evidencing the future availability to developing countries of arguments that the Moon Treaty does impose a moratorium on commercial exploitation. The records of the law of the sea negotiations are replete with Third World statements to the effect that "common heritage" resources are synonymous with "common property." Flowing from this concept of international common ownership has been the assertion that no state can exploit common heritage resources until the international community has established a new legal regime and designated an entity to approve such exploitation on its behalf. Furthermore, commentators have noted that significant parallels exist between the ambiguities in the 1970 Declaration of Principles for the Seabed, which papered over differences on the existence of a moratorium on deep seabed exploitation, and certain ambiguities in the text of the Moon Treaty. As a result, they conclude that the Moon Treaty is easily open to the interpretation by Third World nations that unilateral space resource development is prohibited until a new agreement is concluded. Again, the actual negotiating history belies this interpretation.

These commentators discount the value of U.S. statements on the record in the U.N. Special Political Committee denying the existence of such a moratorium and asserting the right to undertake commercial exploitation before a new treaty is agreed, and after it is agreed, by a state which decides to remain a nonparty. An example of their reasoning is found in the following excerpt from the remarks of Representative John Breaux before the Center for Strategic and International Studies at a seminar held in Washington, on February 19, 1980:

> I am on record that the language of the Agreement can be interpreted to establish such a moratorium. I also am on record as having little confidence in the legal and political efficacy of our Administration's official, unilateral statements to the contrary. I note, simply, that even though we have officially rejected LDC arguments that unilateral deep ocean mining is legally impermissible, the Administration's knees have buckled, when the developing countries have threatened adverse consequences, if the U.S. proceeded to enact domestic legislation to authorize such mining. . . . Could we expect firm resolve from our Executive Branch, in the event that we faced a similar LDC position on space development, based not merely on a truly ambiguous and legally nonbinding U.S. General Assembly resolution, as occurred in the seabed context, but relying on a solemn treaty which can be said with some force to be clear

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[14]Remarks by Rep. John B. Breaux before the Center for Strategic and International Studies, Feb. 19, 1980; remarks of Theodore G. Kronmiller before the Section of Natural Resources Law, American Bar Association, Apr. 26, 1980.

[15]See, e.g., proposal by India at p. 27 of the Galloway study, "Agreement Governing the Activities of States on the Moon and Other Celestial Bodies," (Washington, D.C.: 96th Cong., 2d sess., Senate Committee on Commerce, Science, and Transportation, May 1980), committee print.

on the point? Equally importantly, unilateral statements such as the U.S. has made on the Moon Treaty are, according to the international law of treaties, only a supplementary means of interpretation and may be relied upon only to confirm a reading arrived at by other, more authoritative means.

. . . In the U.N. Special Political Committee, the U.S. made a strong statement rejecting the moratorium interpretation, but did so at such a late state that there was little reason to expect that there would be a substantial LDC response. However, Indonesia, another major participant in the Group of 77, stated prior to the U.S. remarks:

"In accordance with the provisions of that draft . . . the moon had been declared the common heritage of mankind. Neither the Moon's surface nor its subsurface should become the national property of any state. The draft treaty would protect the rights of all states to their share of space resources and assured the developing nations of their share of such resources by the provision to set up an international regime to govern the exploitation of natural resources when such exploitation becomes feasible. In the meantime . . . states retained the right to conduct scientific investigations on the moon but committed themselves to report their findings to the Secretary General and to the international community."

The implication is clear. No right to exploit resources prior to establishment of a regime to govern that activity is recognized. In diplomatic language, this stands in opposition to the U.S. position on a moratorium.

The implication intended by Indonesia and the U.S. position are of equal weight in that debate. However, in the face of these predicted developing country challenges to U.S. rights to proceed with commercial exploitation of space resources, in the absence of the future international agreement called for in the Moon Treaty, private industry, it is argued, will experience enormous practical constraints on its activities in space. It remains to be declared by any of those concerned about or opposing the Moon Treaty, precisely what course of action they now propose for the administration to take. It is clear that there is a body of opposition to the treaty, but there is no articulated alternate course proposed for the U.S. Government, other than to refuse now to sign the agreement and to wait and see what happens.

The following extract of a section from testimony of the L-5 Society's Counsel in hearing before the Space Science and Applications Subcommittee of the House Committee on Science and Technology on September 6, 1979, presents the moratorium argument forcefully.

The Moon Treaty Imposes a Moratorium on Commercial Exploitation

Mr. Chairman, the Administration will argue that the moon treaty does not deter private enterprise and certainly does not impose a moratorium on commercial exploitation. I strongly disagree on both counts. You will recall that the moon treaty calls for a subsequent treaty when exploitation of the resources of our solar system "is about to become feasible." Mr. Chairman, exploitation will never be "about to become feasible" *through the efforts of private enterprise,* if the moon treaty is allowed to become the law of the land.

The development of natural resources is a long and expensive process and normally goes through certain chronological stages. First, there is the period of scientific investigation in which private companies in their own laboratories study and extrapolate assumptions about the resources which have been retrieved by scientists and governments. Second, if they have found scientific samples to be of interest, they may begin to develop inexpensive methods of resource sampling so as to gain a clearer picture of the quality, quantity and distribution of possible resource deposits. Should this activity, which is frequently called prospecting, be fruitful they will at that point, and sometimes even earlier, enter the phase of exploration. At the beginning of exploration the economic feasibility, technological feasibility and marketing considerations are studied. These are fairly general studies, since they occur a decade or more in advance of commercialization. During this period, they may build prototype technology

to help test their technological assumptions and better define an ore body. While throughout these first three stages they will try to minimize costs in view of the high degree of speculation involved, they may spend tens and perhaps hundreds of millions of dollars. These three phases must all precede *exploitation.* In an area that requires new technology and highly speculative predictions about future markets, it is impossible for a public corporation to also take the risk that at the end of a 15 or 20 year period of such significant capital spending for R&D, it will be politically impossible to enter the exploitation or commercial recovery phase of their activity.

Mr. Chairman, we are all familiar with the current thinking that solar power satellites may at least in part be built from raw materials found in outer space. What company could seriously begin to develop solar power technology which would be dependent on mining the mineral resources of the moon if, just as the technology is proved feasible, the U.S. is bound by a treaty to enter into negotiations which may over another period of 10 or more years lead to a treaty anything like the law of the sea treaty? In short, Mr. Chairman, it is my very strong view that the moon treaty in its present form imposes a *de facto* moratorium on private enterprise use of outer space in connection with the development of natural resources.

This treaty does not foreclose the possibility that governments (with private company sub-contractors whose losses are underwritten by the taxpayers) may one day wish to develop the technology under a centrally planned, internationally controlled economic system. What it does do, however, is doom free enterprise initiative in outer space. And it does so at a time when a very long period of government subsidy of the space program may at last be sufficient to spark private initiative. It is hard to believe that Congress has spent tens of billions developing this country's space technology without the expectation that some day our traditional private enterprise system would be in a position to take over. The moon treaty precludes this possibility.

Aside from the textual interpretation of article 11 of the Moon Treaty and related provisions (discussed infra at pp. 331-340), these arguments concerning the treaty's imposition of a *de facto* moratorium draw heavily on the experience of the seabed mining industry.

While the incomplete UNCLOS III negotiations have been in progress for the last 6½ years, several hundred million dollars have been invested by commercial entities in the development of technology and the study of the nature, location of, and best means for processing deep seabed resources. Major consortia have been formed within this same period, and plans apparently exist today within at least some companies to proceed with programs for deep seabed resources exploitation. Nevertheless, industry spokesmen indicate that eventual full-scale deep-sea mining operations by U.S. companies may never occur, because the draft treaty texts near completion at the LOS Conference require further improvements and refinements before they can serve as an acceptable basis for private investment. Evidencing the debilitating effect which the uncertain international political situation has had on ocean mining programs, three of the four consortia with major U.S. participation have during the past 2 years announced severe cutbacks in their expenditures, including disbanding technical teams and closing facilities. Although the United States has just enacted domestic legislation to establish an interim regime for deep-sea mining pending entry into force of an LOS convention (Public Law 96-283), even this law, at the insistence of the administration, imposes a temporary moratorium on commercial exploitation activities until January 1988.

It can be seen that industrial seabed developments are progressing in the face of an explicit U.N. moratorium resolution and a contested

formulation of the nature and content of the regulatory regime to be applied at some future time under the LOS Treaty. Consistent with past experience in early space commercial exploitation, the seabed mining industry was apparently prepared to take risks and to invest capital when the benefits to be obtained are substantial, even though there existed risk and doubt about emerging law. It remains to be seen how far this development will continue.

A relevant aspect of the developmental phase of space technology is that Government demonstration and proof of concept have been consistently practiced throughout the past 20 years of spaceflight activity; although some large industrial entities have themselves funded developmental programs costing tens of millions of dollars, e.g., AT&T's Telstar satellites and RCA's funding of the uprating of lift capacity of the Delta rocket.

The U.S. Government has already modestly invested, more than a million dollars, in feasibility studies of various technical aspects of extraterrestrial resources exploitation, and more funding is anticipated in this area. On the one hand, the level of Government participation traditionally involved in space development activities may suggest that R&D programs for nonterrestrial resources would be less adversely affected by legal and political controversy about the existence of a moratorium than private industry seabed mining programs. On the other hand, some observers have concluded that, because of the close relationship between public funding and private industry programing in the space field, the momentum for Government-sponsored R&D programs for nonterrestrial resources will be seriously eroded by diminished industry interest. Other observers have questioned the assumption that the U.S. Government is any more prepared to confront the political risks envisioned than private enterprise.

It may be useful to consider, in the context of debate over whether or not a moratorium is intended, implied, or likely to result, the views of an international civil servant who has been an employee of the U.N. outer space affairs staff for more than 15 years. Nandisiri Jasentuliyana is Deputy Secretary, U.N. Committee on the Peaceful Uses of Outer Space. At a seminar on the U.N. Moon Treaty, February 19, 1980, held at the Center for Strategic and International Studies, Georgetown University, Washington, D.C., Mr. Jasentuliyana presented a paper entitled "A United Nations Perspective of the Moon Agreement." Mr. Jasentuliyana participated in the years of work of the U.N. committee preparing the text of the treaty and the many reports and discussion summaries issued by the United Nations concerning the treaty. A selected portion of his paper follows dealing with the questions of the regime, exploitation, and whether or not a moratorium is intended, expected, or implied.

In seeking to assure that all nations enjoy equal rights in exploiting and benefiting from space resources, the Moon Agreement specifies that, as exploitation of such resources becomes feasible, but not sooner, an international regime will be established to govern that exploitation. This regime will serve to provide a framework for various nations and non-governmental enterprises to pool their creative energies and co-oper-

ate in seeking the best means of their exploration and development. This type of co-operation cannot be viewed as restrictive or inhibiting.

It is generally accepted that resource development beyond the territorial boundaries of nations what may be called as "common property" should be an international effort. These are areas that are not subject to the jurisdiction of any one country. If such areas and their resources are not managed on an international basis, they will surely be the basis of international conflict and become a vast region open to public and private piracy, sabotage and usurpation. Without some guiding framework which preserves the necessary international stability in these regions and makes the expectations of the international community predictable, one cannot expect public or private enterprises to provide the vast investments that are necessary to encourage the timely development of space resources.

The Moon Agreement, therefore, is not designed to hinder or otherwise place a moratorium on resource development. The only major limitation imposed by the Agreement is the requirement that the moon and other celestial bodies and their resources be used for peaceful purposes only. The Agreement, with foresight, also specifies that States Parties must take measures to prevent the disruption of the existing environmental balance of space. However, these two limitations are the only major qualifications contained in the Agreement concerning the use of resources and they certainly serve to benefit all States. On the contrary, it encourages resource development by permitting scientific investigation, and promoting the establishment of lunar facilities.

Some discussion has centered on the structure and powers of the international regime. It is clear, however, that the proposed international regime would present no danger of cartel or monopoly, for it would not be in any sense exclusive. The regime will be developed by all those nations which are parties to the Moon Agreement and the Agreement itself is open to all States for signature. Therefore, the proposed international regime cannot be considered an exclusive or monopolistic arrangement and, due to the fact that its establishment remains far in the future, the legal framework which it might provide is beyond any present speculation.

According to the Moon Agreement the purpose of a future international regime recognizes the equitable sharing in the benefits derived from the resources and the need to give special consideration to the effort of those countries which have contributed either directly or indirectly to their exploration as well as to the interest and needs of developing countries. These are not revolutionary ideas. International co-operation efforts based on these principles are already in existence and as has been stated elsewhere, INTELSAT and INMARSAT are examples where "those States who have expended large resources, either public or private, to develop space systems to exploit these applications have equitably shared the benefits with the international community".

The Moon Agreement, as it stands, therefore represents a solid basis upon which further space legislation can continue. Independent of its origins the Agreement now represents the expression of the common collective wisdom of all Member States of the United Nations and it responds, in particular, to the needs and possibilities of those that have already advanced their technologies into outer space. The Agreement is neutral as far as the claim of private or public enterprise for resource development is concerned and the few restrictions it imposes are not relevant to the social system of states operating in outer space.

It would be unfair, therefore, to maintain that the end result of many years of painstaking deliberations in which the United States itself has taken a leading part provides a slant towards any one country or any one social system. If there is a bias, there is a bias towards the type of rule of law consecrated by the Charter of the United Nations and such legal instruments and precepts emanating from it.

Second, the LOS precedent. In the arguments of many of the critics of the Moon Treaty, the moratorium question is given subsidiary importance. What is of much greater concern is the possible influence which the deep seabed regime emerging from the LOS Conference might have on the nature and content of the future lunar and celestial body resource regime. This concern is founded on substantial similarities in language between the draft Law of the Sea Treaty provisions

and their predecessor document, the 1970 Declaration of Principles, on the one hand, and the Moon Treaty, on the other. These textual similarities and the negotiating history surrounding them are addressed in the following section of this assessment at pages 334-340.

As will be elaborated further, a purely textual analysis of the Moon Treaty does not reveal how the treaty's opponents conclude that the law of the sea model will be a more compelling precedent for a future lunar and celestial body resource regime than other models in the extant body of space law. This conclusion is based on certain assumptions about the future interests and behavior of Third World and U.S. negotiators which should be clearly understood.

Those who hold the view that the law of the sea experience is virtually inescapable if the present Moon Treaty enters into force for the United States believe that the common heritage doctrine for resources in international areas is an important part of the Third World's program for a new international economic order. Third World control over vital resources is seen as a mechanism for forcing the transfer of wealth, technology, and political power from the North to the South. Developing country attempts to apply the common heritage doctrine, not only to the deep seabeds, but also to Antarctic resources, high technology, and the radio frequency spectrum are part of a consistent pattern. Having spent 10 years at the LOS Conference hammering out an elaborate set of treaty articles which define a common heritage regime, Third World negotiators, these commentators argue, will not see it to their advantage to retreat from the highly desirable LOS model during a new common heritage negotiation for celestial body resources. The further assumption is made that U.S. negotiators, confronted with this overwhelming insistence that the LOS experience serve as a precedent, will in important and substantial areas find their bargaining leverage diminished and their negotiating flexibility restricted. They will, it is maintained, agree to unacceptable provisions which parallel the deep seabed regime, even though it does not appear that the United States would have to make such concessions in the celestial body resource negotiations in order to protect other national interests (as it may have felt compelled to do at the LOS Conference). In short, this reasoning assumes that subsequent resource negotiations will take place in the political environment which is now prevalent in international economic negotiations involving North-South issues, and that U.S. negotiators will be unable or unwilling to adopt the tough negotiating positions and tactics necessary to withstand Third World pressure to follow the LOS model.

Apparently, Department of State officials and others in the administration who support signature and ratification, believe that the required future negotiation of a regime could be done in a manner sufficient to protect U.S. national interests.

It is neither the purpose nor the intent of this review of the positions stated to seek to resolve them. It is clear from the foregoing that there are deeply held convictions on both sides of the argument about the Moon Treaty, and it is probably the most difficult kind of

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an argument to resolve, being focused on speculation about possible future events and the likely consequences that will flow from U.S. signature and ratification of the treaty in the near future.

Having identified the principal issues that have been raised, and having presented examples of the positions and views of key persons in the discussion of the meaning and consequences of the treaty, it remains to consider, in some detail, the text of the treaty itself and the constraints it may contain upon the U.S. capability to exploit extraterrestrial resources.

Constraints on U.S. Capability to Exploit Extraterrestrial Resources

The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (full text at annex A), opened for signature on December 18, 1979, is, in substantial part, a reiteration and elaboration of earlier treaties drawing primarily on the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies of 1967.[16]

The new agreement: 1) restates and extends some constraints on the freedom of states to use the Moon and other celestial bodies, 2) is interpreted by some to imply constraints on resources exploitation in the near future, and 3) in providing for the future creation of a regime to govern the exploitation of extraterrestrial resources, creates the possibility of additional constraints being established at a future time.

In the *Preamble* to the Agreement, other than language directed at prevention of conflict, that is reflected in certain constraints on military activities noted below, the language indicates a clear intent of signatories to promote on the basis of equality the further development of cooperation among states in the exploration and use of the Moon and other celestial bodies. There are no discernible constraints, apparent or implied, in articles 1, 2, 4, 5, 10, 12, 13, 16, 17, or 19 through 21.

Article 3 limits the use of the Moon and other celestial bodies to "exclusively" peaceful purposes, and forbids the placement and the use of nuclear weapons or weapons of mass destruction, conduct of weapons tests, military bases, installations, fortifications, and maneuvers on or in orbit around a celestial body. It reads:

Article 3

1. The moon shall be used by all States Parties exclusively for peaceful purposes.

2. Any threat or use of force or any other hostile act or threat of hostile act on the moon is prohibited. It is likewise prohibited to use the moon in order to commit any such act or to engage in any such threat in relation to the earth, the moon, spacecraft, the personnel of spacecraft or man-made space objects.

3. States Parties shall not place in orbit around or other trajectory to or around the moon objects carrying nuclear weapons or any other kinds of weapons of mass destruction or place or use such weapons on or in the moon.

4. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on the moon shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration and use of the moon shall also not be prohibited.

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[16] "Space Law: Selected Basic Documents," op. cit.

This article embodies the principal constraints upon states parties reflecting the preambular desire "to prevent the moon from becoming an area of international conflict." Paragraph 2 constitutes an expansion of provisions in the 1967 Outer Space Treaty, prohibiting the use of force, the threat of force, or the use or threat of any other hostile act on a celestial body. Use of celestial bodies for such purposes is also prohibited. This duplicates provisions of the U.N. Charter already applicable to space by virtue of the 1967 Outer Space Treaty.

States parties shall not place objects containing nuclear weapons or weapons of mass destruction, or such weapons, in orbit around or in trajectories to or around or on or in celestial bodies under this article. Forbidden in both treaties are weapons tests, military bases, installations and fortification, and military maneuvers on a celestial body. These prohibitions and constraints not only appear in the 1967 Outer Space Treaty, but are reflections of provisions in the 1963 Treaty Banning Nuclear Weapons Tests in the Atmosphere, in Outer Space and Under Water; and the 1959 Treaty on Antarctica.

The constraints set forth in this article have not been referred to in any known public criticism of the draft agreement and do not appear to limit the exploitation of resources in space in any sense referred to in the request for an OTA study of possible constraints on commercial exploitation.

Article 6 is one of the provisions cited by opponents of the Moon Treaty as creating a strong legal inference that commercial enterprises are barred from engaging in any use of extraterrestrial resources for commercial purposes. It reads:

Article 6

1. There shall be freedom of scientific investigation on the moon by all States Parties without discrimination of any kind, on the basis of equality and in accordance with international law.

2. In carrying out scientific investigations and in furtherance of the provisions of this Agreement, the States Parties shall have the right to collect on and remove from the moon samples of its mineral and other substances. Such samples shall remain at the disposal of those States Parties which caused them to be collected and may be used by them for scientific purposes. States Parties shall have regard to the desirability of making a portion of such samples available to other interested States Parties and the international scientific community for scientific investigation. States Parties may in the course of scientific investigations also use mineral and other substances of the moon in quantities appropriate for the support of their missions.

3. States Parties agree on the desirability of exchanging scientific and other personnel on expeditions to or installations on the moon to the greatest extent feasible and practicable.

Paragraph 2 permits the use of resources in "scientific investigations." Thus the issue is the definition of "scientific investigation." To the extent that it excludes R&D activities undertaken by a commercial entity in the hope of future profit, then paragraph 2 of article 6 could be read as implying prohibition of an entity's using resource samples collected from the Moon and other celestial bodies—either for R&D or for the support of its missions. As discussed below, paragraph 8 of article 11 can be read as reinforcing this implied prohibition on the conduct of interim resource activities by states and persons who are not pursuing scientific purposes. There is an opposite

interpretation of the language, denying that by expressly authorizing use it was intended to deny exploitation. Such an argument leads to a more positive reading of paragraph 8 of article 11, as is shown below.

Article 7 establishes requirements of advance notification for certain classes of action. Because of this advance notification, international opposition constituting at least moral constraints, could certainly arise, depending upon the nature of actions undertaken.

Article 7

1. In exploring and using the moon, States Parties shall take measures to prevent the disruption of the existing balance of its environment whether by introducing adverse changes in such environment, its harmful contamination through the introduction of extra-environmental matter or otherwise. States Parties shall also take measures to prevent harmfully affecting the environment of the earth through the introduction of extraterrestrial matter or otherwise.

2. States Parties shall inform the Secretary-General of the United Nations of the measures being adopted by them in accordance with paragraph 1 of this article and shall also to the maximum extent feasible notify him in advance of all placements by them of radio-active materials on the moon and of the purposes of such placements.

3. States Parties shall report to other States Parties and to the Secretary-General concerning areas of the moon having special scientific interest in order that, without prejudice to the rights of other States Parties, consideration may be given to the designation of such areas as international scientific preserves for which special protective arrangements are to be agreed in consultation with the competent organs of the United Nations.

This article is an elaboration and expansion of the terms of article IX of the 1967 Treaty. The opening paragraph reflects the 1967 provisions. Paragraph 2 establishes added responsibilities of states parties, which might be viewed by some as constraints, but which are more akin to notification procedures found in article 5 of the Moon Treaty. The requirements of paragraph 2 are notification actions to be performed in advance of conducting activities. Depending on the nature of "measures being adopted" or the nature of and purposes of radioactive materials to be placed on a celestial body, international opposition, constituting constraints, could certainly arise.

The third paragraph, constitutes a basis for the designation (by an unnamed mechanism or authority) of "areas of the moon having special scientific interest," in order that such areas might be designated (by the unnamed mechanism or authority) as "scientific preserves." This is a vague and ambiguous provision, and some have expressed concern that it could be used to place large areas of potential resources permanently off-limits to exploitation.

It is entirely clear in this article that limitations on certain areas of operation are possible, and advance notice requirements exist with regard to certain kinds of activities. Both measures to control contamination and back-contamination, and uses or deposit of radioactive materials could be involved in exploitation activities. To the extent that article 7 establishes a basis for review and challenge of state activities, it is a source of *potential*, but not presently *actual* constraint. It contemplates in paragraph (3) the possible designation of scientific preserves, the implications of which are not elaborated or addressed.

In *article 8,* to the extent that the third paragraph establishes a rule of right of priority in time, one interpretation is that it could create a constraint of preemption of choice locations for exploitation of resources. Such an interpretation would obviously favor those states with capacity to reach and exploit the Moon relatively early.

Article 8

1. States Parties may pursue their activities in the exploration and use of the moon anywhere on or below its surface, subject to the provisions of this Agreement.

2. For these purposes States Parties may, in particular:

(a) Land their space objects on the moon and launch them from the moon,

(b) Place their personnel, space vehicles, equipment, facilities, stations and installations anywhere on or below the surface of the moon.

3. Activities of States Parties in accordance with paragraphs 1 and 2 of this article shall not interfere with the activities of other States Parties on the moon. Where such interference may occur, the States Parties concerned shall undertake consultations in accordance with article 15, paragraphs 2 and 3.

This article explicitly authorizes "States Parties" to explore or use the Moon, on or below its surface, subject to the agreement. Paragraph (3) directs that authorized activities of States Parties "shall not interfere with the activities of other States Parties on the moon." This provision could be construed to constitute a rule of right of priority—first on site, first in right.

On the other hand, since the ban on interference could apply equally to the activities of both "interfering" states, another interpretation is that a first-in-time priority is not implied. Such an approach to noninterference is found in the 1958 Geneva Convention on the High Seas where, even those commentators who have argued that the freedom of the high seas doctrine applies to ocean mining have sought other legal precedent and support for their contention that international law permits exclusive claims for limited commercial purposes to specific resource deposits.[17]

"Where such interference may occur, States Parties concerned shall undertake consultations . . ." A separate article (15) defines the mechanisms and methods of consultation. Paragraph (3) of article 8 is a condensed and somewhat more restrictive version of the following language contained in article IX of the 1967 Treaty:

If a State Party to the [1967] Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party . . . would cause potentially harmful interference with activities in the peaceful exploration and use of outer space . . . may request consultation concerning the activity or experiment.

Where the 1967 Treaty provision contemplates consultation requests in cases of perceived harmful affects of *any* activities, the newer version contemplates consultation between the "States Par-

[17]Northcutt Ely, "Mining Rights in the Deep Seabed," a paper presented to the American Mining Congress, Oct. 1, 1975.

ties concerned," such consultations being required where such interference may occur. One critic of the draft agreement, in a letter to Defense Secretary Harold Brown, raised the prospect that:

> . . . international authority created under the Celestial Bodies Agreement [author's titling] would [as its principal function] . . . allocate among States the exclusive right to develop the resources of specific areas of our solar system. Presumably, the future space authority will have the power to inquire into any use of territory on a celestial body which may interfere with its own right to grant exclusive rights to the same parcel for resource development. In this regard, we call attention to the combined impact on our future national security interest of provisions in the Celestial Bodies Agreement which extend the coverage of the agreement to "all activities" on celestial bodies; . . . and establish an elaborate system of compulsory conciliation and mediation whenever any State Party claims the activities of another interfere with its exercise of rights.[18]

Leaving the assumption about the future and other issues raised in the foregoing argument aside, the point examined here is whether the text of article 8, taken in conjunction with article 15 does, in fact, "establish an elaborate system of compulsory conciliation and mediation." To the extent that article 8 requires States to engage in consultation, whenever requested to do so, consultation is also provided for in the text of article IX of the 1967 Treaty, which the United States and more than 100 other countries have signed or acceded to, and which more than 55 have ratified. But consultation under the 1967 Outer Space Treaty is only available in cases of "harmful interference," and a state might refuse to consult on grounds that the "harmful" test had not been met. This agreement, therefore, does not "establish" the consultation mechanism, but it does extend it. Article 15 provides the right of any state party to refer a disagreement to the Secretary-General of the United Nations for "assistance." The terms "compulsory conciliation and mediation" do not appear in the agreement.

Article 9 establishes additional notification requirements, and it does constrain states parties by requiring that entities use only that area that is required for a station that is set up on a celestial body. This provision could become a basic tenet of the resources regime to the effect that the size of areas subjected to extraction operations would be limited to that area which an operator can diligently work. This would not permit, for example, staking a claim to an area of known and valuable resources, unless they could be rapidly extracted.

The right of access to and use of an area by one state party under this article does not constitute authority to exclude other states parties from the same area. There may, under some interpretations, be a fundamental conflict of principle between article 9 (2), and article 8 (3), discussed above. This article does establish additional notification requirements, further elaborating article XI of the 1967 Treaty, but they do not appear to constrain states parties' activities in any important way.

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[18]Letter from Leigh S. Ratiner, on behalf of the L-5 Society, to Secretary of Defense Harold Brown, dated Nov. 6, 1979; the letter was also copied to General David C. Jones, U.S. Air Force, Chairman, Joint Chiefs of Staff.

Article 9

1. States Parties may establish manned and unmanned stations on the moon. A State Party establishing a station shall use only that area which is required for the needs of the station and shall immediately inform the Secretary-General of the United Nations of the location and purposes of that station. Subsequently, at annual intervals that State shall likewise inform the Secretary-General whether the station continues in use and whether its purposes have changed.

2. Stations shall be installed in such a manner that they do not impede the free access to all areas of the moon of personnel, vehicles and equipment of other States Parties conducting activities on the moon in accordance with the provisions of this Agreement or of article I of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.

Article 9 essentially requires states establishing a station on the Moon to use only the area required for the station and to notify the Secretary-General immediately and annually as to the location, purpose, and status of the station. Paragraph (2) makes clear that stations are not to impede free access to all areas of the Moon by personnel, vehicles, and equipment of other states parties. This language might be construed to directly and expressly contradict a unilateral attempt by a resource exploiter to claim "exclusive areas" or areas of "exclusive control for exploitation," which could be an indispensable prerequisite to a workable system of resources recovery. This provision would clearly require elaboration in any future regime. The freedom of access and action for peaceful and scientific purposes declared in the 1967 Treaty, article I, also is reflected in this article.

In *article 11* there is a commitment to undertake to establish an international regime, including appropriate procedures, to govern the exploitation of resources. To the extent that constraints are found in article 11, they must, for the most part, be read into the text or be justified by assumptions about the future. There is no language in article 11, or any other article of the agreement, that expressly imposes a moratorium on exploitation. There is explicit reference to article 6 (2), wherein the agreement provides that states parties may use minerals and other substances in support of scientific investigative missions. There is debate over whether or not "use" includes "exploitation."

Article 11

1. The moon and its natural resources are the common heritage of mankind, which finds its expression in the provisions of this Agreement and in particular in paragraph 5 of this article.

2. The moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by any other means.

3. Neither the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become property of any State, international intergovernmental or non-governmental organization, national organization or non-governmental entity or of any natural person. The placement of personnel, space vehicles, equipment facilities, stations and installations on or below the surface of the moon, including structures connected with their surface or subsurface, shall not create a right of ownership over the surface or the subsurface of the moon or any areas thereof. The foregoing provisions are without prejudice to the international regime referred to in paragraph 5 of this article.

4. States Parties have the right to exploration and use of the moon without discrimination of any kind on a basis of equality, and in accordance with international law and the terms of this Agreement.

This article includes eight numbered paragraphs, numbers 5 through 8 are presented and discussed below. The article is divided into parts to facilitate review and discussion.

Article 11 is the principal focus of the critics of this agreement. *Paragraph (1)* formally introduces into the language of space law the phrase "common heritage of mankind." This phrase was first proposed in formal documentation reflecting the aspirations of Third World countries, when it was incorporated in a 1970 U.N. General Assembly declaration of principles relating to the natural resources of the deep seabed, in the context of a proposed Conference on the Law of the Sea. That Conference has been in intermittent sessions since 1973 and has yet to conclude a formally adopted text on the law of the sea. However, following the introduction of the concept of "the common heritage of mankind" into the law of the sea discussions, it was incorporated into proposals for the terminology of the draft Moon Treaty.[19]

Although the 1967 Outer Space Treaty speaks of the exploration and use of outer space, including the Moon and other celestial bodies as "the province of all mankind" (article I), and declares that "outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means," some critics of the Moon Treaty contend that, in the absence of clarification, acceptance of the description of the Moon, other celestial bodies, and their resources as "the common heritage of mankind" would be a mistake for the United States.

Arguing that there is substantial risk that the United States will be strongly pressed to accept as precedent the law of the sea, and to extend the emerging regime for resources management in the ocean context to the resources of the Moon and other celestial bodies, critics have urged Congress and the executive branch not to sign or ratify the Moon Treaty in its present form.

In the deep seabed context, it is argued, the international community has reached a consensus on what the common heritage principle means and that consensus definition—including, as developing countries believe it does, concepts of: 1) majoritarian decisionmaking, 2) central economic planning, 3) production controls, 4) technology transfer, and 5) the potential for monopolization of resources by a Third World controlled organization—is contrary to the basic economic interests of the United States.* Under this view, the common heritage regime being negotiated at the LOS Conference concedes to Third World arguments that "common heritage" means "common property" and, therefore, demands that each individual country have an equal voice in decisions about whether and how to dispose of the resources. As a result, these treaty opponents assert that the Third World and the Soviet bloc have unwarranted influence over decisions in the International Seabed Authority and the United States is com-

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[19]See statement of Ambassador Richard W. Petree, in the U.N. General Assembly Special Political Committee on Nov. 1, 1979, particularly that portion presented at p. 312 of this report.

*See, e.g., sources cited in footnote 20.

paratively disadvantaged. It is beyond the mandate of this study to assess whether the above view is an accurate interpretation of the common heritage concept in the deep seabed context and, if it is, what are the probabilities that developing country negotiators will adopt these same positions when they enter the conference called for to establish a regime to govern extraterrestrial resources exploitation.

If it is signed and ratified, it is argued, a new regime of control and decisionmaking will be constructed from this treaty, and the private enterprise of the United States will never, in those circumstances, risk the venture capital necessary to conduct development and exploitation of the resources of outer space. Several lengthy pieces and statements have been developed elaborating a scenario of socialistic, monopolistic control of space resources in the hands of the Soviet bloc and the Third World.[20]

A number of opponents of the treaty postulate that in the development of a regime to regulate space resources exploitation, the Third World and the U.S.S.R. will control decisions. This postulation ignores the historical facts that primarily and precisely because the Third World and the U.S.S.R. were at loggerheads on the terms of the treaty—the concept of a moratorium, use of the phrase "common heritage," and implications of ultimate control—it took 7 years to complete its negotiation. A separate study done for the Senate Committee on Commerce, Science, and Transportation illuminates that negotiating history.[21]

The concept of technologically competent states negotiating mutually beneficial arrangements with Third World countries is well established in the space arena. The nature of Intelsat, Inmarsat, Intersputnik, and other international organizations, in being and exploiting the use of space, should be taken into account. Lessons learned in negotiating those arrangements could, as a substantive matter, be more relevant than law in other areas, such as maritime matters. The probability that this significant body of law and treaties directly related to expanding activities in space will be rejected for other precedents, however, is not the subject of this study.

This review is intended to consider only the issue of the extent to which the actual language of the treaty constitutes constraints on the freedom of action of the United States and its citizens in space resources exploitation.

Article 11 (1) was worded in a manner explicitly to provide that the definition of the term "common heritage of mankind" should not be sought from or be dependent on external sources. The paragraph reads: "The moon and its natural resources are the common heritage of mankind, which finds its expression in the provisions of this Agreement and in particular in paragraph 5 of this article." Para-

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[20]See, e.g., "The Draft Moon Treaty—Special Report and Analysis," dated Oct. 25, 1979, an unattributed analysis circulated on letterhead stationary of the L-5 Society; R. Grant, "A Treaty to Give Away the Moon," The Washington Star, p. A-11, Dec. 10, 1979; and "Stranglehold on the Moon," an advertisement of United Technologies, in the Washington Post, p. A2, Feb. 14, 1980.

[21]See "Agreement Governing the Activities of States on the Moon and Other Celestial Bodies: History and Analysis," op. cit.

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graph 5 reads: "States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the moon as such exploitation is about to become feasible. This provision shall be implemented in accordance with article 18 of this Agreement."

Article 18

Ten years after the entry into force of this Agreement, the question of the review of the Agreement shall be included in the provisional agenda of the United Nations General Assembly in order to consider, in the light of past application of the Agreement, whether it requires revision. However, at any time after the Agreement has been in effect for five years, the Secretary-General of the United Nations, as depository, shall, at the request of one third of the States Parties to the Agreement and with the concurrence of the majority of the States Parties, convene a conference of the States Parties to review this Agreement. A review conference shall also consider the question of the implementation of the provisions of article 11, paragraph 5, on the basis of the principle referred to in paragraph 1 of that article and taking into account in particular any relevant technological developments.

Thus, on its face, the draft agreement intends to exclude consideration of external sources for definition, because the term "common heritage of mankind . . . finds its expression in the provisions of this Agreement and in particular in paragraph 5 . . . ."

In response to this interpretation, treaty opponents have made two arguments. First, they cite the negotiating history of the Moon Treaty to show that developing country representatives made clear their intent to interpret common heritage within the light of the deep seabed experience. On November 1, 1980, the Mexican Representative stated in the U.N. Special Political Committee that, "Regarding the treaty on the moon . . . this agreement provided that the resources of the moon were the resources of mankind, just like the 'historic decision' on the resources of the seabed." There are various other similar statements made by Third World delegates in the prior record of COPUOS.

Second, opponents interpret the reference in paragraph 1 to "the provisions of this Agreement" as incorporating the principles found in paragraph 7 within the meaning of "common heritage." Thus, "common heritage" definitely includes "orderly and safe development," "rational management," "expansion of opportunities in the use of resources," and "equitable sharing." Since these latter principles are identical to those found in article 150 of the ICNT, Rev. 2, and since they have repeatedly been interpreted by Third World spokesmen to include such concepts as production controls, it is argued that article 11 implicitly draws on the LOS precedent and nullifies the apparent limitation on the meaning of common heritage found in paragraph 1. While it is anticipated that developing countries will support such an interpretation, there is no need to concede the point without responsible argument.

Certain commentators have also argued that the common heritage principle in paragraph 1, together with the cross-reference to paragraph 5, contain the legal inference that exploitation of extraterrestrial resources is prohibited *until* the regime called for is established. The analysis turns on the interpretation of the phrase "establish"

and the phrase "as such exploitation is about to become feasible." (The latter phrase will be discussed below under paragraph 5.) This implied interpretation, however, is inconsistent with the actual negotiating history which clearly records attempts to include language establishing a prohibition on exploitation until a governing regime is established. All such proposals were rejected and no such language survived. To imply such an intent flies in the face of the recorded actions and decisions of the negotiators.

It is clearly stated that states parties "undertake to establish an international regime, including appropriate procedures, to govern the exploitation . . . ." This language does not expressly refer to an obligation to negotiate *and conclude* a future treaty establishing an international legal regime and a new international organization, but some have argued that the reasonable meaning of the term "establish" in this context includes "conclusion" of an agreement and entry into force of a new regime. Assumedly each state reserves to itself the decision as to whether or not it will accept the ultimately negotiated regime.

The commitment in the Moon Treaty is to "undertake to establish an international regime, including appropriate procedures . . . ." There is no express reference of any kind to a "new international organization," although a number of commentators have asserted that "appropriate procedures" is a diplomatic code word for international machinery. To the extent that constraints are found in article 11 (1), they must be read into the text, through other paragraphs by implication, or be justified by assumptions about the future.

Paragraph (2) provides that "the moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by any other means." Other than the opening phrase, this article is a verbatim repetition of the language of the 1967 Outer Space Treaty, article II, which reads: "Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means." Consequently, this paragraph adds not a whit to extant law among parties to the 1967 Outer Space Treaty.

Paragraph (3) is the clearest source of language in the agreement on which one can base a judgment about the kinds of entities that were anticipated by the drafters to be likely actors on the Moon or on other celestial bodies. The list includes: states, international intergovernmental or nongovernmental organizations, national organizations, or nongovernmental entities and natural persons, all of which are explicitly referred to. They are referred to in a sentence which declares that "Neither the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become property" of the indicated categories of entities or persons. In providing explicitly for nonownership of materials "in place," this sentence is a logical extension of paragraph (2) of the same article and article II of the 1967 Treaty. But the corollary to that language is that once material is removed from its place, it becomes the property of the remover. The U.S. delegation explained this intention when it introduced this language and that explanation has not been contradicted.

Paragraph (3) explicitly states that no entity shall have property rights in the surface, subsurface, or natural resources in place. Under article 6, paragraph 2, resources may be used to the extent needed to support scientific missions (but arguably may not be used for commercial purposes). This theme of nonexclusive right to be there and to use resources on celestial bodies for scientific purposes is also contained in but modulated by the second sentence of article 11 (3), which makes clear that placement of personnel, vehicles, stations, or installations does not create a right of ownership.

The concluding sentence of article 11 (3) is potentially a source of problems. It states that "The foregoing provisions are without prejudice to the international regime referred to in paragraph 5 of this article." The nonexclusive right to use and the nonownership provisions could be changed in the process of the formulation of the legal regime. The matter is negotiable; it is not settled. If, as some claim, paragraph 5 implies a moratorium on exploitation, then that implication would be incorporated into the last sentence of paragraph 3. In fact, the matter does not need to be concluded now. Whatever is provided now is "without prejudice to the international regime," i.e., the regime to be eventually concluded under one interpretation. If the interpretation supporting an implied present moratorium is accepted, the point is moot. No exploitation can go forward.

Paragraph (4) reads, "States Parties have the right to exploration and use of the moon without discrimination of any kind on a basis of equality, and in accordance with international law and the terms of this agreement." Critics argue that this provision does not recognize the right to "exploit" resources because that concept is not included in the definition of "use," although many dictionaries describe the terms as synonyms. The term "exploitation" does appear in the treaty, but only in the context of the future regime referred to in paragraphs 5, 7, and 8. Critics assert that standard rules of treaty interpretation foreclose an interpretation that includes "exploitation" within the meaning of "use."

There appears to be no negotiating history to confirm or deny the interpretation given to this language by critics of the treaty.

In the precise language of article 11, paragraphs 1 through 4, constraints alleged by critics are not in the text of the agreement itself. When read with other provisions, it is possible to infer from these paragraphs some conceivable restrictions on freedom of U.S. actions. The argument that these provisions do impose constraints rests heavily on predictions about the reasonably foreseeable regime expected to grow out of this agreement. The study does not undertake to examine the content of such a regime nor any assumptions that decisionmaking in the forum of the creation of the regime will be contrary to the interests and views of developed countries of the non-Communist world. As noted earlier, there is a body of negotiating history in several other contexts, all involving space, which are essentially consistent with the earlier space treaties and which evidence clear accommodation of many nations' interests and the compromise of various nations' objectives. Whether that experience will be sig-

nificant in shaping the future regime is beyond our capacity to foresee.

Continuing the text of Article 11:

5. States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the moon as such exploitation is about to become feasible. This provision shall be implemented in accordance with article 18 of this Agreement.

6. In order to facilitate the establishment of the international regime referred to in paragraph 5 of this article, States Parties shall inform the Secretary-General of the United Nations as well as the public and the international scientific community to the greatest extent feasible and practicable of any natural resources they may discover on the moon.

7. The main purposes of the international regime to be established shall include:

(a) The orderly and safe development of the natural resources of the moon;

(b) The rational management of those resources;

(c) The expansion of opportunities in the use of those resources;

(d) An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the moon shall be given special consideration.

8. All the activities with respect to the natural resources of the moon shall be carried out in a manner compatible with the purposes specified in paragraph 7 of this article and the provisions of article VI, paragraph 2, of this Agreement.

Paragraph (5) has been examined in some aspects earlier. This paragraph should be understood to be the linchpin of the arguments supporting the notion of a moratorium. It is important to understand that the negotiators of the Moon Treaty had before them explicit proposals to be included calling for a moratorium on exploitation until coming into force of the regime. That language was not accepted and is not in the treaty. In addition, several major negotiating delegations entered statements on the record reflecting their countries' views that the treaty did not establish a moratorium.

Those who claim paragraph 5 can be read to create an implicit moratorium on exploitation note that no provision of the Moon Treaty explicitly recognizes the present right of states to engage in exploitation. Thus, the compromise language found in article 11 is, they argue, sufficiently ambiguous to permit both interpretations. Also, they point to the statement of the Indonesian Representative in the U.N. Special Political Committee, quoted above at p. 321, as evidence that the legislative history of the provision is also subject to both interpretations.

Given that the preparation of a regime to govern exploitation of resources is to be undertaken "as such exploitation is about to become feasible," one can conclude that there is no implication and certainly no assurance that exploitation cannot proceed. This reading is supported by that fact that explicit proposals were made to include language establishing a moratorium and that language was rejected. Another reading of this same phrase, however, is that the regime must be established simultaneously with, or just before, exploitation becomes feasible. When combined with a definition of "establish" as covering the actual entry into force of a regime rather than the commencement of negotiations about the regime (see discussion above), this latter reading suggests an implicit ban on exploitation prior to such entry into force.

Paragraph (6) requires that states parties inform the U.N. Secretary General as well as the public and the international scientific community, to the greatest extent feasible and practical of any natural resources they may discover on the Moon. This paragraph reflects established and practiced U.S. policy. It imposes on states parties the obligation of publishing discoveries. In a recent NASA *Lunar Materials Handbook*[22] the compiled record of more than 10 years of analysis of lunar materials was published. In addition, articles in scientific and academic journals by scientists in many countries have reported on results of detailed studies. Through cooperative programs with NASA, scientists in more than 20 countries have been provided lunar sample materials for study, with the proviso that results of the analysis would be published in order to add to the world's knowledge about the Moon and its resources. Nevertheless, some commentators have suggested that this disclosure obligation might be inconsistent with a system of incentives for private enterprise exploration of space resources based on the proprietary value of discovery rights.

In *paragraph (7)* the main purposes of the proposed regime are highlighted as including:

> (a) The orderly and safe development of the natural resources of the moon;
> (b) The rational management of those resources;
> (c) The expansion of opportunities in the use of those resources; [and]
> (d) An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the moon shall be given special consideration.

It has been pointed out that these stated purposes are so vague as to make them fertile ground for the imposition of Third World controls, limitations, extractions of taxation, demands for technology transfer, and special rights or privileges because they are developing countries. As noted earlier, treaty opponents also point to the identity of certain phrases in paragraph 7 and principles contained in article 150 of the ICNT Rev. 2, and some countries' statements about the meaning of these phrases in order to support the perceived negative impacts. Interestingly, some critics are selective in commenting on paragraph 7(d), because they describe that paragraph as establishing a right of discrimination in favor of developing countries to the disadvantage of other countries. This argument appears to ignore the language which reads "*. . . the efforts of those countries which have contributed either directly* or indirectly *to the exploration of the moon shall be given special consideration.*" One reason may be that these critics do not believe that the express preference for exploring countries will be given the same weight as the several implied preferences for developing countries in this paragraph. However, such an assumption should be articulated. Paragraph 7 does not give special recognition to the interests of states which have engaged in *exploitation.* Additionally, the critics ignore the purport of the opening phrase—i.e., there shall be an *equitable* sharing, possibly because the term "equitable" is, itself, open to negotiation and there is no desire to depend on a future negotiation.

[22] *Handbook of Lunar Materials,* (Wash. D.C.: Scientific and Technical Information Office, NASA Headquarters, February 1980), NASA reference publication 1057.

Paragraph (8) requires that activities on the Moon be compatible with paragraph 7 and with article 6, paragraph 2 of the agreement. One reading of the text is that it makes clear that exploitation is contemplated to take place, and that it may precede the existence of the regime, because it says "All the activities with respect to the natural resources of the moon shall be carried out in a manner compatible with the purposes specified in paragraph 7 of this article and the provisions of Article 6, paragraph 2, of the Agreement." It can be argued that this statement would have been entirely superfluous if it had been expected that there could be no exploitation until there were a regime. However, another reading is that this paragraph preseves the moratorium implied through paragraph 5 by cross-referencing paragraph 7 (which includes a reference to the "international regime") and, more importantly, that it preserves the moratorium on commercial exploitation inferred from paragraph 2 of article 6 by expressly referring to that provision. Under this view, the paragraph is not superfluous because, rather than referring to "exploitation" only, as is done in paragraph 5 and indirectly in paragraph 7, paragraph 8 covers "All the activities with respect to the natural resources."

In any event, under both interpretations, paragraph 8 subjects resource exploration to a requirement that it "be carried out in a manner compatible with [paragraph 7's] purposes." It is, of course, not possible to predict exactly how the vague purposes will constrain U.S. activities in connection with resource exploration, but it is clearly reasonable to characterize this provision as a possible "constraint."

Considered in its entirety, article 11 does not establish explicit constraints on states parties to the agreement other than the ambiguous obligations under paragraphs 5 and 8. The article also can be read, and has been read by some, to impose implied restrictions on the freedom of action of the United States under paragraphs 1, 5, and 8. Clearly it contemplates a future in which constraints could be forthcoming. It does raise questions of rights of ownership of materials or natural resources removed and reduced to use. This article does not forbid use, although there are differing opinions about "use" including "exploitation." It does authorize use in paragraph (4); use shall be without discrimination of any kind and on a basis of equality. In due course, when it appears that exploitation is about to become feasible, a regime to govern exploitation is to be established. The commencement of that effort is tied to the feasibility of exploitation, and the termination is, under one interpretation, indefinite, and under another interpretation must necessarily precede exploitation. There is no interpretation of article 11, or any other article of this agreement, that expressly requires a moratorium on exploitation. Arguments supporting a moratorium find it implicitly in the treaty. There is explicit reference to article 6 (2) wherein the agreement provides that states may use mineral and other substances in support of scientific investigative missions.

On its face, *article 14* does not contain constraints on the states parties but it does contemplate future lawmaking activity which may be shown by experience to be necessary.

Article 14

1. States Parties to this Agreement shall bear international responsibility for national activities on the moon whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Agreement. States Parties shall ensure that non-governmental entities under their jurisdiction shall engage in activities on the moon only under the authority and continuing supervision of the appropriate State Party.

2. States Parties recognize that detailed arrangements concerning liability for damage caused on the moon, in addition to the provisions of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies and the Convention on International Liability for Damage Caused by Space Objects, may become necessary as a result of more extensive activities on the moon. Any such arrangements shall be elaborated in accordance with the procedure provided for in article 18 of this Agreement.

This article is also an elaboration of provisions contained in the 1967 Treaty and the Liability Convention. There is no new law in this article, but there is recognition that some new or additional provisions may prove necessary in light of experience on the Moon. The procedures outlined in article 18 provide a basic mechanism by use of which new provisions could be formulated. In its present form this article contains no constraints on states parties.

Article 15 provides that operating facilities in space are subject to visits, after advance notice and consultation. The purpose of the visitation provision (originally contained in article XII of the 1967 Outer Space Treaty) is to provide a means of verification that the arms control provisions in article 3 of this treaty are being complied with and to permit verification of compliance with other provisions of this treaty. This article also provides and describes mechanisms for conflict resolution.

Article 15

1. Each State Party may assure itself that the activities of other States Parties in the exploration and use of the moon are compatible with the provisions of this Agreement. To this end, all space vehicles, equipment, facilities, stations and installations on the moon shall be open to other States Parties. Such States Parties shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited. In pursuance of this article, any State Party may act on its own behalf or with the full or partial assistance of any other State Party or through appropriate international procedures within the framework of the United Nations and in accordance with the Charter.

2. A State Party which has reason to believe that another State Party is not fulfilling the obligations incumbent upon it pursuant to this Agreement or that another State Party is interfering with the rights which the former State has under this Agreement may request consultations with that Party. A State Party receiving such a request shall enter into such consultations without delay. Any other State Party which requests to do so shall be entitled to take part in the consultations. Each State Party participating in such consultations shall seek a mutually acceptable resolution of any controversy and shall bear in mind the rights and interests of all States Parties. The Secretary-General of the United Nations shall be informed of the results of the consultations and transmit the information received to all States Parties concerned.

3. If the consultations do not lead to a mutually acceptable settlement which has due regard for the rights and interests of all the States Parties, the parties concerned

shall take all measures to settle the dispute by other peaceful means of their choice and appropriate to the circumstances and the nature of the dispute. If difficulties arise in connection with the opening of consultations or if consultations do not lead to a mutually acceptable settlement, any State Party may seek the assistance of the Secretary-General without seeking the consent of any other State Party concerned, in order to resolve the controversy. A State Party which does not maintain diplomatic relations with another State Party concerned shall participate in such consultations, at its choice, either itself or through another State Party or the Secretary-General, as intermediary.

Paragraph 1 authorizes visits by one state to the facilities of another state after "reasonable advance notice" and the holding of "appropriate consultations." To the extent that visitation rights exist for one state, they exist for all states parties. However, while article XII of the 1967 Treaty makes the visitation right elaborated in paragraph 1, expressly a reciprocal right, it is possible to read article 15, paragraph 1 of the Moon Treaty as not permitting a state to refuse visitation to another state which it claims is not providing reciprocal rights. The reciprocal right (between signatories, not *any* State) to visit, after advance notice and consultation, is not clearly defined, but it is not a right to search. Some commentators have described it as a right to search, but they cite no support for this broad interpretation.

Where one state believes or has reason to believe that another state is not fulfilling obligations under this agreement, or that the other state is interfering with its rights, the first state may request consultations. The state receiving the request is required to enter into consultation without delay. Results of the consultation are to be reported to the U.N. Secretary-General who will notify all states parties concerned.

Contemplating that the consultations may not in all cases prove successful or satisfactory, states parties are urged to resolve differences by peaceful means of their choice. Any state may seek assistance of the Secretary-General in order to resolve a controversy. States without diplomatic relations may achieve resolution of differences through intermediary parties. This does not necessarily constitute a mechanism of a mandatory or binding nature; it could be seen as a codification of the normal practices of states in consultation to resolve differences.

Article 18 provides mechanisms for review of the agreement. Although it does not contain present constraints on the rights or actions of states, it does contemplate future conferences or meetings from which constraints could emerge.

Article 18

Ten years after the entry into force of this Agreement, the question of the review of the Agreement shall be included in the provisional agenda of the United Nations General Assembly in order to consider, in the light of past application of the Agreement, whether it requires revision. However, at any time after the agreement has been in effect for five years, the Secretary-General of the United Nations, as depository, shall, at the request of one third of the States Parties to the Agreement and with the concurrence of the majority of the States Parties, convene a conference of the States Parties to review this Agreement. A review conference shall also consider the question of the implementation of the provisions of article 11, paragraph 5, on the basis of the principle referred to in paragraph 1 of that article and taking into account in particular any relevant technological developments.

Contemplating that technological developments will occur, and that in due course, flight to and use of celestial bodies will occur, this article provides for a review conference to examine this agreement after 5 years, if requested by one-third of the states parties and agreed to by a majority; and in any case, the question of review of the agreement is to be placed on the agenda of the U.N. General Assembly 10 years after the entry into force of the agreement.

One of the important questions having to do with a future review conference will be "What provision is made in the rules of procedure for conference decisionmaking?" If the conference is to take decisions by majority vote, some very different outcomes may occur. In the forums of the U.N. Committee on the Peaceful Uses of Outer Space and its subcommittees, decisions are reached by consensus procedures. These same concensus procedures are currently in practice in UNCLOS III.

Consensus has made possible the negotiation of the five major U.N.-developed treaties on outer space. Accommodation and compromise of many conflicting interests have resulted from use of the consensus procedure. If the review conference goes to a voting procedure using simple or larger majority voting, it is possible that final actions by such a conference will not enjoy as wide an acceptance by states as the earlier agreements have had. In any case, no state is obliged to become a party to the results or final acts of any future conference. Staying outside of a future regime, of course, would create important legal and political uncertainties.

Article 19

1. This Agreement shall be open for signature by all states at United Nations Headquarters in New York.

2. This Agreement shall be subject to ratification by signatory States. Any State which does not sign this Agreement before its entry into force in accordance with paragraph 3 of this article may accede to it at any time. Instruments of ratification or accession shall be deposited with the Secretary-General of the United Nations.

3. This Agreement shall enter into force on the thirtieth day following the date of deposit of the fifth instrument of ratification.

4. For each state depositing its instrument of ratification or accession after the entry into force of this Agreement, it shall enter into force on the thirtieth day following the day of deposit of any such instrument.

5. The Secretary-General promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification or accession to this Agreement, the date of its entry into force and other notices.

This standard article on signature, accession, and deposit does not establish constraints upon states. Some opponents have raised the issue that it provides for entry into force of the agreement after ratification by only five countries. Its entry into force is, of course, with reference to the rights and obligations of the signatory states only. Unless or until it is signed by a very large majority of states, it would not become evidence of a source of the international community's expectations and views and thereby a source of moral constraint on other, nonsignatory states. Critics urge that the United States should not sign or ratify in order not to be bound. In the nonsignatory posture, the United States would forgo the rights of a signatory while ultimately possibly being subjected to the limitations. Some opponents apparently still favor the nonsignatory posture, believing

that in not signing the United States does not forgo any significant rights, but in signing it accepts undesirable actual and potential constraints.

Article 20

Any State Party to this Agreement may give notice of its withdrawal from the Agreement one year after its entry into force by written notification to the Secretary-General of the United Nations. Such withdrawal shall take effect one year from the date of receipt of this notification.

It does not appear that critics ever mention that article 20 provides for withdrawal of states parties from this agreement upon 1 year's notice. If, after signature, the United States were to find that unacceptable, inimical developments occurred under this treaty, the United States could, theoretically, at any time after 1 year of the treaty's existence, withdraw voluntarily from the agreement. Critics would undoubtedly reply that for a host of political and foreign policy reasons, it is highly unlikely that the United States would ever exercise this option. The feasibility of withdrawal under some future circumstances should be no more unthinkable than withdrawal from the International Labor Organization.

Not only does this article not provide constraints upon states parties, it provides ultimately for the release from constraints which may, in the future, prove to be unacceptable to the United States. Factors which might influence the United States to consider withdrawal are not within the scope of this study.

This completes the article-by-article review. The following section presents a brief recapitulation of the principal findings with reference to constraints upon the freedom of exploitation by states parties to this agreement.

Summary of Constraints

The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (full text at annex A), opened for signature on December 18, 1979, is, in substantial part, a reiteration and elaboration of earlier treaties drawing primarily on the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies of 1967.[23]

The new agreement restates and extends some constraints on the freedom of states to use the Moon and other celestial bodies; under some interpretations, it creates implied constraints on resource exploitation; and, in providing for the future creation of a regime to govern the exploitation of resources, the agreement creates at least the possibility of additional constraints being established at a future time.

In the *Preamble* to the Agreement, other than language directed at prevention of conflict, that is reflected in certain constraints on military activities noted below, the language indicates a clear intent of signatories to promote on the basis of equality the further development of cooperation among states in the exploration and use of the Moon and other celestial bodies.

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[23] "Space Law: Selected Basic Documents," op. cit.

Like the 1967 Outer Space Treaty, article 3 limits the use of the Moon and other celestial bodies to "exclusively" peaceful purposes, and forbids the placement and use of nuclear weapons and weapons of mass destruction, conduct of weapons tests, military bases, installations, fortifications, and maneuvers on a celestial body.

Article 6 can be read to contain an inference that while states may use extraterrestrial resources for scientific missions, they should not do so for commercial purposes.

Article 7 establishes requirements of advance notification for certain classes of action. Depending on the nature of "measures being adopted" or the nature of and purposes of radioactive materials to be placed on a celestial body, international opposition, constituting constraints, could certainly arise. Both measures to control contamination and back-contamination, and uses of radioactive materials could be involved in exploitation activities. To the extent that article 7 establishes a basis for review and challenge of state activities, it is a source of potential, if not actual constraint. It also contemplates, in paragraph 3, the creation of scientific preserves, the implications of which are not elaborated or addressed.

In *article 8,* one reading of the third paragraph is that it establishes a rule of right of priority in time, and could create a constraint of preemption of choice locations for exploitation of resources.

Article 9 establishes notification requirements beyond those in the 1967 Outer Space Treaty. It does not appear to impose significant constraints on states parties beyond requiring that entities use only that area that is required for a station that is set up on a celestial body.

In *article 11* there is a commitment to "undertake to establish" an international regime, including appropriate procedures to govern the exploitation of resources. There is disagreement over whether or not this language obligates a state to "conclude" a new treaty. There is also dispute over whether or not reference to "appropriate procedures" is a reference to a "new international organization." To the extent that constraints are found in article 11, they appear in the above described commitments and in a provision requiring current activities related to resources to be compatible with provisions considered by some to be vague and ambiguous, open to various interpretations. Additional implied constraints must be read into the text based on parallelisms with other documents, especially those in the LOS negotiations, or be justified by assumptions about the likely future behavior of states. There is no explicit language in the treaty that imposes a moratorium on exploitation. There is an argument of implied moratorium. There is explicit reference to article 6 (2), wherein the agreement provides that states parties may use minerals and other substances in support of scientific investigative missions.

On its face, *article 14* does not contain present constraints on the states parties but it does contemplate future lawmaking activity which may be shown by experience to be necessary.

In *article 15,* to the extent states operating facilities in space find subjection to visits after advance notice and consultation to be a con-

straint, this article contains that constraint. It also provides and describes mechanisms for conflict resolution.

Article 18 provides mechanisms for review of the agreement. Although it does not contain constraints on the rights or actions of states, it does contemplate future conferences or meetings from which constraints could emerge.

There are no discernable constraints, apparent or implied, in articles 1, 2, 4, 5, 10, 12, 13, 16, 17, or 19 through 21.

6. CURRENT AND POSSIBLE CONGRESSIONAL ACTIONS

There are several activities in progress and other possible congressional actions concerning the Moon Treaty, some in the near future and some available in the longer term future, which are not all mutually exclusive. It is clear that there is no compelling need for the U.S. Government to act on the Moon Treaty now or in the near future. The treaty has been opened for signature and will remain open for signature or accession indefinitely. Consequently, there is as much time available to consider the treaty and its implications 1) as the administration may desire before reaching a decision on signature, and 2) as Congress may require before providing Senate advice and consent to ratification, if it is signed.

There is a potential but unquantifiable impact on the U.S. Delegation's credibility in any future space-related negotiations, if the U.S. Government should postpone action indefinitely, i.e., for a period of longer than 2 or 3 years. The United States proposed substantial parts of the language in the treaty and functioned as an active negotiator in its development. Foreign governments may expect the early signatories of this treaty to include the United States, and may question its good faith if it ultimately declines to sign. That situation is obviously not unique to this case and there have been other international agreements negotiated but not signed, or even signed but not ratified.

Current Activities in Progress

Congress has commenced certain actions on the Moon Treaty including:

- developing an institutional position while certain members oppose administration signature of the treaty; and
- convening hearings to establish a clear, reliable, official, and comprehensive record concerning the treaty.

Possible Near Future Actions

As of this writing, actions available to Congress in the near-term future include:

- soliciting submission to Congress of the report of the interagency task force in the executive branch currently reviewing the treaty and its implications, and
- planning and convening a congressionally hosted panel series or review conference on the treaty, if deemed necessary to supplement currently planned hearings.

Oversight committees in both houses can continue their posture of opposition to signature of the treaty by the administration, in order

to avoid its ever being presented for advice and consent to ratification. If this course is followed exclusively, a full, clear, and accurate congressional record on this treaty may never be established.

Another action already exercised in both houses is the convening of oversight hearings to establish a record of responsible and informed commentary on the Moon Treaty and its implications. In routine oversight hearing held by the House Subcommittee on Space Science and Applications in September 1979, the first congressional testimony on the Moon Treaty was heard. In July 1980, the Senate Committee on Commerce, Science, and Transportation plans hearings on the treaty. Such hearings could begin with a presentation by the State Department, on behalf of the administration, of a review of the negotiating history and submission of a factually accurate description of how the treaty was developed. This would be desirable, because there is a substantial body of misstatement, misunderstanding, and even distortion of facts in articles and commentary concerning this treaty on both sides of the issues. Any agency of the Government that has contributed to, or that is likely to be affected by the treaty could also be invited to testify, including, for example, the National Aeronautics and Space Administration, the Department of Energy, the Department of Defense, the Department of the Interior (Bureau of Mines), and any other potentially affected agency.

There is an articulated body of opinion about the cross-relationships between the law of the sea negotiations and the Moon Treaty. A potentially concluding session of the Third U.N. Conference on Law of the Sea (UNCLOS III) convenes in Geneva in July 1980. A clear and accurate report on the preparation for, conduct of, and results of that resumed ninth session of the Conference could be obtained from responsible U.S. Government representatives and involved industry officials. Aerospace, mining, academic, or research institution spokesmen and representatives of public interest groups could also be heard at such hearings to help complete the record.

The administration has in process at this writing an interagency review of the Moon Treaty and its implications. Congressional leaders may wish to seek access to the final interagency review documents as soon as the review is concluded and a report is rendered. Given the foreign policy and long-term industrial interests in this matter, possibly including sensitive, classified, or proprietary information, the interagency report may be a classified document and may not be available for general publication.

Another available choice is a congressionally organized and hosted panel series or review conference of several days duration, with a printed record. Although this is a national election year and many members may be away from Washington for parts of the summer and fall, it is possible that the Congressional Research Service, or OTA, or a combined effort of these legislative agencies could plan, coordinate, and convene such a meeting to be held in congressional facilities. With proper planning and coordination, interested members of both houses should be able to preside and/or participate.

Possible Long-Term Actions

Longer term actions available to Congress include:

- withdrawing the informal advice against signature and preparing for treaty hearings for purposes of providing advice and consent to ratification;
- developing appropriate reservations, understandings, or declarations to be incorporated in any eventual instrument of ratification submitted by the United States;
- considering what, if any, legislation may be appropriate to meet U.S. industrial needs concerning possible future exploitation of extraterrestrial resources;
- studying the possibility of the State Department taking an initiative to place before the U.N. Outer Space Committee a proposal to develop an early protocol to the Moon Treaty on matters of definition of terms and clarification of vagueries and ambiguities in the text; or
- maintaining a firm position in opposition to signature by the administration, based on a clear record that the Moon Treaty is unacceptable to the people and the Government of the United States.

At its council meeting in April 1980, the International Law Section of the American Bar Association (ABA) adopted a resolution recommending signature and ratification of the Moon Treaty by the U.S. Government, with a series of proposed declarations to be included in the U.S. Government instrument of ratification. The Natural Resources Law Section of the ABA has adopted a resolution recommending that the United States not sign or ratify the Moon Treaty. Both resolutions will be submitted to the ABA's House of Delegates meeting for action in September 1980. Formal submission of any ABA resolution to Congress must await action by the House of Delegates.

To understand the implications and utility of the possible use of reservations, understandings, or declarations contained in a formal instrument of ratification, it is necessary to review briefly some aspects of relevant law and practice.

A treaty is negotiated, usually under authority of the Secretary of State, who holds such authority delegated by the President. When the text has been agreed between the parties it is accepted in some symbolic way, i.e., by initialing the text, or signing the text, or voting for a resolution of a conference confirming it to be a "true text" or "Final Acts" of the conference. A treaty generally provides for a formal date of "opening for signature," and on or after the designated date, officials for "signatory" states sign the treaty. In the United States, the signed treaty is then submitted to the Senate for advice and consent to ratification. If advice and consent are given by action of the Senate, the President, through the Secretary of State, arranges for deposit with the depository government of the "instrument of ratification." With the deposit of that instrument and formal proclamation of the treaty by the President, the treaty becomes part of the law of the land.

Under provisions of the Vienna Convention on the Law of Treaties (a convention that currently reflects the broadly accepted international law of treaties) there are provisions which allow states to include reservations, understandings, or declarations as part of the instrument of ratification.

- A *reservation* makes a substantive change in a treaty obligation, and most commonly takes the form of a refusal to be bound by a particular article or provision.
- An *understanding* is an interpretation of an article or provision.
- A *declaration* is a statement of policy.

If any of these qualifications relate to the international application of the treaty, it is binding in international law as between the United States and the accepting or nonobjecting states, and is binding as well in U.S. law. If it relates not to the international application of the treaty but only to U.S. domestic law or procedure, then it is binding in U.S. law and is not relevant for international law purposes.

Under international law, a multilateral treaty, like the Moon Treaty, is, in effect, a set of bilateral treaty relationships. When reservations or declarations are included in the instrument of ratification, the following consequences would result.

The U.S. instrument of ratification, including the qualifications, would be sent to the depository (in this case the U.N. Secretary-General) who would circulate the instrument to all parties to the treaty. International treaty law gives each party 1 year in which to respond to any qualifications included in the instrument of ratification. (See article 20 of the Vienna Convention on the Law of Treaties.) Silence for a year is taken as acceptance of such qualifications.

If a party objects to the U.S. reservations or understandings or any of them, within a year, it might do so only for the record, in which case that party's Moon Treaty relationship with the United States would be established, with the U.S. reservations and understandings fully effective. A party might also object with the stated intention of preventing its treaty relationship with the United States from entering into force. There are no other alternatives. In the latter case, the United States and the objecting state will not have a treaty relationship with respect to the Moon Treaty. On the other hand, the United States and all state parties either accepting, or objecting only for the record, will have a treaty relationship, and the U.S. qualifications would govern.

In short, the United States cannot be compelled to accept a treaty obligation to which it has not agreed to be bound. The United States would of course have an identical right to respond to any qualifications attached by other state parties to their ratifications of the Treaty.

Although there is no history of subsequent protocols associated with previously adopted space treaties, there is precedent for the clarification or elaboration of international treaties by means of protocols added to them, either at the time of their negotiation or subsequently. If it were concluded, after study, that a protocol to the Moon Treaty would be helpful to clarify definitions of terms used therein, and to eliminate vagueries or ambiguities in the treaty as it exists, the

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United States could submit for consideration a protocol to the Moon Treaty containing appropriate proposals. It would appear to be desirable to pursue such definition and clarification in the U.N. Outer Space Committee and its subcommittees because of the consensus procedure that prevails in those bodies and because those bodies were the originators of the treaty.

In lieu of conclusions or findings from this study, taking into account the complexity and breadth of the political, economic, and institutional issues involved, OTA has tried to identify constraints on the United States, express or implied, contained in the Moon Treaty. The summary of that assessment is contained in "Summary of Constraints" in chapter 5. (See pp. 343-345.)

ANNEX A
TEXT OF THE MOON TREATY

Agreement Governing the Activities of States on the Moon and Other Celestial Bodies

The States Parties to this Agreement,

Noting the achievements of States in the exploration and use of the moon and other celestial bodies,

Recognizing that the moon, as a natural satellite of the earth, has an important role to play in the exploration of outer space,

Determined to promote on the basis of equality the further development of co-operation among States in the exploration and use of the moon and other celestial bodies,

Desiring to prevent the moon from becoming an area of international conflict,

Bearing in mind the benefits which may be derived from the exploitation of the natural resources of the moon and other celestial bodies,

Recalling the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies,[2] the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space,[3] the Convention on International Liability for Damage Caused by Space Objects,[4] and the Convention on Registration of Objects Launched into Outer Space,[5]

Taking into account the need to define and develop the provisions of these international instruments in relation to the moon and other celestial bodies, having regard to further progress in the exploration and use of outer space,

Have agreed on the following:

Article 1

1. The provisions of this Agreement relating to the moon shall also apply to other celestial bodies within the solar system, other than the earth, except in so far as specific legal norms enter into force with respect to any of these celestial bodies.

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[2]General Assembly resolution 2222 (XXI), annex.
[3]General Assembly resolution 2345 (XXII), annex.
[4]General Assembly resolution 2777 (XXVI), annex.
[5]General Assembly resolution 3235 (XXIX), annex.

2. For the purposes of this Agreement reference to the moon shall include orbits around or other trajectories to or around it.

3. This Agreement does not apply to extraterrestrial materials which reach the surface of the earth by natural means.

Article 2

All activities on the moon, including its exploration and use, shall be carried out in accordance with international law, in particular the Charter of the United Nations, and taking into account the Declaration on Principles of International Law concerning Friendly Relations and Co-operation among States in accordance with the Charter of the United Nations,[6] adopted by the General Assembly on 24 October 1970, in the interest of maintaining international peace and security and promoting international co-operation and mutual understanding, and with due regard to the corresponding interests of all other States Parties.

Article 3

1. The moon shall be used by all States Parties exclusively for peaceful purposes.

2. Any threat or use of force or any other hostile act or threat of hostile act on the moon is prohibited. It is likewise prohibited to use the moon in order to commit any such act or to engage in any such threat in relation to the earth, the moon, spacecraft, the personnel of spacecraft or man-made space objects.

3. States Parties shall not place in orbit around or other trajectory to or around the moon objects carrying nuclear weapons or any other kinds of weapons of mass destruction or place or use such weapons on or in the moon.

4. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on the moon shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration and use of the moon shall also not be prohibited.

Article 4

1. The exploration and use of the moon shall be the province of all mankind and shall be carried out for the benefit and in the

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[6]General Assembly resolution 2625 (XXV), annex.

interests of all countries, irrespective of their degree of economic or scientific development. Due regard shall be paid to the interests of present and future generations as well as to the need to promote higher standards of living and conditions of economic and social progress and development in accordance with the Charter of the United Nations.

2. States Parties shall be guided by the principle of co-operation and mutual assistance in all their activities concerning the exploration and use of the moon. International co-operation in pursuance of this Agreement should be as wide as possible and may take place on a multilateral basis, on a bilateral basis, or through international intergovernmental organizations.

Article 5

1. States Parties shall inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of their activities concerned with the exploration and use of the moon. Information on the time, purposes, locations, orbital parameters and duration shall be given in respect of each mission to the moon as soon as possible after launching, while information on the results of each mission, including scientific results, shall be furnished upon completion of the mission. In the case of a mission lasting more than 60 days, information on conduct of the mission, including any scientific results, shall be given periodically, at thirty-day intervals. For missions lasting more than six months, only significant additions to such information need be reported thereafter.

2. If a State Party becomes aware that another State Party plans to operate simultaneously in the same area of or in the same orbit around or trajectory to or around the moon, it shall promptly inform the other State of the timing of and plans for its own operations.

3. In carrying out activities under this agreement, States Parties shall promptly inform the Secretary-General, as well as the public and the international scientific community, of any phenomena they discover in outer space, including the moon, which could endanger human life or health, as well as of any indication of organic life.

Article 6

1. There shall be freedom of scientific investigation on the moon by all States Parties without discrimination of any kind, on the basis of equality and in accordance with international law.

2. In carrying out scientific investigations and in furtherance of the provisions of this Agreement, the States Parties shall have the right to collect on and remove from the moon samples of its mineral and other substances. Such samples shall remain at the disposal of those States Parties which caused them to be collected and may be used by them for scientific purposes. States Parties shall have regard to the

desirability of making a portion of such samples available to other interested States Parties and the international scientific community for scientific investigation. States Parties may in the course of scientific investigations also use mineral and other substances of the moon in quantities appropriate for the support of their missions.

3. States Parties agree on the desirability of exchanging scientific and other personnel on expeditions to or installations on the moon to the greatest extent feasible and practicable.

Article 7

1. In exploring and using the moon, States Parties shall take measures to prevent the disruption of the existing balance of its environment, whether by introducing adverse changes in that environment, by its harmful contamination through the introduction of extra-environmental matter or otherwise. States Parties shall also take measures to prevent harmfully affecting the environment of the earth through the introduction of extraterrestrial matter or otherwise.

2. States Parties shall inform the Secretary-General of the United Nations of the measures being adopted by them in accordance with paragraph 1 of this article and shall also, to the extent feasible, notify him in advance of all placements by them of radio-active materials on the moon and of the purposes of such placements.

3. States Parties shall report to other States Parties and to the Secretary-General concerning areas of the moon having special scientific interest in order that, without prejudice to the rights of other States Parties, consideration may be given to the designation of such areas as international scientific preserves for which special protective arrangements are to be agreed upon in consultation with the competent bodies of the United Nations.

Article 8

1. States Parties may pursue their activities in the exploration and use of the moon anywhere on or below its surface, subject to the provisions of this Agreement.

2. For these purposes States Parties may, in particular:

(a) Land their space objects on the moon and launch them from the moon;

(b) Place their personnel, space vehicles, equipment, facilities, stations and installations anywhere on or below the surface of the moon.

Personnel, space vehicles, equipment, facilities, stations and installations may move or be moved freely over or below the surface of the moon.

3. Activities of States Parties in accordance with paragraphs 1 and 2 of this article shall not interfere with the activities of other States Parties on the moon. Where such interference may occur, the States Parties concerned shall undertake consultations in accordance with article XV, paragraphs 2 and 3, of this Agreement.

Article 9

1. State Parties may establish manned and unmanned stations on the moon. A State Party establishing a station shall use only that area which is required for the needs of the station and shall immediately inform the Secretary-General of the United Nations of the location and purposes of that station. Subsequently, at annual intervals that State shall likewise inform the Secretary-General whether the station continues in use and whether it purposes have changed.

2. Stations shall be installed in such a manner that they do not impede the free access to all areas of the moon of personnel, vehicles and equipment of other States Parties conducting activities on the moon in accordance with the provisions of this Agreement or of article I of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.[2]

Article 10

1. States Parties shall adopt all practicable measures to safeguard the life and health of persons on the moon. For this purpose they shall regard any person on the moon as an astronaut within the meaning of article V of the Treaty on Principles Governing the Activities of States on the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies[2] and as part of the personnel of a spacecraft within the meaning of the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space.[3]

2. States Parties shall offer shelter in their stations, installations, vehicles and other facilities to persons in distress on the moon.

Article 11

1. The moon and its natural resources are the common heritage of mankind, which finds its expression in the provisions of this Agreement, in particular in paragraph 5 of this article.

2. The moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by any other means.

3. Neither the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become property of any State, international intergovernmental or non-governmental organization, national organization or non-governmental entity or of any natural person. The placement of personnel, space vehicles, equipment, facilities, stations and installations on or below the surface of the moon, including structures connected with its surface or subsurface, shall not create a right of ownership over the surface or the subsurface of the moon or any areas thereof. The foregoing provisions are without prejudice to the international regime referred to in paragraph 5 of this article.

4. States Parties have the right to exploration and use of the moon without discrimination of any kind, on the basis of equality and in accordance with international law and the provisions of this Agreement.

5. States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the moon as such exploitation is about to become feasible. This provision shall be implemented in accordance with article 18 of this Agreement.

6. In order to facilitate the establishment of the international regime referred to in paragraph 5 of this article, States Parties shall inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of any natural resources they may discover on the moon.

7. The main purposes of the international regime to be established shall include:

(a) The orderly and safe development of the natural resources of the moon;

(b) The rational management of those resources;

(c) The expansion of opportunities in the use of those resources;

(d) An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the moon, shall be given special consideration.

8. All the activities with respect to the natural resources of the moon shall be carried out in a manner compatible with the purposes specified in paragraph 7 of this article and the provisions of article 6, paragraph 2, of this Agreement.

Article 12

1. States Parties shall retain jurisdiction and control over their personnel, space vehicles, equipment, facilities, stations and installations on the moon. The ownership of space vehicles, equipment, facilities, stations and installations shall not be affected by their presence on the moon.

2. Vehicles, installations and equipment or their component parts found in places other than their intended location shall be dealt with in accordance with article V of the Agreement on Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space.[3]

3. In the event of an emergency involving a threat to human life, States Parties may use the equipment, vehicles, installations, facilities or supplies of other States Parties on the moon. Prompt notification of such use shall be made to the Secretary-General of the United Nations or the State Party concerned.

Article 13

A State Party which learns of the crash landing, forced landing or other unintended landing on the moon of a space object, or its component parts, that were not launched by it, shall promptly inform the launching State Party and the Secretary-General of the United Nations.

Article 14

1. States Parties to this Agreement shall bear international responsibility for national activities on the moon, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions of this Agreement. States Parties shall ensure that non-governmental entities under their jurisdiction shall engage in activities on the moon only under the authority and continuing supervision of the appropriate State Party.

2. States Parties recognize that detailed arrangements concerning liability for damage caused on the moon, in addition to the provisions of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies[2] and the Convention on International Liability for Damage Caused by Space Objects,[4] may become necessary as a result of more extensive activities on the moon. Any such arrangements shall be elaborated in accordance with the procedure provided for in article 18 of this Agreement.

Article 15

1. Each State Party may assure itself that the activities of other States Parties in the exploration and use of the moon are compatible with the provisions of this Agreement. To this end, all space vehicles, equipment, facilities, stations and installations on the moon shall be open to other States Parties. Such States Parties shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited. In pursuance of this article, any State Party may act on its own behalf or with the full or partial assistance of any other State Party or through appropriate international procedures within the framework of the United Nations and in accordance with the Charter.

2. A State Party which has reason to believe that another State Party is not fulfilling the obligations incumbent upon it pursuant to this Agreement or that another State Party is interfering with the rights which the former State has under this Agreement may request consultations with that State Party. A State Party receiving such a request shall enter into such consultations without delay. Any other State Party which requests to do so shall be entitled to take part in the consultations. Each State Party participating in such consultations shall seek a mutually acceptable resolution of any controversy and shall bear in mind the rights and interests of all States Parties. The Secretary-General of the United Nations shall be informed of the results of the consultations and transmit the information received to all States Parties concerned.

3. If the consultations do not lead to a mutually acceptable settlement which has due regard for the rights and interests of all States Parties, the parties concerned shall take all measures to settle the dispute by other peaceful means of their choice appropriate to the circumstances and the nature of the dispute. If difficulties arise in connexion with the opening of consultations or if consultations do not lead to a mutually acceptable settlement, any State Party may seek the assistance of the Secretary-General, without seeking the consent of any other State Party concerned, in order to resolve the controversy. A State Party which does not maintain diplomatic relations with another State Party concerned shall participate in such consultations, at its choice, either itself or through another State Party or the Secretary-General, as intermediary.

Article 16

With the exception of articles 17 to 21, references in this Agreement to States shall be deemed to apply to any international intergovernmental organization which conducts space activities if the organization declares its acceptance of the rights and obligations provided for in this Agreement and if a majority of the States members of the organization are States Parties to this Agreement and to the Treaty on Principles Governing the Activities of States in the

Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.[2] States members of any such organization which are States Parties to this Agreement shall take all appropriate steps to ensure that the organization makes a declaration in accordance with the provisions of this article.

Article 17

Any State Party to this Agreement may propose amendments to the Agreement. Amendments shall enter into force for each state Party to the Agreement accepting the amendments upon their acceptance by a majority of the States Parties to the Agreement and thereafter for each remaining State Party to the Agreement on the date of acceptance by it.

Article 18

Ten years after the entry into force of this Agreement, the question of the review of the Agreement shall be included in the provisional agenda of the General Assembly of the United Nations in order to consider, in the light of past application of the Agreement, whether it requires revision. However, at any time after the Agreement has been in force for five years, the Secretary-General of the United Nations, as depository, shall, at the request of one third of the States Parties to the Agreement and with the concurrence of the majority of the States Parties, convene a conference of the States Parties to review this Agreement. A review conference shall also consider the question of the implementation of the provisions of article 11, paragraph 5, on the basis of the principle referred to in paragraph 1 of that article and taking into account in particular any relevant technological developments.

Article 19

1. This Agreement shall be open for signature by all States at United Nations Headquarters in New York.

2. This Agreement shall be subject to ratification by signatory States. Any State which does not sign this Agreement before its entry into force in accordance with paragraph 3 of this article may accede to it at any time. Instruments of ratification or accession shall be deposited with the Secretary-General of the United Nations.

3. This Agreement shall enter into force on the thirtieth day following the date of deposit of the fifth instrument of ratification.

4. For each State depositing its instrument of ratification or accession after the entry into force of this Agreement, it shall enter into force on the thirtieth day following the date of deposit of any such instrument.

5. The Secretary-General shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification or accession to this Agreement, the date of its entry into force and other notices.

Article 20

Any State Party to this Agreement may give notice of its withdrawal from the Agreement one year after its entry into force by written notification to the Secretary-General of the United Nations. Such withdrawal shall take effect one year from the date of receipt of this notification.

Article 21

The original of this Agreement, of which the Arabic, Chinese, English, French, Russian and Spanish texts are equally authentic, shall be deposited with the Secretary-General of the United Nations, who shall send certified copies thereof to all signatory and acceding States.

IN WITNESS WHEREOF the undersigned, being duly authorized thereto by their respective Governments, have signed this Agreement, opened for signature at New York on December 18, 1979.

ANNEX B
PERSONS INTERVIEWED FOR THIS STUDY

John Disher, S. R. Radin, and J. von Puttkamer, NASA, Mar. 25, 1980.
Neil Hosenball, NASA, Apr. 21, 1980.
Victor Comras, Department of State, May 13, 1980.
Congressman Don Fuqua, June 23, 1980.
Leigh Ratiner and Rebecca Wright, L-5 Society, July 1, 1980.

Telephone interviews on aspects of the study were held with:
1. Stephen Bond, Deparment of State.
2. Eilene Galloway, Consultant.
3. Jerry Grey, AIAA.
4. Neil Hosenball, NASA.
5. Herbert Reis, Department of State.
6. David B. S. Smith, MIT.

Although a number of additional interviews were requested, for a variety of reasons they could not be conducted in the time available.

ANNEX C
WORKSHOP PARTICIPANTS
March 31, 1980

Invited participants

*James Arnold
Univ. of Calif., San Diego

*Stephen Bond, Esq.
Dept. of State/Asst. Legal Adviser

John Disher
NASA, Advanced Programs

Bevan M. French
NASA, Planetary Programs

*Eilene Galloway
Consultant

Jerry Grey
AIAA

*Noel Hinners, Director
National Air & Space Museum

S. Neil Hosenball
NASA, General Counsel

Lloyd E. Jones
Consultant

M. J. Maltagliati
AIA

Ray Pepping
McDonnell Douglas

Irwin M. Pikus
NSF

Leigh Ratiner
L-5 Society, Counsel

John R. Sevier
Lunar & Planetary Institute

Willis Shapley
Consultant

Charles S. Sheldon II
Congressional Research Service

David B. S. Smith
MIT

Mr. Ronald F. Stowe
SBS

Observers

Marjorie A. Browne
Congressional Research Service

James J. Gehrig
Senate Committee on Commerce, Science, and Technology

Mark Kieffer
NASA/International

Barbara Luxemberg
Congressional Research Service

Ralph D. Martin
Dept. of State/Legal

Robert J. Newman
McDonnell Douglas

Rebecca Wright
L-5 Society

OTA staff in attendance

Eric Willis, Chairman
Stephen E. Doyle
Donald D. Light
Zalman Shavell
Sam Hale
Vladimir Naleszkiewcz
Fred Wood
Liz Emanuel

*Did not attend but commented separately.

ANNEX D

1. State Department Informal Working Paper
dated 17 October 1979

Benefits to the United States of the Celestial Bodies Agreement

There are three kinds of benefits to the United States in the Celestial Bodies Agreement. These concern:

1. Safeguarding human life on celestial bodies (CB's).

2. Promoting exchanges of scientific results of activities on CB's.

3. Enhancing opportunities for exploration, research and utilization of natural resources of CB's.

The CB Agreement is based on the 1967 Outer Space Treaty which prohibits sovereign or exclusive claims to CB's, bans aggression and other illegal uses of force on CB's, and forbids nuclear weaponry, military bases, weapon testing and military maneuvers on CB's.

The benefits of the Celestial Bodies Agreement are:

1. Safeguarding human life on CB's.

   -- Obligation of parties to inform of phenomena that could endanger human life and of any indication of organic life.

   -- Obligation to safeguard human life and to accord to all persons on CB's special Astronaut Agreement treatment regardless of the scientific or commercial character of their activities.

   -- Obligation to offer shelter to persons in distress.

   -- Right to emergency use of CB facilities of other parties if necessary to save life.

   -- Duty to notify in event of crash landings.

   -- Duty to inform if mission locations may overlap.

2. Promoting exchange of scientific results of CB activities.

   -- Confirming freedom of scientific investigation.

   -- Requiring notification of CB activities and their results on mission completion or every 30 days for long-duration activities.

   -- Requiring reports of discovery of areas of special scientific interest; possibility of designating such areas as scientific preserves.

-- Obligation to take measures to protect the balance of CB environments.

-- Duty to consider the possibility of sharing samples with the international scientific community.

-- Desirability of exchanging scientific and other personnel on CB missions.

-- Duty to notify of any placement of radioactive materials on a CB.

-- Confirming right to collect and remove samples for scientific investigation and to use CB substances to support scientific missions.

3. Enhancing opportunities for exploration, research and utilization of CB natural resources.

-- Recalling the UN Charter's goal of promoting higher living standards.

-- Obligation to take measures to protect CB environments (see 1, above).

-- Duty to accord Astronaut Agreement treatment to all personnel, including those engaged in exploration (see 1, above).

-- Confirming the right to land objects on CB's.

-- Confirming the right to place personnel and equipment on and below the surface of a CB, and to move them about freely.

-- Right to be free of interference from other parties.

-- Right to obtain return of equipment that has gone astray.

-- Requirement that other countries confine their activities and facilities to those areas of a CB necessary to specific missions.

-- Prohibiting foreign claims of rights to CB areas not actively being worked.

-- Declaration that CB's and their natural resources are the common heritage of mankind, meaning that the parties to the CB Agreement have an interest in exploitation on CB's which interest is to be defined by free negotiation at a conference of parties to be called in the event exploitation proves feasible. Note: Any eventual regime will bind only those countries that accept it. Acceptance of a regime by the United States will require advice and consent.

-- Duty to inform the scientific community to greatest extent feasible and practicable of natural resources discovered on a CB.

-- Denying any moratorium on exploitation in the period before a

mutually acceptable treaty negotiated at a regime conference enters into force.

-- Establishing industry-supportive objectives of exploitation, to be spelled out by mutual agreement when a regime conference is held:

  -- Orderly and safe development of CB resources.

  -- Rational management of resources.

  -- Expansion of opportunities in use of resources.

  -- Equitable sharing among parties of resource benefits with special consideration for developing country needs and space power investments.

-- Right to obtain meaningful consultation with any party whose CB activities may jeopardize U.S. plans and activities.

-- Recognition that a protective special liability regime governing CB activities may need to be negotiated.

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2. Memorandum of the L-5 Society

We have previously furnished you with information concerning the moon treaty and the position of the L-5 Society on this international agreement. Our principal reasons for opposing the moon treaty are that it would:

--create a moratorium on commercial exploitation of the resources of the moon and other celestial bodies, until a second, much more comprehensive treaty for regulating resource activities is concluded;

--establish guiding principles for the negotiation of this second treaty which are completely antithetical to the commercial development of outer space resources by private enterprise; and

--thereby give other countries tremendous political control over the timing and direction of expanding commercial uses of outer space, as well as the question whether to permit such uses.

Recently, the Department of State began distributing a short paper summarizing its arguments in support of the moon treaty. We thought you would be interested in our commentary on these arguments.

To briefly state our conclusions, we have found that most of the provisions that the Department of State considers to be benefits of the moon treaty are already embodied in other multilateral treaties. In those few instances where material additions would be made to the existing body of law on outer space, the changes are incremental and have no real, practical importance for the United States. We believe that a number of the provisions in the moon treaty cited by the Department of State as benefits actually pose serious disadvantages to the American people. In short, our analysis of the Administration's justification for the moon treaty leads to the conclusion that the marginal advances which might be made in a few provisions are far outweighed by the enormous sacrifice that would be required of our Nation's future economic interests in space development.

[The following analysis was dated November 5, 1979.]

Benefits Alleged By the Department of State

1. Safeguarding human life on celestial bodies

-- Obligation of parties to inform of phenomena that could endanger human life and of any indication of organic life.

Response

The provision of the moon treaty to which the State Department refers closely parallels, and makes only minor changes to, existing international law.

While Article V, paragraph 3, of the moon treaty obligates States Parties to inform others of phenomena in outer space that could endanger

"human life or health," Article V of the Outer Space Treaty already imposes a duty to inform of phenomena "which could constitute a danger to the life or health of astronauts." The term "astronaut" is not actually defined in the body of international law concerning outer space; the Agreement on the Rescue of Astronauts, while not defining the term, refers consistently to "personnel of a spacecraft." Applying this meaning, the only new obligation imposed under the moon treaty would be the duty to warn of phenomena in outer space that would endanger humans who are not associated with a space-craft--extending possibly to humans on earth. This modification is insignificant because it is unnecessary; the objective of safeguarding human life in outer space (or on earth) is shared by all nations, and it is difficult to imagine an instance where one State would not take the simple and humanitarian step of warning others of danger.

The specific obligation to inform of any indication of organic life under the moon treaty is new, but the Outer Space treaty imposes a general obligation on States Parties to inform the public "of the nature, conduct, locations and results" of their activities in outer space and on celestial bodies (Article XI). This new provision in the moon treaty is thus insignificant because: a) States Parties already have a general duty to disclose the discovery of organic life in outer space; and b) it is inconceivable that a State discovering organic life in outer space would fail to disclose that fact to the public and scientific community at large.

-- Obligation to safeguard human life and to accord to all persons on celestial bodies special Astronaut Agreement treatment regardless of the scientific or commercial character of their activities.

Response

The provision of the moon treaty to which the State Department refers is a beneficial change to existing international law, but the advantage is outweighed by the costs of the other provisions.

Article X, paragraph 1, of the moon treaty obligates States Parties to "safeguard the life and health of persons on the moon." On the other hand, Article V of the Outer Space Treaty directs that States Parties shall "render...all possible assistance in the event of accident, distress or emergency landing" to the "astronauts" of other State Parties; and that same article requires the astronauts of one State Party to "render all possible assistance" to other astronauts. Article X of the moon treaty would also extend these provisions to "any person on the moon." Thus, the moon treaty would strengthen both the nature of the obligation (i.e., adopting measures to safeguard life, as distinguished from rendering assistance in the event of distress, etc.) and the scope of the obligation (i.e., to any person on the moon, as distinguished from an astronaut).

These changes to existing law, while beneficial, are nevertheless of little practical importance. First, the extension of the scope of the obligation to non-astronauts on the moon is not timely; the day when humans will be present on celestial bodies in life-systems independent of a space-craft is far into the future. Second, the changes in both the scope

and nature of the objective are unnecessary, since these provisions only restate what are humanitarian standards of conduct for all nations. Third, the provision in Article X, paragraph 1, of the moon treaty which would require adopting "all practicable measures to safeguard" life can be read as limited by the second sentence's cross-reference to existing obligations in the Outer Space Treaty and Return of Astronauts Agreements.

The second part of the State Department argument erroneously implies that astronauts engaged in commercial activities under the Outer Space Treaty or the Return of Astronauts Agreement would not be entitled to the same protection as those engaged in scientific activities. In fact, the Outer Space Treaty does not even attempt to define the term "astronaut," merely describing such persons as "envoys of mankind." Similarly, the Return of Astronauts Agreement accords all "personnel of a spacecraft" identical treatment in the situations it covers--regardless of their purpose.

-- Obligation to offer shelter to persons in distress.

Response

The provision of the moon treaty to which the State Department refers makes only minor changes to existing international law.

Article X, paragraph 2, of the moon treaty merely elaborates the basic obligation found in Article V of the Outer Space Treaty for States Parties "to render all possible assistance" to astronauts in distress, and for the astronauts of one State Party to assist those of another.

Similarly, Article 3 of the Return of Astronauts Agreement requires States Parties who are in a position to do so to assist in search and rescue operations for personnel of a spacecraft who need assistance in any place beyond the territory of a sovereign State; and Article 4 requires the prompt return of such personnel to "representatives of the launching authority," or home state, when they are found in a place beyond State territorial jurisdiction as a result of "accident, distress, emergency or unintended landing."* Presumably, these acts would require providing shelter.

Here again, the importance of this elaboration depends on the definition of the term "astronauts." Overall, it is not an important addition to international law because: a) the time when persons will be present in space who are not deemed to be astronauts is so far into the future; and b) a treaty obligation to act in a humanitarian manner is unnecessary.

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*It is clearly possible to interpret the term "place not under the jurisdiction of any State" in the Return of Astronauts Agreement to apply to outer space, including on celestial bodies.

-- Right to emergency use of celestial body facilities of other parties if necessary to save lives.

Response

The provision of the moon treaty to which the State Department refers makes only minor change to existing international law.

Article XII, paragraph 3, is a new concept in the body of outer space law--it gives a State Party the right to use another's "equipment, vehicles, installations, facilities or supplies" in a life-threatening situation on the moon or on other celestial bodies. While the motivation underlying this provision is certainly laudable, the actual need for the change is muted by the likelihood that no State would object to the use of its property in outer space by others, where necessary to save life. In fact, the right to use another State's property for this purpose is really a corollary to the existing affirmative obligations on States Parties under the Outer Space Treaty and Return of Astronauts Agreement to render all possible assistance to astronauts in distress. (See discussion on pages E5-E6)

-- Duty to notify in event of crash landings.

Response

The provision of the moon treaty to which the State Department refers closely parallels, and makes no significant change to, existing internaitonal law.

While Article XIII of the moon treaty requires a State Party learning of a crash landing on the moon to inform both the launching State and the UN Secretary General, Article I of the Return of Astronauts Agreement requires a State Party learning of a crash landing in any "place not under the jurisdiction of any State" to inform both the launching State (or if unknown, the public) and the Secretary General.* Indeed, the return of Astronauts Agreement imposes an even broader obligation by also requiring State Parties to give notice of situations of accident or distress not involving crash landings.

-- Duty to inform if mission locations may overlap.

Response

The provision of the moon treaty to which the State Department refers closely parallels, and makes only minor changes to, existing international law.

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*See footnote on [previous page].

Article XI of the Outer Space Treaty already obligates State Parties to inform of the nature, conduct and locations of their activities in outer space, including those on celestial bodies. Article IX of the same treaty requires States Parties to consult where the activity of one "would cause potentially harmful interference" with the activities of another. Accordingly, the provisions of Article V, paragraph 2, of the moon treaty (requiring a State Party aware that another State intends to operate in the same area, or in the same orbit or trajectory to or around the moon, to inform the other State of "the timing of and plans for its own operations") add little to existing obligations. Indeed, they only differ from the provisions of the Outer Space treaty in that they make the seriousness of the potential interference irrelevant.

2. Promoting exchange of scientific results of celestial body activities.

Response

The provision of the moon treaty to which the State Department refers is taken practically verbatim from an existing treaty. If anything, the moon treaty has disadvantageous implications on this point.

Article I of the Outer Space Treaty already provides that "[t]here shall be freedom of scientific investigation in outer space, including the moon and other celestial bodies."

Article VI, paragraph 1, of the moon treaty could even be viewed as an attempt to restrict freedom of scientific research by providing that "[t]here shall be freedom of scientific investigation on the moon by all States Parties" [emphasis added], since Article I of the Outer Space Treaty recognizes the right of all States to conduct scientific research freely. Although the Outer Space Committee agreed that the moon treaty would not derogate from the Outer Space Treaty, this apparent attempt to narrow the right of scientific research on the moon to States Parties--in contrast to provisions of the Outer Space treaty--is still very presumptuous, given that the moon treaty may enter into force with only five ratifications.

-- Requiring notification of celestial body activities and their results on mission completion or every 30 days for long duration activities.

Response

The provision of the moon treaty to which the State Department refers closely parallels, and makes only minor change to, existing international law.

Article V, paragraph 1, of the moon treaty essentially tracks the obligations imposed under Article XI of the Outer Space Treaty and Article IV of the Registration Convention, even though it contains certain new,

specific provisions concerning the duty to inform other States of activities on celestial bodies. Article XI of the Outer Space Treaty provides that States Parties "agree to inform" the public "to the greatest extent feasible and practicable, of the nature, conduct, locations and results" of their outer space activities. Article IV of the Registration Convention requires launching States to inform of "basic orbital parameters" and the "general function" of their space objects. Article V of the moon treaty also limits the duty to inform with the phrase "to the greatest extent feasible and practicable," thereby qualifying the rest of that paragraph. The only new provisions on this subject in the moon treaty, therefore, are the provisions establishing special 30 day reporting requirements for longer missions--a mere elaboration of existing reporting requirements.

-- Requiring reports of discovery of areas of special scientific interest; possibility of designating such areas as scientific preserves.

Response

The provision of the moon treaty to which the State Department initially refers closely parallels existing international law; the second provision to which it refers is merely hortatory.

The provision in Article VII, paragraph 3, of the moon treaty requiring States Parties to report "concerning areas of the moon having special scientific interest" is--like the provision in Article V discussed on the preceding page--merely a more specific formulation of the obligation in article XI of the Outer Space Treaty to inform of the results of activities on the moon.

The provision in Article VII, paragraph 3, of the moon treaty which states that the purpose of this reporting requirement is "in order that, without prejudice to the rights of other States Parties, consideration may be given to the designation of such areas as international scientific preserves for which special protective arrangements are to be agreed in consultation with the competent organs of the United Nations" [emphasis added] does not impose any binding obligation. It is merely hortatory and thus has little practical value.

-- Obligation to take measures to protect the balance of celestial body environments.

Response

The provision of the moon treaty to which the State Department refers is a beneficial change to existing international law, but the advantage is outweighed by the costs of other provisions.

While Article VII, paragraph 1, of the moon treaty provides that States Parties "shall take measures to prevent the disruption of the existing

balance" of the environment of celestial bodies, Article IX of the Outer Space Treaty already establishes a comparable obligation. The latter provides that "States Parties shall... conduct exploration of [celestial bodies] so as to avoid their harmful contamination... and, where necessary, shall adopt appropriate measures for this purpose."

The new provisions in the moon treaty are an improvement because: a) they slightly strengthen the nature of the duty (i.e., from adopting necessary and appropriate measures to taking measures); and b) they cover a broader range of effects (i.e., disruption of the existing balance through adverse changes, harmful contamination "or otherwise"). These improvements do not, however, justify the costs incurred by other provisions of the moon treaty, since the basic obligation to protect the environment of celestial bodies already exists under the Outer Space Treaty.

-- Duty to consider the possibility of sharing samples with the international scientific community.

Response

The provision of the moon treaty to which the State Department refers is merely hortatory.

Article VI, paragraph 2, of the moon treaty provides, in part, that "States Parties shall have regard to the desirability" of sharing moon samples with others. Clearly, the provision creates no specific enforceable obligation; it differs little in effect from the provisions of Article IX of the Outer Space Treaty establishing a principle of "co-operation and mutual assistance" for outer space activities.

-- Desirability of exchanging scientific and other personnel on celestial body missions.

Response

The provision to which the State Department refers is merely hortatory.

Article VI, paragraph 3, of the moon treaty provides that the "States Parties agree on the desirability" of exchanging personnel on missions. Like the provision in paragraph 2 of the article discussed [in the preceding response paragraph], this language creates no specific, enforceable obligation. Moreover, it is also duplicative of existing language in Article I of the Outer Space Treaty requiring States to "facilitate and encourage international cooperation in [scientific] investigation".

-- Duty to notify of any placement of radioactive materials on a celestial body.

Response

The provision of the moon treaty to which the State Department refers is a beneficial change in existing international law, but the advantage is outweighed by the costs of other provisions.

Article VII, paragraph 2, of the moon treaty requires States Parties "to the maximum extent feasible [to] notify [the Secretary General] in advance of all placements by them of radioactive materials on the moon and the purposes of such placements." Article XI of the Outer Space Treaty requires States Parties to inform of the nature and location of their activities in outer space; Article V of that treaty requires States Parties to disclose "phenomena" that would endanger astronauts; and Article IX requires States Parties to adopt necessary and appropriate measures to avoid harmful contamination of celestial bodies. Thus, while specific reference to radio-active materials disposal and storage in the moon treaty would be a material addition to the body of space law, these existing obligations mean that the improvement does not justify the costs of the moon treaty.

-- Confirming right to collect and remove samples for scientific investigation and to use celestial body substances to support scientific missions.

Response

The provision of the moon treaty to which the State Department refers closely parallels existing international law.

International law is established not only through treaty-making but also through state practice. As the State department itself recognizes in its use of the term "confirming", the right to collect samples for scientific purposes has been exercised by States without significant challenge since the Apollo mission landed on the moon. Thus, the provisions of Article VI, paragraph 2, of the moon treaty are merely a codification of customary international law on this particular point.

Enhancing opportunities for exploration, research and exploitation of celestial body natural resources.

-- Recalling the UN Charter's goal of promoting higher living standards.

Response

The provision of the moon treaty to which the State Department refers is merely hortatory.

Article IV, paragraph 1, of the moon treaty provides that "[d]ue regard shall be paid" to the need to promote higher living standards "in accordance with the Charter of the United Nations." Thus, the provision establishes no specific, binding obligation. Moreover, since the general goal of improving living standards is already contained in the UN Charter, a reference to that identical goal in the moon treaty is completely unnecessary.

There is even a possibility that the provision to which the State Department refers may be detrimental, because it follows a sentence which declares that the "exploration and use of the moon shall be the province of all mankind." It therefore might be viewed as an elaboration of the meaning of the phrase "province of all mankind" which, until now, has been undefined in international space law. The selective incorporation of this particular principle from the Charter (i.e., promoting higher living standards) would thus be seen as superimposing special preferences for developing countries onto the "province" concept.

-- Obligation to take measures to protect celestial body environments (see 1 [sic:2], above).

Response

The provision of the moon treaty to which the State Department refers is a beneficial change to existing international law, but the advantage is outweighed by the costs of other provisions.

This alleged benefit is identical to that commented upon on page [E-9] above [obligation to take measures to protect the balance of celestial body environments].

-- Duty to accord Astronaut Agreement treatment to all personnel, including those engaged in exploration (see 1, above).

Response

The provision of the moon treaty to which the State Department refers closely parallels, and makes only minor change to, existing international law.

This alleged benefit is identical to that commented upon on page [E-5] above [obligation to safeguard human life and to accord to all persons on celestial bodies special Astronaut Agreement treatment regardless of the scientific or commercial character of their activities].

-- Confirming the right to land objects on celestial bodies.

Response

The provision of the moon treaty to which the State Department refers closely parallels existing international law.

Article I of the Outer Space Treaty provides that celestial bodies "shall be free for exploration and use by all States" and that "there shall be free access to all areas of celestial bodies." State custom and practice has expanded the "open to use" and "free access" doctrines so as to grant States the right to land objects on the moon, and presumably on other celestial bodies. Thus, Article VIII, paragraph 2(a), of the moon treaty is unnecessary, sinced it does not significantly alter existing international law on this point. State Department recognizes this fact by its use of the term "confirming."

-- Confirming the right to place personnel and equipment on and below the surface of a celestial body, and to move them about freely.

Response

The provision of the moon treaty to which the State Department refers closely parallels, existing international law.

The provisions of Article VIII, paragraph 2, describing the right of free access on celestial bodies--like those discussed on the preceding page--merely re-state existing international law, established in Article I of the Outer Space Treaty and elaborated through State custom and practice. Here again, State Department recognizes this fact by its use of the term "confirming."

-- Right to be free of interference from other parties.

Response

The provision of the moon treaty to which the State Department refers may be a beneficial change in existing international law, but the advantage is outweighed by the costs of other provisions.

Article VIII, paragraph 3, of the moon treaty provides "[a]ctivities of States Parties...shall not interfere with the activities of other States Parties on the moon." This language significantly strengthens the noninterference provisions of Article IX of the Outer Space Treaty, which require States Parties to pay "due regard to the corresponding interests of all other States Parties" and consult when their activities "could cause potentially harmful interference" with other States Parties' activities.

An absolute prohibition on interference, however, is not inherently an advantage to the exploration and use of natural resources. In this case,

since all States Parties have apparently equal rights to explore and use the same resources, the ban on interference does not promote development. What is first required to give meaning to a prohibition on interference--but not provided here--is some determination as to priority of rights.

-- Right to obtain return of equipment that has gone astray.

Response

The provision of the moon treaty to which the State Department refers closely parallels, and makes only minor change to, existing international law.

Article XII, paragraph 2, of the moon treaty merely provides that "[v]ehicles, installations and equipment or their component parts found in places other than their intended location shall be dealt with in accordance with Article V" of the Return of Astronauts Agreement. The latter provision directs that "objects launched into outer space or their component parts found beyond the territorial limits of the launching authority" shall be returned upon request of the launching State.

The duty to return is stated more generally in Article VIII of the Outer Space Treaty, where it applies to objects or their component parts "launched into outer space, including objects landed or constructed on a celestial body." Whether or not the existing duty to return extends to objects manufactured in space and not launched therefore depends on the interpretation of this quoted phrase in the Outer Space Treaty. In any event the possible expansion of the obligation in the moon treaty is minor.

-- Requirement that other countries confine their activities and facilities to those areas of a celestial body necessary to specific missions.

Response

The provision of the moon treaty to which the State Department refers may be a beneficial change to existing international law, but the advantage is outweighed by the costs of other provisions.

Article IX, paragraph 1, of the moon treaty directs States Parties "establishing a station" to "use only that area which is required for the needs of the station." Since paragraph 2 of the same article directs that stations "be installed in such a manner that they do not impede the free access to all areas of the moon" of other States Parties, it is unclear what is meant in paragraph 1 by the term "establishing." In any event the principle of non-appropriation in both the moon treaty and the Outer Space Treaty would seem to preclude any one State Party from attempting to exclude others from use of an area of a celestial body. In short, this provision in the moon treaty is probably superfluous.

The possible usefulness of this particular provision in the context of a resource development regime could be the limitation it might impose on the size of resource deposits claimed to those areas actually worked or exploited. Since national claims to any part of the moon or its resources in place are prohibited by Article XI of the treaty, however, the alleged benefit raised by the State Department is made wholly meaningless.

-- Prohibiting foreign claims of rights to celestial body areas not actively being worked.

Response

The provision of the moon treaty to which State Department refers appears irrelevant to the benefit alleged.

This alleged benefit appears to be merely a restatement of the alleged benefit commented upon [in] the preceding [response]. Since Article XI of the moon treaty and Article II of the Outer Space Treaty prohibit "foreign claims" to celestial bodies, the point made by the State Department appears to be irrelevant.

-- Declaration that celestial bodies and their natural resources are the common heritage of mankind, meaning that the parties to the Celestial Body Agreement have an interest in exploitation on celestial bodies which interest is to be defined by free negotiation at a conference of parties to be called in the event exploitation proves feasible. Note: Any eventual regime will bind only those countries that accept it. Acceptance of a regime by the United States will require advice and consent.

Response

The provision of the moon treaty to which State Department refers is a detrimental change to existing international law.

Article XI, paragraph 1, of the moon treaty declares celestial bodies and their resources to be "the common heritage of mankind". This phrase has a definite legal and political meaning that is directly inconsistent with United States interests in the commercial development of outer space resources (as explained in Attachment A to this commentary).

State Department's argument that the future regime to be negotiated will only bind the U.S. if we ratify the later agreement ignores practical considerations. If we ratify this moon treaty, then we will be obligated under Article XI, paragraph 5, to "establish" a resource exploitation regime. If we then reject the subsequent regime the majority of States Parties negotiate, the political pressure on the U.S. to go along will be tremendous. No commercial entity will be able to afford to stay outside the new regime.

-- Duty to inform the scientific community to greatest extent feasible and practicable of natural resources discovered on a celestial body.

Response

The provision of the moon treaty to which the State Department refers is a detrimental change to existing international law.

Article XI, paragraph 6, of the moon treaty does require States Parties to disclose resources discovered on celestial bodies. This provision is arguably only a slight expansion of the existing obligation under Article XI of the Outer Space Treaty to inform of the results of outer space activities. To the extent the moon treaty makes the disclosure obligation more specific with respect to resources, however, it is probably detrimental to U.S. interests in commercial resource development. The reason is that mandatory disclosure of resource discoveries is a disincentive to private exploration for resources for commercial purposes.

-- Denying any moratorium on exploitation in the period before a mutually acceptable treaty negotiated at a regime conference enters into force.

Response

The provision of the moon treaty to which the State Department refers is a detrimental change to existing international law.

The State Department erroneously argues that the provisions of paragraphs 4, 5 and 8 of Article XI of the moon treaty make clear that there is no moratorium on exploitation of resources pending the establishment of the new regime. Exactly the opposite is true, as is explained in Attachment A to this commentary. [The explanation referred to is found on pp. XX of the main body of this OTA report.] In the absence of the moon treaty, existing international law cannot be construed to impose any moratorium on resource development.

-- Establishing industry-supportive objectives of exploitation, to be spelled out by mutual agreement when a regime conference is held:

-- Orderly and safe development of celestial body resources.

-- Rational management of resources.

-- Expansion of opportunities in use of resources.

-- Equitable sharing among parties of resource benefits with special consideration for developing country needs and space power investments.

Response

The provisions of the moon treaty to shich State Department refers are detrimental changes in existing international law.

The objectives for a subsequent resource regime set forth in Article XI, paragraph 7, are demonstrably anti-development, and not "industry-supportive" as State Department claims. Each of these four objectives is a diplomatic code-word for a basic system of resource exploitation antithetical to private investment (as is detailed in Attachment A to this commentary).

-- Right to obtain meaningful consultation with any party whose celestial body activities may jeopardize U.S. plans and activities.

Response

The provision of the moon treaty to which State Department refers is a beneficial change to existing international law; the advantage gained, however, is outweighed by the overall costs of the treaty.

Article XV, paragraphs 2 and 3, of the moon treaty detail a procedure of mandatory State Party consultations and Secretary General mediation in disputes arising under the treaty. While this procedure is a useful improvement to the present provisions for voluntary consultations where activities in outer space may cause potentially harmful interference with each other (Article IX of the Outer Space Treaty), it naturally does not provide for any means of binding dispute settlement. Thus, it is of minimal importance.

-- Recognition that a protective special liability regime governing celestial body activities may need to be negotiated.

Response

The provision of the moon treaty to which State Department refers is merely hortatory.

Article XIV, paragraph 2, of the moon treaty merely states that States Parties "recognize" that a later agreement on liabiity may need to be negotiated. It therefore makes no meaningful headway in the field of liability. Moreover, this provision of the moon treaty does not suggest any particular content of a special liability regime, "protective" or otherwise.