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CONTENTS

TOWARDS A NEW LEGAL REGIME FOR THE USE OF NUCLEAR POWER SOURCES IN OUTER SPACE

*He Qizhi**

In January 1978 a malfunctioning Soviet nuclear powered satellite, COSMOS-954, re-entered the earth's atmosphere and disintegrated, scattering radioactive debris over a wide area of the Canadian Northwest Territory. In January 1983/February 1984, another Soviet Satellite, COSMOS-1402, which had a nuclear reactor on board, irregularly re-entered the atmosphere and broke into three parts. Although these three parts, including the compact part carrying the core of the nuclear reactor, were burned up in the dense atmosphere, the incident raised world-wide concern justified by the risk of hazards it involved. Since 1978, the issue of the safe use of nuclear power sources (NPS) in outer space has been placed on the agenda of the Committee on Peaceful Uses of Outer Space (COPUOS) and its two subordinate bodies, the Scientific and Technical Sub-Committee and the Legal Sub-Committee, with a view toward elaborating legal principles on the use of NPS in space. It has been a new subject in the progressive development of international space law.

I. *The Necessity and Potential Hazards of the Use of NPS in Outer Space*

The use of NPS in outer space is a sophisticated technology aimed at providing electric power for spacecraft sub-systems such as attitude control, communications and command, as well as operations of various equipment on board. At present, solar cells, chemical batteries, and other fuel cells have generally been used for most satellite missions, solar cells proving to be the most valuable and economic choice among them. These non-nuclear sources of power, however, present certain disadvantages such as relatively short lifetimes, low generating capacities, and inability to provide energy while not in the sun.[1] In these circumstances, there is a general trend in favor of the use of

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The views expressed in this article are those of the author, and do not necessarily represent those of any organization with which he is connected.

1. In the case of solar cells, there is speculation that significant amounts of power could be supplied from massive space arrays of solar cells beaming gigawatts to earth by microwaves. Yet, on the basis of present knowledge, solar cells in conjunction with electrical storage devices appear capable of producing power of about 50 kw. Large solar panels may produce unacceptable drag in low-orbit missions and involve complex unfolding mechanisms to convert from launch to operational configuration. Therefore, at higher outputs the solar panels begin to lose their power to weight advantage. *See* Ques-

NPS for space missions, particularly long duration missions and deep space missions.

There are two types of NPS currently used in outer space. The first is the isotopic source in which energy is derived from the decay of a radioactive isotope. The second is the nuclear reactor which derives its thermal energy from controlled fission process. For both types, a converter is needed to produce electricity from the nuclear heat sources. The former is simpler and its output lower than the latter. For higher outputs and longer duration, a nuclear reactor would be the logical choice.

The first nuclear powered satellite carrying an isotopic source was launched by the United States. It had a generating capacity of 2.7 electrical watts.[2] The chosen isotope was plutonium-238, which has been generally used in the United States program. The electrical power provided by an isotopic generator is estimated to be from 2.7 to 500 watts, with the maximum output limited to 1 kw.[3] Nuclear fuels are contained in a capsule which will remain sealed and not break up when it penetrates the atmosphere and impacts on land and which will withstand corrosion in water.[4]

The Soviet Union, besides carrying on research and development work on isotope-type electricity generators,[5] has given greater efforts to the development of a nuclear reactor. In 1964, a "Romaska" type was produced. It contained a total of 49 kilograms of uranium-235, with an electrical output of 500 watts and 1,500 hours lifetime. In the 1970's, as a result of improvement, a "Topaz" type reactor was produced and a safe life of 5,000 hours and an electrical output of 5-10 kilowatts could be achieved. These reactors have been used by the COSMOS series in either low or high orbits and in deep space.[6]

The possibility of malfunctioning nuclear powered satellites entering the earth is not rare. The first re-entry occurred in April, 1964, when the United States Transit/SNAP-9A deflected from its normal flight route and vaporized over the Indian Ocean, dispersing 17,000 curies of plutonium-238 at high altitude. In May, 1968, the Nimbus/SNAP-19 system re-entered and the fuel was recovered from the sea off the California coast. In April, 1970, the Apollo 13/

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tions Relating to the Use of Nuclear Power Sources in Outer Space, U.N. Doc. A/AC.105/220, at 12-13 (1978).

2. Use of Radioactive Materials by the U.S. for Space Power Generation, U.N. Doc. A/AC.105/102, at 1 (1978).

3. U.N. Doc. A/AC.105/L.102 (1978); A/AC.105/220 (1978).

4. *Id.*

5. The first isotope generator "Orion-1", using polonium-210, came into being in 1965 in the Soviet Union and was tested on board COSMOS-84 and COSMOS-90, with an electrical output of 22 watts at the beginning and 8 watts at the end of its 3,000-hour lifetime. *See* U.N. Doc. A/AC.105/220/Add.1, at 19 (1978).

6. U.N. Doc. A/AC.105/220/Add.1, at 16-19 (1978).

SNAP-27 unit survived re-entry and sank in the deep South Pacific Ocean.[7]

The two incidents of aborted nuclear powered satellites announced by the Soviet Union were mentioned at the beginning of this paper. COSMOS-954, with a nuclear reactor of the "Romashka" type on board, was launched on September 17, 1977 in a low orbit on a mission of marine observation. According to design, it would be abandoned by being lifted to a higher orbit after completing its mission; but, it failed and disintegrated scattering debris in Canadian territory. In operation "Morning-light," carried out by Canada with assistance from the United States, a significant amount of debris and particles, some of them highly radioactive, was recovered.[8] COSMOS-1402, launched on August 30, 1982, was also for marine observation. It carried 45 kg of highly enriched uranium-235, and was to be boosted to a high orbit of 900 km after completing its mission. However, it also failed and broke into three parts which were burned up after re-entry. The incident raised concerns among states and forced emergency planning agencies in many countries to upgrade their operations in forestalling the threat.[9]

From the foregoing review, it can be seen that although the incidents occurred, so far uncontrolled re-entry of nuclear powered satellites has not caused major disastrous effects. It must be recognized that the use of NPS in space involves an inherent risk that can not be wholly eliminated due to the large amount of radioactive material contained in such sources. Nuclear powered satellites dispatched beyond earth orbit for interplanetary exploration and those re-boosted to higher orbits after their missions have been completed will bring no harm to the earth. But, as to malfunctioning nuclear powered satellites re-entering the atmosphere, it will be impossible to exclude radiological hazards resulting from the dispersal of their radioactive material in the biosphere. The hazards to man will primarily be radiological, arising from radiation exposure through both direct external radiation and internal radiation from inhalation or ingestion.[10] In view of such possible dangers, the issue of elaborating legal principles on the use of NPS in outer space for protecting human life and environment from harmful effects caused by radiological material of malfunctioning nuclear powered satellites has become an important subject of international concern, and has been a main item on the agenda of COPUOS and its two subordinate bodies, the Scientific and Technical Sub-Committee and the Legal Sub-Committee.

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7. U.N. Doc. A/AC.105/L.105, Attachment 5 (1978).

8. Legault and Farand, Canada's Claim for Damage Caused by the Soviet COSMOS-954 satellite, reference paper submitted at the Symposium on Conditions Essential for Maintaining Outer Space for Peaceful Uses, organized jointly by the International Institute of Space Law and the United Nations University (1984).

9. Facts on File, at 16G3, 58A2, 88D3 (1983).

10. U.N. Doc. A/AC.105/220, at 13-14 (1978).

II. *The Course of Deliberation*

An elaboration of legal principles on the use of NPS in outer space should be founded on a full understanding of the development of relevant space science and technology. Thus, the deliberation on this issue in COPUOS and its two subordinate bodies has been mainly carried on in the following two fields.

A. *The Scientific and Technical Aspects of the Use of NPS in Outer Space*

The issue was first raised by Canada in the Scientific and Technical Sub-Committee convened on February 13, 1978.[11] In the discussion, Canada, joined by eight other countries, submitted a proposal[12] calling for the establishment of a Working Group to consider "Questions Relating to the Use of Nuclear Power Sources in Outer Space." The efforts of this Committee should be paralleled by studies of legal implications in the Legal Sub-Committee.

The subjects suggested for preliminary study included: alternative power sources for satellites and their advantages and disadvantages; restrictions on the use of NPS; precautions respecting radioactive contamination at launch, during the mission, or during or after re-entry; technical feasibility of providing early notification of re-entry, associated risks, and probable time and place of impact; the possibility of providing emergency assistance for search, recovery and clean-up operations, etc. The purpose of such study was to provide a technical base for a multilateral regime of strict and effective standards, safeguards, and limitations pertaining to the use of NPS in outer space. This proposal, having received the approval of the Scientific and Technical Sub-Committee and of COPUOS, was adopted by the General Assembly on November 10, 1978.[13]

Accordingly, the Working Group was set up in February 1979. After deliberation in its first session the Working Group arrived at the conclusion that NPS can safely be used in outer space, provided certain safety considerations are met in full. The safety requirements listed by the Working Group were:

1) that appropriate measures for radiation protection during all phases of an orbital mission of a spacecraft with NPS, *viz.*, launch, parking orbit, operational orbit, or re-entry, should be derived principally from the existing internationally accepted basic standards recommended by the International Commission on Radiological Protection (ICRP), in particular, ICRP document No. 26.

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11. Canada raised this problem after the COSMOS-954 incident occured above its territory and elimination work was still in progress. *See* U.N. Doc. A/AC.105/C.1/SR.188, at 6 (1978).

12. U.N. Doc. A/AC.105/C.1/L.103 (1978). The eight other countries were: Australia, Colombia, Ecuador, Egypt, Italy, Japan, Nigeria and Sweden.

13. U.N. Doc. GA/Res.33/16 (1978).

2) that the safety of radio-isotope systems would be assured by designing them to contain the radio-isotope for all normal and abnormal conditions. The design should ensure minimal leakage of the radioactive contents and must at least meet the limits recommended by ICRP in all circumstances including launch accidents, re-entry into the atmosphere, impact, and prolonged water immersion.

3) that the safety of reactor systems do no present any difficulty when they are started and operated in orbits sufficiently high to give time for radioactive materials to decay to a safe level in space after the end of the mission. In this way, the dose equivalents at the time of re-entry could be guaranteed in all circumstances to be within the limits recommended by ICRP for non-accident conditions. For those reactors that are intended for use in low orbits where the radioactive materials do not have sufficient time to decay to an acceptable level, safety depends on the start of the operation in orbit and the success of boosting NPS to a higher orbit after the operation is completed. In the event of an unsuccessful boost into higher orbit, the system must in all circumstances be capable of dispersing the radioactive material so that when the material reaches the earth, the radiological hazards conform to the recommendations of ICRP.[14]

The second important element reached by the Working Group was the essential need for early notification of an unprogrammed re-entry of a NPS.[15] The Working Group stressed that existing standards and practices do not provide any specific guidelines for notification concerning NPS used by space objects, except as proposed in a resolution by the General Assembly (GA/Res. 33/16). This resolution requests that the launching state inform the states concerned in the event that a space object with NPS on board is malfunctioning with a risk of re-entry of radioactive materials to earth.[16]

However, such early notification of unprogrammed re-entry is not easy and remains one of the most difficult and intractable problems of orbital mechanics, due to various elusive factors.[17] Therefore, the Working Group decided that there was a need for further studies in certain fields, including the evaluation of orbital mechanics for a more accurate prediction of the

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14. U.N. Doc. A/AC.105/238, Annex II, paras. 13-15 (1979).

15. *Id.* at para. 18.

16. *Id.* at para. 17.

17. In this connection, for most of those satellites which do not perform any maneuvers in the last phases of their lives, decay days can be predicted with an error of about 10 per cent of their remaining lifetime. Thus, a prediction of 10 days before decay would be likely to be in error by one day, and a prediction of 10 hours before decay might be in error by about one hour during which time a satellite travels more than half way around the world. Therefore, although a track over the earth on the final orbit can be specified about a day in advance, the predicted re-entry point along this track may still be in error by thousands of kilometers. *Id.* at para. 20.

phenomena.[18]

The third important element in the report of the Working Group dealt with search and recovery operations. The Working Group expressed the hope that in the event that a state affected requests assistance for search and recovery from other states, such other states will respond promptly to provide the necessary assistance.[19]

In the second session held in February, 1980, the Working Group, besides reaffirming the conclusions reached in its first session and making a general review of related technical questions, was particularly concerned with the formulation of radiation standards which would serve to protect the population and the environment during launch, parking orbit, operational orbit, and reentry. In this connection, guidelines were provided in para. 12 of ICRP publication 26.[20]

In the third session held in February 1981, the Working Group made special efforts to deal with the issue of notification. As a result, a format was agreed upon for notification of re-entering space vehicles containing NPS which may give rise to radiological hazards. The format, as a supplement to the general provision of GA/Res.33/16, consisted of two parts: system parameters and information on the radiological risk of nuclear power sources.[21]

B. *The Legal Implications of the Use of NPS in Outer Space*

Following the session of the Scientific and Technical Sub-Committee in February, 1978, a working paper sponsored by 15 countries at the instance of Canada was submitted to the Legal Sub-Committee in April, 1978.[22] It called for a review of relevant international legal instruments with a view of adopting supplementary legal measures, including possibly a further convention or legal documents for protecting the integrity of human life and environment. The working paper was not discussed and was reintroduced in 1979, but a consensus was not reached because some delegations insisted that it was inadvisable to initiate legal studies on this issue before some conclusions had been reached in the Scientific and Technical Sub-Committee. However, at its session in June, 1979, the parent committee, after receiving the report of the Scientific and Technical Sub-Committee,[23] recommended by consensus that the Legal

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18. *Id.* at para. 40.

19. *Id.* at para. 26.

20. *See infra* text *Safety Measures* under the heading *Main Issues of Deliberation.*

21. *See infra* text *Notification* under the heading *Main Issues of Deliberation.*

22. U.N. Doc. A/AC.105/C.2/L.115 (1978). The fifteen countries were: Australia, Belgium, Canada, Chile, Colombia, Egypt, Federal Republic of Germany, Iran, Italy, Japan, Kenya, Mexico, Sierra Leone, Sweden and the United Kingdom.

23. *See supra*, note 14.

Sub-Committee include in its agenda, at the next session in 1980, an item entitled "Review of Existing International Law Relevant to Outer Space Activities With a View to Determining the Appropriateness of Supplementing Such Law With Provisions Relating to the Uses of Nuclear Power Sources in Outer Space,"[24] which was approved by the General Assembly on December 5, 1979.[25]

When the Legal Sub-Committee met in 1980, it opened debate on the above item. Canada submitted a new working paper[26] covering issues respecting safety, notification, and assistance on the use of NPS in outer space. Many developing and western countries expressed the view that provisions in the existing five multilateral treaties on outer space are inadequate to deal with the NPS problem, and held that the Committee should initiate deliberations along the lines set out in the Canadian working paper, with a view to elaborating new supplementary rules.

Countries of the Soviet bloc held opposing views, stressing that the use of NPS in outer space is not only legal, but desirable, and the provisions of the existing treaties can effectively remove the harmful effects and consequences which might arise from the use of NPS. Moreover, they argued that specific problems resulting from certain circumstances can be dealt with separately, and there is no ground for elaborating new legal instruments.

No decision was made in the parent Committee in 1980, but the General Assembly adopted a resolution[27] to change the title of this item to "Consideration of the Possibility of Supplementing the Norms of International Law Relevant to the Use of Nuclear Power Sources in Outer Space," and requested that the Legal Sub-Committee review this item in its next session by a Working Group.

Since 1981, the Legal Sub-Committee has established a Working Group for consideration of this item, but no progress was made in 1981-1982 due to basic differences existing among the countries concerned. In 1983, Canada submitted a consolidated working paper[28] which coordinated the views expressed in the course of past deliberation and which included the format of notification on re-entry provided in the report of the second session of the Working Group of the Scientific and Technical Sub-Committee. The Working Group of the Legal Sub-Committee focused its discussion in 1983 on the issue of notification on re-entry, and as a result, accepted the above mentioned format as a basis for reaching consensus in the near future. In 1984, in an effort to achieve further progress on the existing achievement, Canada, China, Sweden and later the Netherlands, submitted two working papers[29] in succession. The main pur-

24. U.N. Doc. GA/34/20 (1980).

25. U.N. Doc. GA/34/66 (1980).

26. U.N. Doc. A/AC.105/271, Annex III (1980).

27. U.N. Doc. GA/34/34 (1980).

28. U.N. Doc. A/AC.105/C.2/L.137 (1983).

29. U.N. Doc. WG/NPS (1984)/WP.2 (1984); U.N. Doc. WG/NPS (1984)/W.P.4

pose was to substantiate safety measures in line with those already agreed to by the Working Group of the Scientific and Technical Sub-Committee in its second session. They failed to reach agreement; however, by 1985 the Working Group of the Legal Sub-Committee, after repeated informal consultation, arrived at a preliminary agreement on the draft text of assistance, and succeeded in adding a new supplementary paragraph to the agreed upon provisions on the format and procedure of notification on re-entry. These measures were finalized in the 1986 session. They constituted a notable achievement in the deliberation of this item by the Legal Sub-Committee.

III. *Main Issues of Deliberation*

Elaboration of legal principles for the use of NPS in outer space is a new subject of space law. After many years of exploration and discussion in COPUOS and its two Sub-Committees, the main issues can be summed up under the following headings, on some of which agreement has been reached, while others require further consultation for coordinating different views in order to formulate common rules.

A. *Notification*

Since the problem of the use of NPS in outer space was first under discussion in 1978, a number of working papers on this question have been submitted. The proposals contained therein can be grouped into two categories. The first concerns notification by the launching state before launch of a space object with NPS on board. The second concerns notification by the launching state in case of re-entry of a malfunctioning space object with NPS on board.

Existing standards and practices do not provide any specific guidelines for notification of the use of NPS in outer space except those provided in General Assembly resolution 33/16. The resolution requests that the launching state inform states concerned in the event a space object with NPS on board is malfunctioning with a risk of re-entry of radioactive materials.[30] During the discussion in the Legal Sub-Committee, Canada and many other countries expressed the necessity of notification by the launching state before the launch. However, the Soviet Union and other Eastern European countries insisted that such notification was unnecessary since a space object with NPS on board operating normally was in no way different from, and no more dangerous than,

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(1984).

30. *See supra* note 16. However, Art. 7§2 of the 1980 Moon Agreement requires launching states to notify the Secretary-General of the United Nations in advance of all placements by them of radioactive materials on the moon and other celestial bodies as well as the trajectories to, from and around their orbits and of the purposes of such placements. But, this clause only refers to lunar launchings. Existing space law does not obligate the prior notification of the launch of any space object, including a space object with NPS on board.

other space objects with non-nuclear power sources. They further held that a notification in advance might cause unjustified anxiety and fear in the general public. In view of the strong reluctancy on the part of the main space powers to give notification in advance of the launch of a space object with NPS on board, it would be very difficult to reach agreement by requiring them to accept such a condition.

With regard to notification of re-entry of a malfunctioning space object with NPS on board, the first session of the Working Group of the Scientific and Technical Sub-Committee has already arrived at the conclusion that the earliest possible notification of such an occurrence is essential.[31] The third session of the Working Group further agreed by consensus on the format of such notification.[32] On this basis, the Working Group of the Legal Sub-Committee, following discussion and a number of informal consultations, agreed upon the following provisions in 1983:

> Any state launching a space object with nuclear power sources on board should timely inform states concerned in the event this space object is malfunctioning with a risk of re-entry of radioactive materials to the earth. The information should be in accordance with the following format:
> 1. System parameters
> 1.1 Name of launching state or states including the address of the authority which may be contacted for additional information or assistance in case of accident
> 1.2 International designation
> 1.3 Date and territory or location of launch
> 1.4 Information required for best prediction of orbit lifetime, trajectory and impact region
> 1.5 General function of spacecraft
> 2. Information on the radiological risk of nuclear power source(s)
> 2.1 Type of NPS: radio-isotopic/reactor
> 2.2 The probable physical form, amount and general radiological characteristics of the fuel and contaminated and/or activitated components likely to reach the ground. The term 'fuel' refers to the nuclear material used as the source of heat or power.
> This information should also be transmitted to the Secretary General of the United Nations.[33]

In the above provisions, the first and last paragraphs refer to the procedure of notification. In accordance with the above agreed upon formulation, notification should be given whenever a "space object is malfunctioning with a

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31. *See supra* note 15.

32. *See supra* note 21. The agreed format reached in the third session of the Working Group of the Scientific and Technical Sub-Committee was contained in U.N. Doc. A/AC.105/287, Annex II, at 4 (1981).

33. U.N. Doc. A/AC.105/320, Annex II, at 22-23 (1983).

risk of re-entry of radioactive materials to the earth." If the operation is normal or the re-entry to earth takes place as planned, then it is not necessary to give notification. The second important element is that notification should be given "timely" to "states concerned". The word "timely" means that notification should be given no later than when the malfunction is discovered. The addressee should in the first place be "states concerned," which include states on whose territory radiological materials could land and also states possessing tracking facilities who are in need of the information provided in the format for monitoring purposes. The last paragraph provides that the notification should also be given to the Secretary-General of the United Nations; that means to all countries. This is justified as the orbit lifetime and place of re-entry cannot be accurately predicted and could be in error by thousands of kilometers.[34] Therefore, it is expedient to inform the Secretary-General of the United Nations and through him the international community of the incident in light of imperfections of forecast of the re-entry.

With regard to the format of notification, it is quite logical for lawyers to adopt the text already agreed upon by the technical experts which is contained in the report of the third session of the Working Group of the Scientific and Technical Sub-Committee.[35] In analyzing the format, it should be noted that in the section of "System parameters", all provisions, except 1.4 are borrowed from the appropriate provisions of the format of notification in the 1975 Registration Convention.[36] The new paragraph 1.4 is of particular significance since the information provided therein is helpful in answering the important question—where and when the re-entry of a malfunctioning space object with NPS on board will be taking place.[37]

The information in section 2 of the format is for answering another important question—What are the exact kind and amount of radioactive materials which could reach the earth due to the re-entry of a malfunctioning space object with NPS on board. Such information is specially needed for organizing and carrying out the search, clean-up and recovery operations, and will be very useful for enabling the affected state to work out a more appropriate emergency plan for providing the necessary technical means and personnel to deal with the radiological risks of the incident which has occurred in its territory.

In 1983, the Federal Republic of Germany submitted a working paper[38] to

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34. *See supra* note 17.

35. *See* supra notes 21, 32.

36. Art. IV of the Convention on Registration of Objects Launched into Outer Space (1975). For the text of the Convention, *see* U.N. Doc. A/Res. 3235, Annex IXXX (1974).

37. In a strict sense, 1.4 was worded in general terms, since accurate prediction of orbit lifetime and place of re-entry remains one of the most difficult and intractable problems of orbital mechanics. *See supra* notes 17, 34.

38. U.N. Doc. A/AC.105/C.2/L.138 (1983); U.N. Doc. A/AC.105/320, Annex III, at 29-34 (1983).

the Legal Sub-Committee illustrating the experience of the unprogrammed re-entry of COSMOS-1402. On the basis of this experience, the paper suggested that the launching state should provide "timely and comprehensive information". In 1984, FGR again raised this issue in a working paper[39] that would require the launching state to provide repeated and updated information as re-entry approaches. Following consultation and discussion in 1984-1986, the Working Group has finally succeeded in agreeing by consensus to add the following two paragraphs to the above-mentioned format on notification:

> The information, in accordance with the format above, should be provided by the launching state as soon as the malfunction has become known. It should be updated as frequently as practicable and the frequency of dissemination of the updated information should increase as the anticipated time of re-entry into the dense layers of the Earth's atmosphere approaches so that the international community would be informed of the situation and would have sufficient time to plan for any national response activities deemed necessary.
>
> The updated information should also be transmitted to the Secretary-General of the United Nations with the same frequency.[40]

As a whole, the above draft text on notification reached by consensus in the Legal Sub-Committee appears to be rather comprehensive and suits the needs of the various parties concerned. These provisions on notification will constitute an integral part of the new legal regime for the use of nuclear power sources in outer space.

B. *Assistance*

As most countries lack the tracking facilities and necessary technology, equipment, men and financial resources to cope with incidents of re-entry of space objects with NPS on board, the problem of providing emergency assistance is of great concern to a majority of countries, particularly the developing countries. An important point at issue is to whom the victim state or states should direct its or their petition for assistance, i.e., to the launching state only or also to other states. The existing treaty provisions in this respect are of little assistance. Article 5.4 of the 1968 Rescue Agreement provides:

> A contracting party which has reason to believe that a space object or its component parts discovered in territory under its jurisdiction, or recovered by it elsewhere, is of a hazardous or deleterious nature may so notify the launching authority, which shall immediately take effective steps, under the direction and control of the said Contracting

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39. U.N. Doc. A/AC. 105/C.2/L.146 (1984); U.N. Doc. A/AC.105/337, Annex IV, at 36-37 (1984).

40. U.N. Doc. A/AC.105/370, Annex II, at 17 (1986).

> Party, to eliminate possible danger of harm.[41]

Article XXI of the 1972 Liability Convention provides:

> If the damage caused by a space object presents a large-scale danger to human life or seriously interfers with the living conditions of the population of the functioning of vital centers, the state parties, and in particular the launching state, shall examine the possibility of rendering appropriate and rapid assistance to the state which has suffered the damage, when it so requests. . . .[42]

From the above quoted two clauses, it is clear that although the victim states may request the launching state to provide assistance, the provisions do not prohibit the victim state from requesting assistance from states other than the launching state. The latter clause further broadens the scope of states to provide assistance to include all States Parties to the Convention.

During discussion both in the Working Group and the plenary session of the Legal Sub-Committee, the Soviet Union insisted that the launching state had a priority right to provide assistance to the victim state. The Soviet Union based its assertion on 5.4 of the Rescue Agreement and stressed that only the experts of the launching state had specific knowledge of the space object with NPS, and therefore, only the launching state could render effective and economical assistance; moreover, unnecessary costs might be incurred without the participation of the launching state, and the launching state has no obligation to bear the unnecessary expenses due to its non-participation. However, other countries held the view that it is a sovereign right of the victim state to decide from which state it will seek assistance, be it the launching state or not. In any case, the launching state should be responsible for all costs of the search, clean-up and recovery operations. This issue of compensation would be better dealt with in the section on liability.

After discussions and repeated informal consultations in the 1985 and 1986 sessions, the Working Group of the Legal Sub-Committee arrived at an agreement by consensus on the theme of assistance as follows:

> Upon the notification of an expected re-entry into the Earth's atmosphere of a space object containing a nuclear power source on board and its components, all states possessing space monitoring and tracking facilities, in the spirit of international cooperation, shall communicate the relevant information that they may have available on the malfunctioning space object with a nuclear power source on board to the Secretary-General of the United Nations and the state concerned

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41. For the text of the Agreement on the Rescue of Astronauts, the Return of the Astronauts and the Return of Objects Launched into Outer Space (1968), *see* U.N. Doc. A/Res.2345, Annex XXII (1967).

42. For the text of the Convention on International Liability for Damage Caused by Space Objects (1972), *see* U.N. Doc. A/Res.2777, Annex XXVI (1971).

as promptly as possible to allow states that might be affected to assess the situation and take any precautionary measures deemed necessary.

After re-entry into the Earth's atmosphere of a space object containing a nuclear power source on board and its components:

(a) The launching state shall promptly offer, and if requested by the affected state,* provide promptly the necessary assistance to eliminate actual and possible harmful effects;

(b) All states, other than the launching state, with relevant technical capabilities and international organizations with such technical capabilities shall, to the extent possible, provide necessary assistance upon request by an affected state.

In providing the assistance in accordance with subparagraphs (a) and (b) above, the special needs of developing countries should be taken into account.

(*The question of the definition of the term "affected state" is to be considered later).[43]

The above agreed upon draft text on assistance has cleared up some uncertain points in the existing legal instruments. Due to inherent risks involved in the re-entry of space objects with NPS on board, it would be necessary to strengthen the tracking and monitoring network. The above-mentioned draft provision requires all states possessing monitoring and tracking facilities to cooperate with one another in this field. Such an arrangement is fully consistent with Article IX of the 1967 Outer Space Treaty,[44] which provides that in the exploration and use of outer space, "States Parties to the Treaty shall be guided by the principle of cooperation and mutual assistance." The said text permits the affected state in whose territory the accident takes place to resort either to the launching state or to other states or international organizations for assistance. With such a flexible provision, it would be able to meet the various demands of the affected state.

C. *Liability*

On the question of liability, the 1967 Outer Space Treaty contains a general provision that States Parties to the Treaty shall bear international responsibility for their activities in outer space, whether such activities are carried on by governmental or non-governmental agencies (Article VI). The Treaty also provides that each State Party to the Treaty is internationally liable for damage caused by its space objects to other States Parties or their natural or juridical persons on the earth, in air, or in outer space. (Article VII).[45]

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43. U.N. Doc. A/AC.105/370, Annex II, paras. 5.4-5.5, at 17-18 (1986).

44. For text 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 (1967), *see* U.N. Doc. A/Res.2222, Annex XXI (1966).

45. *Id.*

The 1972 Liability Convention further provides that "a launching state shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the earth or to aircraft in flight" (Article II), and the compensation "shall be determined in accordance with international law and the principles of justice and equity in order to provide such reparation in respect of the damage as will restore the person, natural or juridical, state or international organization on whose behalf the claim is presented to the condition which would have existed if the damage had not occurred". (Article XII).[46]

On the other hand, according to Article V of the 1968 Rescue Agreement, the launching state seems to be liable to pay for such expenses only if it requests the return of the material that has re-entered from another state which recovers such material.[47] Moreover, the "damage" as defined by the Liability Convention must cause loss of life, personal injury or damage to property (Article I),[48] but no mention is made of damage to the environment. As large amounts of expense will be incurred from search and clean-up of radioactive materials to restore the condition that existed before the incident occurred, such damage to the environment should also be included and be compensated for by the launching State. All of these issues need further clarification.

In the Working Group of the Legal Sub-Committee, the Soviet Union and some Eastern European countries held that the existing treaties, particularly the Liability Convention, are adequate and sufficient to deal with issues which arise due to accidents involving malfunctioning space objects with NPS. In the discussion, they tended to be occupied with the issue of liability along with the problem of assistance. But, most countries insisted that the issues of assistance and liability, though having linkages, are two different questions which should be dealt with separately. Assistance could be provided by all countries with such capabilities, including the launching state; while compensation should only be paid by the launching state.

The Canadian working paper submitted in 1981, did not refer to liability.[49] After accommodating the views of a number of countries, the Canadian working paper of 1983 added another section on liability as an independent principle.[50] In dealing with the incident involving COSMOS-954, Canada based its demands to the Soviet Union mainly on provisions of the Liability Convention.[51] After three years of negotiation, the two countries signed a Protocol on

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46. *See supra* note 42.

47. *See supra* note 41.

48. *See supra* note 42.

49. U.N. Doc. A/AC.105/320, Annex IV, at 4-6 (1981).

50. U.N. Doc. A/AC.105/320 Annex III, at 25-28 (1983).

51. One of the crucial assertion in Canada's "Statement of Claim" was based on the definition of damage provided in the Liability Convention, and read as follows: "The deposit of hazardous radioactive debris from the satellite throughout a large area of Canadian territory, and the presence of that debris in the environment rendering

April 21, 1981, by which Canada accepted the payment of 3 million Canadian dollars "in full and final settlement of all matters connected with the disintegration of the Soviet satellite COSMOS-954 in January 1978."[52] The above sum was about half of the amount of the 6 million Canadian dollars which Canada originally claimed from the Soviet Union. A characteristic of the Protocol is that Canada obtained compensation while the Soviet Union made the payment without accepting liability. This case, having settled the dispute arising from the COSMOS-954 incident by providing a temporary adjustment of interest, lacks a legal component that is essential to the creation of international law. It remains uncertain whether this case will set a precedent establishing a rule of international space law on state responsibility and liability. Therefore, in developing a comprehensive regime governing the use of nuclear power sources in outer space, it is still necessary to formulate a definite and separate article and provisions on the issue of liability.

D. *Safety Measures*

The 1967 Outer Space Treaty contains a general provision which provides that in the exploration and use of outer space, States Parties to the Treaty shall avoid harmful contamination (Article IX).[53] With regard to specific measures on radiological protection, the Working Group of the Scientific and Technical Sub-Committee, in its first session held in 1979, agreed that such measures for adequate radiation protection during all phases of an orbital mission of a space object with NPS should be derived principally from the existing and internationally recognized basic standards recommended by ICRP, in particular ICRP publication 26.[54] In the second session, the Working Group, besides reaffirming those recommendations agreed upon in the first session, took particular note of the ICRP recommendations contained in paragraph 12 of its publication 26 as follows:

> (a) No practice shall be adopted unless its introduction produces a positive net benefit:
> (b) All exposures shall be kept as low as reasonably achievable, economic and social factors being taken into account; and
> (c) The dose equivalent to individuals shall not exceed the limits recommended for the appropriate circumstances by the commission.[55]

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part of Canada's territory unfit for use, constituted damage to property within the meaning of the Convention." *See* International Legal Materials at 905 (1979).

52. Department of External Affairs of Canada, communique No.27 (1981).

53. *See supra* note 44.

54. U.N. Doc. A/AC.105/238, Annex II, at 2 (1979).

55. *See supra* note 20. *See also* U.N. Doc. A/AC.105/267, Annex II, ¶ 11, at 2 (1980).

It was recognized that a careful analysis of these issues should be undertaken by the launching states prior to the use of NPS in space; and, the result of such an analysis should be communicated to other states to the extent feasible. Concerning dose limits, the Working Group agreed that in each case, prior to launch, an assessment of the collective and individual dose equivalent commitments must be carried out for all planned phases of a space mission with NPS. The Working Group further noted that ICRP publication 26 recommends an annual dose equivalent limit for workers of 50 mSv (5 rem) whole body dose (or equivalent doses to parts of the body), and an annual dose equivalent limit for the most highly exposed members of the public (the critical group) of 5 mSv from all man-made sources. The Working Group recommended that these limits not be exceeded during the normal phase of an NPS mission.[56]

In an effort to make progress in the field of safety measures, Canada, China, and Sweden, later joined by the Netherlands, submitted two working papers[57] to the Legal Sub-Committee. The main contents therein were based on what had been achieved by consensus in the Working Group of the Scientific and Technical Sub-Committee as mentioned above. When deliberation on the issue of safety measures is restarted in the Working Group of the Legal Sub-Committee, the Working Group will likely proceed further and make decisions on the basis of the results already achieved by the technical experts.

IV. *Perspective of a New Regime*

Developments in space technology point to the trend that nuclear power sources seem to be a preferred technical choice for certain important space missions due to their advantages, such as long life, compactness and ability to operate independently of solar radiation. In these circumstances, the establishment of a new legal regime to deal with the unique questions arising from the use of NPS in outer space is an important problem which must be satisfactorily solved in order to ensure its safe use for space missions. Despite great discrepancies in views with respect to the issues involved and the slow pace in moving forward, the general trend thus far has appeared to be a steady and constructive one toward the evolvement of a new regime for the use of NPS in outer space.

In 1985, the Legal Sub-Committee agreed by consensus that the title of this item in the agenda be changed to "The Elaboration of Draft Principles Relevant to the Use of Nuclear Power Sources in Outer Space."[58] This is indeed noteworthy since the change of title signifies that substantive progress has been made in the deliberation of this item. It may be recalled that when this item was first placed on the agenda, it was under the title "Review of

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56. *Id.* ¶ 11, 12, at 3.

57. *See supra* note 29.

58. U.N. Doc. A/AC.105/352, Annex II, at 29 (1985).

Existing International Law Relevant to Outer Space Activities With a View to Determining the Appropriateness of Supplementing Such Law With Provisions Relating to the Use of Nuclear Power Sources in Outer Space."[59] In 1981, as the discussion progressed, it was renamed as "Consideration of the Possibility of Supplementing the Norms of International Law Relevant to the Use of Nuclear Power Sources in Outer Space."[60] For the purpose of facilitating the work of deliberation, the Chinese Delegation as early as 1982, at the twenty-fourth session of COPUOS, urged that the title of this item should be adequately changed[61], and afterwards, together with the Canadian and other delegations, proposed in the Legal Sub-Committee in 1983 and 1984 to change the title of this agenda item to "Consideration of Supplementing the Norms of International Law Relevant to the Use of Nuclear Power Sources in Outer Space Through Its Working Group". But, such proposals to make necessary changes in the agenda items only succeeded after reaching consensus in 1985. This change more correctly reflected and corresponded to the actual process of deliberation in the Working Group in that consideration of this item had far surpassed the procedural process and entered substantive discussion. This new title will undoubtedly be helpful to the deliberation work for achieving better results.

So far, the efforts of COPUOS and its two Sub-Committees have been directed toward the assessment of the four main issues mentioned in the previous part of this paper. These issues are notification, including procedure and information to be transmitted before an unprogrammed re-entry; emergency assistance; liability for damages; and safety measures. Since agreements by consensus mainly have been reached on notification and assistance, and since the issue of legal liability of the launching state for harm caused by NPS seems to be clear and uncontroverted, the future concern of COPUOS and its two Sub-Committees on the use of NPS in outer space will be concentrated on the issue of new safety standards. While the relevance of basic criteria contained in document No. 26 of the ICRP was suggested by the technical experts,[62] these standards are merely recommendations. Therefore, after analysis by the Legal Sub-Committee as to the completeness of such standards in the legal sense, it would be desirable to formulate and agree upon new specific principles and rules on the basis of such recommendations. These principles and rules constitute an integral part of a new international agreement under COPUOS sponsorship.

Another important question is, are there any other issues which should be

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59. *See supra* note 24.

60. *See supra* note 27.

61. U.N. Doc. A/AC.105/PV.237, at 7 (1982). The proposed title was "Consideration of the Questions Supplementing the Norms of International Law Relevant to the Use of Nuclear Power Sources in Outer Space."

62. *See supra* notes 54, 55.

included in the legal framework for the use of NPS in outer space. In 1985, the Working Group of the Legal Sub-Committee, at the instance of some delegations, suggested that the theme of protection of space objects with NPS on board should be discussed in addition to the four main issues enumerated above. But, some delegations were of the view that the protection of space objects with NPS on board must not be considered except with reference to the protection vis-a-vis fortuitous external events, and that protection vis-a-vis international agreement is a matter which is beyond any mandate given to COPUOS and its Sub-Committees.[63] The recent Canadian working paper, submitted in 1986 to the Legal Sub-Committee,[64] contained five principles of which four correspond to those that have already been agreed upon. Only the fifth principle, concerning safety assessments and notification, remains to be agreed upon and thrashed out through consultation.

As evidenced by the developments, analyzed above, the evolution of a new legal regime for the use of NPS in outer space has been a growing trend and has gained momentum in recent years. Although a long and difficult process has to be gone through and many thorny problems still have to be tackled, adequate results can nevertheless be expected and achieved step by step with a spirit of compromise and through untiring efforts.

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63. U.N. Doc. A/AC.105/352, Annex II, at 27 (1985).

64. U.N. Doc. A/AC.105/370, Annex IV, at 28-30 (1986).

MANUFACTURERS' LIABILITY UNDER UNITED STATES LAW FOR PRODUCTS USED IN COMMERCIAL SPACE ACTIVITIES

*Randal R. Craft, Jr.**

I. *Introduction*

The Challenger disaster has emphatically reminded us that, even in a government-run manned space program with high standards and vaunted safeguards, accidents will occur. Commercial space programs will be no different, and there is now an intensified interest in the legal liabilities that may arise out of accidents in (or on the way to) outer space.

This article describes the likelihood that United States product liability law will be applied to determine the liability of manufacturers for personal injury, property damage, and economic loss allegedly caused by the use of those manufacturers' products in commercial space activities. Application of U.S. product liability law is made possible by the rather limited scope of the international space law agreements relating to liability, which agreements are briefly reviewed herein. This article concludes with an account of current aspects of U.S. product liability law that are of particular interest to manufacturers whose products are being used in commercial space activities.

Of course, use of the term "U.S. product liability law" is not intended to suggest the existence of any monolithic body of law; the term is used here only as a shorthand reference to the individualistic and often inconsistent product liability laws, statutory and decisional, of the various states of the United States, as well as potentially applicable federal laws, such as admiralty law.

It should be noted that, to the extent that international and domestic laws permit, parties involved in commercial space activities may, by contractual agreement, allocate among themselves the responsibility, risk of loss, insurance costs, etc., as they see fit, provided that the parties' bargaining positions are not too unequal and that the contract provisions otherwise comply with public policy. In this and other ways, proper planning with the assistance of United States product liability counsel can help minimize manufacturers' risks under U.S. product liability law. However, exculpatory agreements will probably have little or no effect on the rights of anyone who is not, directly or indirectly, a party to the contract.

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II. *Applying United States Product Liability Law to Accidents in Outer Space.*

Courts of other countries seldom apply United States product liability law to any of the issues in a product liability lawsuit. Therefore, claimants who are seeking to have U.S. product liability law apply to their cases will take advantage of every opportunity to prosecute their product liability claims in United States courts.

Foreign claimants want to have the substantive product liability law of the United States applied to their cases because the U.S. product liability law makes it easier for plaintiffs to recover from manufacturers for damage caused by the manufacturers' products, although this may change somewhat in Europe under the new EEC directive on product liability.[1] Even when U.S. courts apply foreign substantive law to the measure of damages, United States juries are more than generous in determining the appropriate level of damages. Claimants are also intrigued by the possibility of obtaining punitive damages in the U.S. Finally, claimants can finance their U.S. lawsuits through the contingent fee system.[2]

Of course, even when they have proper jurisdiction over the subject matter and parties in a lawsuit, U.S. courts are increasingly dismissing certain actions against American defendants by foreign plaintiffs on the ground of *forum non conveniens*. We began this trend in 1978 in *Bouvy-Loggers v. Pan American World Airways, Inc.*,[3] which arose out of the Tenerife aircraft collision, and the current high-water mark of the *forum non conveniens* doctrine is found in the United States Supreme Court decision in *Piper Aircraft Corp. v. Reyno*.[4] However, the doctrine gives the trial courts much discretion not to dismiss the actions,[5] which discretion will be exercised on the basis of the particular facts of

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1. *But see* Diederiks-Verschoor, *Special Aspects of Products Liability in Relation to Space Transportation*, PRODUCT LIABILITY IN AIR AND SPACE TRANSPORTATION 165, 175 (K-H. Bockstiegel ed. 1977) (Directive should not be used to regulate product liability in space transportation).

2. Use of a contingency fee is probably inappropriate when there is little or no contingency involved, which might be the case where a state is automatically liable or when the private defendant does not contest liability. *See, e.g.*, Craft, *The Direct Approach to Early Settlement of Mass Disaster Cases*, MANAGEMENT OF COMPLEX MASS TORT LITIGATION 431 (P. Glazer ed. 1986).

3. 15 Av. Cas. (CCH) 17,153 (S.D.N.Y. 1978). *See* Craft, *Factors Influencing Settlement of Personal Injury and Death Claims in Aircraft Accident Litigation*, 46 J. AIR L. & COM. 895, 908-10 (1981).

4. 454 U.S. 235 (1981).

5. Recent cases in which the courts denied American defendants' motions to dismiss lawsuits by foreign plaintiffs on the ground of *forum non conveniens* include Friends for All Children, Inc. v. Lockheed Aircraft Corp., 717 F.2d 602 (D.C. Cir. 1983), and *In re* Aircraft Disaster Near Bombay, India on January 1, 1978, 531 F. Supp. 1175

the case before the court.[6] Major considerations are whether the lawsuit can be reinstituted in a more convenient foreign forum and whether plaintiffs will be able to get proper relief in that forum.[7] (It should be noted that U.S. courts will generally impose certain conditions on *forum non conveniens* dismissals in order to help protect the plaintiffs.) Another consideration of major importance is whether litigating the lawsuits in a U.S. court would preclude a U.S. defendant from having access to the relevant foreign witnesses and records and from bringing other likely foreign defendants into the lawsuit by means of third-party claims (recourse actions).[8]

All in all, the likelihood is that the *forum non conveniens* doctrine will not generate a steady stream of dismissals of foreign plaintiffs' product liability claims arising out of commercial space activities. Accordingly, because most claims instituted in U.S. courts by foreign plaintiffs and U.S. plaintiffs will probably not be dismissed on the ground of *forum non conveniens*, the more interesting issue is whether those U.S. courts will choose to apply U.S. law to those claims. (The determination of this issue may influence, but is seldom dispositive of, the outcome of the *forum non conveniens* issue itself.)

Initially, it must be emphasized that United States courts generally use a *depecage* approach that allows the laws of different jurisdictions to be applied to different issues in a case. At the present time, most U.S. courts are more likely to choose the law applicable to a particular issue in a product liability case on the basis of an analysis of the relationships among the parties with respect to that issue, the connection between the parties and the jurisdiction in which the accident occurred, the various jurisdictions' governmental interests in the application of their laws, the various governmental interests in the outcome of the issues, and so forth. Even in those U.S. jurisdictions that still follow *lex loci delicti*, the *lex loci* approach is less likely to be followed when the location of the accident is found to be fortuitous. Furthermore, some courts make every effort to apply the law of the forum jurisdiction, that is, the law of the jurisdiction in which the plaintiff has instituted his lawsuit (assuming that the court has jurisdictional power over the defendants and that the forum jurisdiction has sufficient contacts and interests to satisfy Constitutional requirements of fairness in choice of law). Naturally, in any court the law of the forum

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(W.D. Wash. 1982).

6. *See* Craft, *Forum Non Conveniens Considerations in Product Liability Litigation*, MANAGEMENT OF COMPLEX MASS TORT LITIGATION 403 (P. Glazer ed., 1986).

7. Perhaps the most significant recent decision in this area is *In re* Union Carbide Corporation Gas Plant Disaster at Bhopal, India, 634 F. Supp. 842 (S.D.N.Y. 1986). A consolidated lawsuit consisting of 145 lawsuits on behalf of thousands of Indians was dismissed on the grounds that, under the circumstances, the Indian legal system would be better able to determine the cause of the accident and fix liability; the overwhelming majority of witnesses and evidence was in India, as were the claimants; and India had a substantial interest in the accident and the outcome of the litigation.

8. *See, e.g.*, Wahlin v. Edo Corp., 17 Av. Cas. (CCH) 17,562 (N.Y. Sup. Ct. 1982).

jurisdiction will be applied where the court finds that there is no real conflict between that law and the other jurisdictions' laws that might otherwise be applied.

Many factors are considered by U.S. courts in deciding what laws to apply to conventional product liability cases. Additional factors will be considered if a case arises out of an accident or activity in outer space. One such factor would be the identity of the launching state in which the space object in question is registered. Since outer space is itself not a "jurisdiction," identifying the registry state (see Part III.C *infra*) might determine the jurisdiction in which the accident or the conduct (on the space object) may be said to have occurred. (This would still not be dispositive unless a strict *lex loci delicti* rule was followed.) Depending on where the accident occurs, the court may also have to decide whether the launching state of registry has jurisdiction and control over the spacecraft during the entire flight up into space, including any flight through airspace of other countries passed through on the way to outer space; the "functionalist" approach answers this question in the affirmative.[9]

Similar choice of law problems arise in cases involving maritime activities that take place beyond the territory of any nation. (Indeed, the United States government's recognition of this similarity is reflected in the way that the criminal jurisdiction exercised by the United States over crimes on space vehicles of U.S. registry resembles the U.S. exercise of jurisdiction over crimes on aircraft over the high seas.)[10] In a maritime case where there is a conflict among the potentially applicable laws of various nations, the governmental interest analysis used by U.S. courts will, among other factors, take into account the ship's registration in a particular nation much as they would take into account a nation's territorial jurisdiction over the location of an accident.[11]

Simple explanations of the choice of law rules that may be applied by U.S. courts will probably be inaccurate. Equally inaccurate will be any attempt to predict in a complex case the law that will be chosen as a result of the application of the ambiguous and often inconsistent choice-of-law rules. Nevertheless,

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9. *See* Gál, *Fundamental Links and Conflicts Between Legal Rules of Air and Space Flights*, PROC. 26th COLLOQ. L. OUTER SPACE 77 (1983).

10. 18 U.S.C.A. § 7(6), Pub. L. No. 97-96, 95 Stat. 1210 (1981). Although of very limited practical interest, another potential analogy may be found in laws applicable to Antarctica. *See, e.g.*, P. JESSUP & H. TAUBENFELD, CONTROLS FOR OUTER SPACE AND THE ANTARCTIC ANALOGY (1959).

11. *Cf.* Lauritzen v. Larsen, 345 U.S. 571 (1953). The issue of choice of law in international waters may be governed by the Convention on the High Seas, April 29, 1958, 13 U.S.T. 2313, T.I.A.S. No. 5200. Article 1 states that the term "high seas" means all parts of the sea that are not included in the territorial seas or in the internal waters of a state. As to which law applies in such a nationless void, Article 5 states that "[s]hips have the nationality of the state whose flag they are entitled to fly." Article 6 provides that ships shall sail under the flag of one state only and, save in exceptional cases expressly provided for in this or other international treaties, shall be subject to its exclusive jurisdiction on the high seas.

some weak generalizations may be risked in an effort to bring some semblance of order, however oversimplified, out of this chaos: In deciding which law will be applied to determine the elements of damages recoverable by foreign and domestic plaintiffs in a product liability action, U.S. courts will generally apply the damage laws of the domicile of the injured party. In order to determine whether the manufacturer will be held strictly liable or liable for negligent conduct in manufacturing and designing the product, U.S. courts will tend to apply the law of the jurisdiction that has the most liberal grounds for recovery against the manufacturer, provided that that jurisdiction had a reasonably foreseeable connection with the product and the parties to the lawsuit. An exception to this is when the court making this decision is sitting in the jurisdiction where the manufacturer is located; in that situation the courts tend to apply the law of the forum jurisdiction. (Again, in determining that U.S. product liability law is to be applied in a particular case, a court will use the foregoing principles to determine which U.S. jurisdictions are the ones whose laws should be applied.)

Commentators have suggested that there be a unification or harmonization of the choice-of-law rules used in resolving tort and contract claims that have their genesis in outer space.[12] This will apparently not happen in the foreseeable future. It must be concluded, then, that United States product liability law will probably be applied by U.S. courts to determine manufacturers' liability for damage caused by products used in commercial space activities in cases where the product was manufactured in the United States, where the product constituted part of a space object launched by the United States or registered in the United States,[13] or where the damages not unforeseeably occurred in the United States. (This conclusion would not apply in the unlikely case in which an American plaintiff is suing a foreign manufacturer whose home jurisdiction provides a more liberal basis for recovery by the plaintiff.)

III. *International Space Law.*

Of course, when U.S. law is applied, that law includes the international agreements to which the U.S. is a party. To the extent that their provisions are pertinent, these agreements are controlling, and they must be described here. (Recognizing that virtually every article on space law liabilities includes a tiresome recitation of the provisions of the relevant international agreements, the following descriptions are especially brief and are intended to offer some new perspectives.)

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12. *See, e.g.*, Haanappel, *Product Liability in Space Law*, 2 HOUS. J. INT'L L. 55, 62-64 (1979); DeSaussure & Haanappel, *A Unified Multinational Approach to the Application of Tort and Contract Principles to Outer Space*, 6 SYRACUSE J. INT'L L. & COM. 1 (1978).

13. *Cf.* Bourély, *The Spacelab Program and Related Legal Issues*, 11 J. SPACE L. 27, 31-32 (1983).

A. *The Outer Space Treaty of 1967.*

The Outer Space Treaty[14] is remarkable in that, in addition to leaving "space activity" undefined, it does not define "outer space". The absence of such a definition in this and other international agreements is due to the disagreement among the nations of the world concerning the lower limit of outer space, that is, the boundary between airspace ("inner space") and outer space.[15] The Soviet Union has proposed that 100-110 kilometers above the Earth's sea level be considered as the lower limit of outer space, but this is higher than the lowest practical perigee of some satellites with eccentric orbits, and it might seem incongruous to say that any satellite in its own orbit was not in outer space. For this and other reasons, the United States prefers to avoid setting any specific altitude limit at this time.

A number of equatorial nations have asserted sovereignty over satellites in geostationary orbits permanently above their territory. Of course, since the satellites have a definite orbital velocity that is simply synchronized with the Earth's rate of rotation, to suggest that the satellites are stationary may be a Ptolemaic misnomer.

The Chicago Convention[16] gives each nation complete and exclusive sovereignty above its territory, but this refers only to the airspace below the lower limit of outer space. Therefore, the uncertainty about the boundary between airspace and outer space leads to uncertainty as to which laws are applicable to activities or occurrences in the vicinity of that boundary.

Article II of the Outer Space Treaty precludes nations from claiming sovereignty over outer space. Nations are, however, permitted to exercise jurisdiction over space objects.[17] Indeed, the Treaty, in conjunction with an envisioned registration system, requires each state to exercise jurisdiction and control over its registered space objects, and over any personnel thereon, while in outer space or on a celestial body (Article VIII). The Treaty's goal with respect to

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14. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, January 27, 1967, 18 U.S.T. 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205. There are 93 signatories to this treaty, including the United States and most other technologically advanced countries.

15. *See, e.g.*, Cheng, *The Legal Status of Outer Space and Relevant Issues: Delineation of Outer Space and Definition of Peaceful Use*, 11 J. SPACE L. 89 (1983); Kopal, *The Question of Defining Outer Space*, 8 J. SPACE L. 154 (1980); Sloup, *Outer Space Delimitation Proposals: Enlightened Jurisprudence or Celestial Shakedown? Some Implications for Private Enterprise*, 2 HOUS. J. INT'L L. 87, 106-12 (1979); *The Problem of the Demarcation of Air Space and Outer Space*, PROC. 59th CONF. INT'L L. A. 168-207 (1980).

16. Convention on International Civil Aviation, Dec. 7, 1944, art. 1, 61 Stat. 1180, T.I.A.S. No. 1591.

17. *See generally* Rothblatt, *State Jurisdiction and Control in Outer Space*, PROC. 26th COLLOQ. L. OUTER SPACE 135 (1983).

commercial (private) space activities is to make each nation's government responsible for seeing that commercial space activities comply with international law (Article III) and, more particularly, with the nation's obligations under the treaty itself (Article VI). According to the United States State Department, the U.S. has this obligation despite the absence of internal U.S. legislation, which is to say that Article VI of the treaty is self-executing in the U.S.

Article VI makes the appropriate governments responsible for authorizing and supervising non-governmental space activities. In the United States, this may lead to a situation where the government's control over private commercial space activities will become similar to the regulatory control that it exercises today over licensed aviation activities.[18] However, although it may already have some such power to regulate space activities, NASA apparently does not desire this role.[19]

Under Article VII, each nation that launches or procures the launching of an object into outer space and each nation from whose territory or facility an object is launched is internationally liable for damage to other nations that are also parties to the treaty or to those nations' natural or juridical persons. In conjunction with Article VI, Article IX also makes a nation responsible for supervision of space activities of its nationals notwithstanding that nation's non-involvement with the relevant launch. In particular, a non-launching nation may be subject to responsibility under Article VI for damages caused by a space object launched by its nationals not from the territory of that or any other nation but, instead, for example, from the high seas.[20]

Accordingly, a nation involved in the launch of a space object will clearly be liable under the treaty for any damages to another nation or to another nation's nationals that were caused by defects or dangerous conditions in that space object. Further, it may be argued that a nation that is not involved in the launch of a space object but in which the space object was manufactured is subject to liability under Article VI for any damages to another nation or to another nation's nationals that were caused by defects in the space object; my view is that this argument goes beyond the intended obligations under the treaty.

Curiously, a strict reading of the treaty would seem to make a launching nation liable for defects in a space object that was manufactured by a private company in the very nation making the damage claim against the launching nation. Such a strict construction of the treaty would probably yield to practical considerations, but exactly how this would be accomplished would depend

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18. Menter, *Legal Aspects of Commercial Space Activities*, paper presented at the First National Institute on Aviation Litigation and Space Law sponsored by the American Bar Association (1982).

19. Hosenball, *The Law Applicable to the Use of Space for Commercial Activities*, PROC. 26th COLLOQ. L. OUTER SPACE 145 (1983).

20. *See* Gorove, *Space Stations - Issues of Liability, Responsibility and Damage*, PROC. 27th COLLOQ. L. OUTER SPACE 251, 253 (1984).

upon the particular situation.

No specific procedures are established by the Outer Space Treaty for prosecution of damage claims, nor does the treaty describe or limit the damages recoverable, though it may be assumed that it provides for recovery only of provable compensatory damages.[21]

B. *The Liability Convention.*

The Liability Convention of 1972,[22] which took eight years to negotiate,[23] was the next international agreement to deal with liabilities. As its formal title demonstrates, the Convention deals only with international liability for damage caused by space objects. The Convention defines a launching nation (Article I(c)) in the same way as the Outer Space Treaty and makes such a launching nation absolutely liable to pay compensation for damage proximately caused by its space object to persons or property on the surface of the earth or to aircraft in flight (Article II). The term "space object" is defined to include component parts of a space object, as well as its launch vehicle and parts thereof (Article I(d)).[24] A launching nation is not absolutely liable for damage caused by its space object to another launching nation's space object or to persons or property on board another launching state's space object (unless the other space object is on the surface of the earth). Instead, the nation that launched the damage-causing space object will be liable only if the damage is due to its fault or the fault of persons for whom it is responsible (Article III). Whenever there are two or more launching nations responsible for damages caused by a jointly launched space object or for damages caused to a third nation by separately launched space objects, the launching nations will be jointly and severally liable for such damages, but, as between themselves, the "burden of compensation" (apportionment or allocation of responsibility) is to be determined in accordance with the extent to which each was at fault.[25] For

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21. Compensatory damages for extended effects of harmful contamination, which contracting nations are required to avoid under Article IX, could be in the hundreds of millions of dollars.

22. Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, T.I.A.S. No. 7762. The Liability Convention has 80 signatories, including the United States and most of the other technologically advanced countries; among the non-signatories is The People's Republic of China.

23. N.M. MATTE, AEROSPACE LAW 153 (1977).

24. The definition of space object, when considered along with other provisions of the Liability Convention and the Outer Space Treaty, gives rise to some doubt as to whether a space station is a space object, particularly if it is a permanent station on the Moon or other celestial body. *Compare* N.M. MATTE, AEROSPACE LAW 156 (1977), *with* Gorove, *Space Stations - Issues of Liability, Responsibility and Damage*, PROC. 27th COLLOQ. L. OUTER SPACE 251 (1984).

25. Practical difficulties in applying Articles II and III to various scenarios are

example, the United States and any other state for whom shuttle launch services are provided on a particular flight would be jointly and severally liable for damages caused by the shuttle or other space objects launched on that flight.[26] Because of this, the launching nations will enter into pre-launch agreements allocating risks among themselves.

Inexplicably, the Liability Convention exonerates a launching nation from absolute liability to the extent the launching nation can establish that the damage resulted from gross negligence or intentional acts or omissions on the part of a claimant nation or its nationals. (Article VI.1) This defense is of limited utility, for, as indicated above, absolute liability is imposed only in situations where the damaged party is unlikely to have been even minimally negligent, much less grossly negligent. In any event, to the extent that this provision has any practical application at all, it will probably be the source of some vigorous disputes, just as similar provisions have caused much controversy in aviation cases.

The Liability Convention does not control liability of a launching nation to its own nationals. (Article VII) Furthermore, although the term "launching" includes an attempted launching (Article I(b)), Article VII states that the Convention does not control liability of a launching nation to foreign nationals present for launch operations.

In describing the damages recoverable under the Liability Convention, Article XII refers to compensation that is to be based upon international law and principles of justice and equity in order to restore the damaged party "to the condition which would have existed if the damage had not occurred." This might seem to allow unlimited recovery for provable compensatory damages proximately caused by the space object, including mental damages (*e.g.*, pain and suffering), "moral" damages, and various kinds of consequential economic damages.[27] Nevertheless, it has been suggested that the Convention is not sufficiently victim-oriented and that victims will be unlikely to recover full compensation under the Convention.[28] It may be asked whether the Convention allows recovery of more elements of compensatory damages than are provided for by the law of the domicile of the victim; my view is that in such a case recovery should be no greater than that provided for by the domicile's law.

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discussed in M. FORKOSCH, OUTER SPACE AND LEGAL LIABILITY 75-87 (1982).

26. Menter, *Legal Responsibility for Outer Space Activities*, PROC. 26th COLLOQ. L. OUTER SPACE 121, 122 (1983).

27. Nesgos, *International and Domestic Law Applicable to Commercial Launch Vehicle Transportation*, PROC. 27th COLLOQ. L. OUTER SPACE 98, 101 (1984); Christol, *International Liability for Damages Caused by Space Objects*, 74 AM. J. INT'L L. 346, 357-68 (1980); Gorove, *Liability of the State and Private Companies for Mishaps Involving Space Activities*, paper presented at the Second National Institute on Litigation in Aviation and Space Law sponsored by the American Bar Association (1983).

28. *See, e.g.*, Reijnen, *Outer Space Law and Private Enterprise in Outer Space: An International Perspective*, 2 HOUS. J. INT'L L. 65, 75 (1979).

The Convention's procedures for making claim against the launching nation have also been criticized. These claims must first be pursued through diplomatic channels (Article IX); if that does not result in resolution of the claim, then the Convention provides for the establishment of a claims commission upon the request of either party to the claim (Article XIV). Nevertheless, the claims commission decisions are not final or binding unless all parties have so agreed.[29]

The Convention does not deal with the way in which an injured national is to present his claim to his own government for prosecution against another nation. Domestic law will control this, as well as the procedure for a national to make claim against his own government for his damages that it caused. The Liability Convention also does not apply to claims made by or against non-contracting nations.[30]

More significant is the non-exclusivity of the Convention.[31] In other words, even where the Liability Convention does apply, it is not exclusive. The victims of damages caused by defective space objects may desire to sue the objects' manufacturers directly, especially when the manufacturers are United States companies that can be sued directly in United States courts under a more liberal standard of recovery.

In any event, even in situations where launching nations pay damages pursuant to the Convention, it is to be expected that, in the absence of contractual provisions to the contrary, the nations will seek indemnity from private manufacturers whose space objects caused the damage. Indeed, it has been suggested that a nation absolutely liable under international law for space activities of its own private industry will, in turn, ultimately promulgate laws making that industry absolutely liable to the nation.[32] Again, domestic law, not international law, will govern such claims over (recourse actions), as well as direct actions by victims against those manufacturers.[33]

C. *The Registration Convention.*

The Outer Space Treaty subjects a space object (while in outer space or on

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29. Comment, *Legal Ramifications of the Uncontrolled Return of Space Objects to Earth*, 45 J. AIR LAW & COM. 457 (1980).

30. These nations and their nationals will be at some procedural disadvantage. Magdelénat, *Spacecraft Insurance*, 7 ANNALS OF AIR AND SPACE L. 363, 368 (1982).

31. *See* Gorove, *Legal Aspects of International Space Flight*, 3 ANNALS OF AIR & SPACE L. 409, 417-19 (1978).

32. Böckstiegel, *Present and Future Regulation of Space Activities by Private Industry*, SYMP. SPACE ACTIVITIES & IMPLICATIONS (1980).

33. Matte, *Special Aspects of Product Liability in Relation to Space Transportation*, PRODUCT LIABILITY IN AIR AND SPACE TRANSPORTATION 181, 185-86 (K-H. Böckstiegel ed. 1977).

a celestial body) and any person on that space object to the jurisdiction and control of the nation in which the object is registered. But neither that treaty nor the Liability Convention made any further reference to registration, so registration was covered in the 1974 Registration Convention.[34]

This Convention requires the launching nation to maintain a registry in which each space object launched by that nation is to be registered. (Where there are two or more launching nations, they must determine among themselves which will register the object, for, as with aircraft under Article 18 of the Chicago Convention, there can be only a single registration for a space object.) Because each nation of registry determines the contents of its registry and the conditions under which the registry will be maintained (Article II.3), it has been argued that the Convention is not clear enough about requiring private companies to register their space objects with their governments and is also too lax in requiring timely notification of the United Nations Secretary General about the technical aspects of the launch, orbit, and function of the space object being launched.[35]

Another aspect of the Registration Convention that is of possible relevance to liability issues is the obligation the convention imposes on the contracting nations to help identify any unidentified space object that has caused damage (Article VI).

Of course, as noted in Section II *supra*, the registration may well have an effect on the determination of the law to be applied to various issues concerning the manufacture and operation of that object.

D. *Other International Agreements.*

There are other international agreements relating to space activities, but their primary relevance to product liability is in the indirect way that their provisions occasionally help clarify certain concepts in the above-described agreements.

Additional international agreements have been suggested and may someday come into force to deal with unresolved issues.[36] For example, since 1980 the Space Law Committee of the International Law Association has been work-

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34. Convention on the Registration of Objects Launched into Outer Space, January 14, 1975, 28 U.S.T. 695, T.I.A.S. No. 8480. There are 41 signatories to this convention, including the United States.

35. Reijnen, *supra* note 28, at 71, 75; de Crombrugghe, *International Interaction and Profits Regarding Launching of Satellites*, PROC. 27th COLLOQ. L. OUTER SPACE 298, 299 (1984). Legal problems of registration of space objects are the subject of a number of papers published in PROC. 28th COLLOQ. L. OUTER SPACE 173-207 (1985).

36. *See generally* Christol, *The Growth of Space Law*, ASTRONAUTICS & AERONAUTICS 111 (1981), and Jasentuliyana, *Treaty Law and Outer Space: Can the United Nations Play an Effective Role?* 11 ANNALS AIR & SPACE L. 219 (1986).

ing on a draft convention on the settlement of space law disputes.[37] (Interestingly, one study predicted many years ago that, when space travel becomes more highly developed, the nations will not want to be held responsible for private space activities.)[38]

Private companies involved in commercial space activities[39] may be surprised to find how much is left unresolved by current international space law agreements. This lack of resolution extends not only to matters not dealt with by the agreements but also to many matters that the agreements do attempt to cover. Customary international law may help fill in some of the gaps, but, except for certain admiralty principles, customary international law is imprecise and not very predictable.[40] Because current international agreements will seldom be pertinent to determining manufacturers' liability under U.S. law for products used in commercial space activities, it is the domestic law of the United States that will usually be determinative.

IV. *U.S. Domestic Law of Product Liability.*

The United States may some day have a preemptive federal law controlling product liability (see Section IV.G *infra*), at least product liability in space, but thus far it seems that, when U.S. product liability law is applied in a case, it will be the laws of one or more of the various states of the U.S. This may be seen in the recent cases in which satellite insurers and reinsurers have sued McDonnell Douglas and other companies involved in manufacturing the rocket motors whose malfunctions caused the failure of the Palapa B-2 and Westar VI satellites to achieve their proper orbits. *Appalachian Ins. Co. v. McDonnell Douglas Corp.*;[41] *Lexington Ins. Co. v. McDonnell Douglas Corp.*[42] In the Westar case, defendants moved for summary judgment on the basis of federal law, but this motion was denied on the ground that California law, not

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37. Böckstiegel, *Proposed Draft Convention on the Settlement of Space Law Disputes*, 12 J. SPACE L. 136 (1985); Böckstiegel, *Space Law Problems at the Turn of the Century*, PROC. 26th COLLOQ. L. OUTER SPACE 339, 342 (1983); Böckstiegel, *Convention on the Settlement of Space Law Disputes*, PROC. 26th COLLOQ. L. OUTER SPACE 179 (1983); Böckstiegel, *The Settlement of Space Law Disputes - Working Paper*, PROC. 59th CONF. INT'L L. A. 188 (1980).

38. M. SEARA VAZQUEZ, COSMIC INTERNATIONAL LAW 123-24 (1965).

39. The magazine *Aerospace America*, published by the American Institute of Aeronautics & Astronautics, assembled as of April 1, 1984, a list of over 350 companies directly involved in commercial space activities.

40. Dula, *United States Government Authorization and Supervision of Non-Governmental Space Activities: Present Law and Future Possibilities*, PROC. 27th COLLOQ. L. OUTER SPACE 35, 37-38 (1984).

41. No. 481712 (Cal. Super. Ct., Sept. 8, 1986).

42. No. 481713 (Cal. Super. Ct., Sept. 8, 1986).

federal law, should be applied because the manufacturers resided in California and because the U.S. Congress had not shown any intent to preempt tort actions involving defective products manufactured by private enterprise which arise in space.[43]

A. *Product Liability Law in Admiralty.*

Anyone remotely familiar with the crazy-quilt of product liability laws of the various states of the United States will recognize that they are too complex and inconsistent to be summarized accurately or meaningfully. Given the need here to oversimplify, one way to attempt to describe the product liability law of the United States is to describe the product liability law that is used by U.S. courts in maritime cases, especially those involving accidents on the high seas. Maritime law is subject to many specific statutes and international agreements[44] and contains many arcane doctrines. However, neither the idiosyncracies of maritime law nor its incorporation of customary international law[45] have precluded the "general" maritime law from attempting to absorb the best, or at least the most widely accepted, principles of product liability law from the laws of the various states of the United States.[46] In some measure, then, the general maritime law offers a generalized picture of the state of U.S. product liability law. Moreover, there is much to be said for the proposition that space law will develop so that it will become more like maritime law than like aviation law.[47] Fortunately, although my practice is primarily devoted to aviation and space matters, my law firm is heavily involved in maritime law, and I have been engaged in maritime law matters not only when airplanes have fallen into the ocean[48] but also in dealing with maritime product liability law as applied to vessels.

The general product liability principles recognized by maritime law include not only the maritime-related implied warranty of workmanlike service,[49] but also the implied warranties of fitness and merchantability.[50] Negligence by

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43. Appalachian Ins. Co., *supra*, Memorandum and Order of Sept. 8, 1986.

44. These treaties have been compiled in N. SINGH, INTERNATIONAL MARITIME LAW CONVENTIONS (1983).

45. *See generally* Lauritzen v. Larsen, 345 U.S. 571, 581-82 (1953).

46. *Cf.* Watz v. Zapata Off-Shore Co., 431 F.2d 100, 113 (5th Cir. 1970).

47. Twelve papers on the comparison between sea and space law are published in PROC. 28th COLLOQ. L. OUTER SPACE 118-172 (1985).

48. Many of the cases that developed the maritime product liability law were in fact aviation cases in which aircraft crashed at sea.

49. *See, e.g.*, Hurdich v. Eastmount Shipping Corp., 503 F.2d 397 (2d Cir. 1974).

50. *See, e.g.*, Schaeffer v. Michigan-Ohio Navigation Co., 416 F.2d 217, 221-22 (6th Cir. 1969); Ohio Barge Line, Inc. v. Dravo Corp., 326 F. Supp. 863, 865-66 (W.D.

the claimant does not preclude recovery for a breach of an implied warranty but may reduce the amount of recovery in accordance with the extent of the claimant's negligence.[51]

Of course, manufacturers may be held liable for negligence in design, planning, manufacturing, assembling, inspecting, testing, and servicing their products and their components.[52] In addition, they may be subjected to liability for negligence in furnishing insufficient manuals, instructions, and warnings regarding operations, maintenance, and repairs of products and their components.[53] Negligence in failing to make or recommend safety repairs or modifications to their products and their components will also subject manufacturers to liability.[54] Shipbuilders, as well as component-part manufacturers, owe a duty of reasonable care in the design and construction of their products to any person who may foreseeably be injured or whose property may foreseeably be damaged by the failure of the manufacturer to exercise such care.[55] If negligence or fault of the claimant is found to have contributed to the accident, this does not preclude recovery but may reduce the claimant's recovery.[56]

With respect to strict liability, maritime law has adopted Section 402A of the Second Restatement of Torts.[57] Thus, manufacturers (and other suppli-

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Pa. 1971); Montgomery v. Goodyear Tire & Rubber Co., 231 F. Supp. 447, 453-54 (S.D.N.Y. 1964).

51. *See, e.g.*, Lewis v. Timco, Inc., 716 F.2d 1425 (5th Cir. 1983).

52. *See, e.g.*, *In re* Oil Spill by Amoco Cadiz, 699 F.2d 909 (7th Cir. 1983); Jig the Third Corp. v. Puritan Marine Ins. Underwriters Corp., 519 F.2d 171 (5th Cir. 1975), *cert. denied*, 424 U.S. 954 (1976); Pan Am. World Airways, Inc. v. United Aircraft Corp., 56 Del. 187, 192 A.2d 913 (1963), *aff'd*, 57 Del. 322, 199 A.2d 758 (1964) (manufacturer liable for, *inter alia*, failure to test product component in vibrating environment in which it was to be used). *Cf.* Mickle v. Blackmon, 252 S.C. 202, 166 S.E.2d 173, 184-88 (1969) (manufacturer must design and manufacture product to withstand reasonably foreseeable environmental situations, even those not caused by manufacturer).

53. *See, e.g.*, Schaeffer v. Michigan-Ohio Navigation Co., 416 F.2d 217, 222-23 (6th Cir. 1969) (manufacturer failed to warn operator of hazards involved in repairs to product).

54. *See, e.g.*, Noel v. United Aircraft Corp., 342 F.2d 232, 236-37 (3rd Cir. 1964) (manufacturer has continuing post-delivery duty to develop and adapt improvements to make products safer).

55. *See, e.g.*, Jones v. Binder Welding and Machine Works, Inc., 581 F.2d 1331 (9th Cir. 1978).

56. *See, e.g.*, Hurdich v. Eastmount Shipping Corp., 503 F.2d 397 (2d Cir. 1974); Ohio Barge Line, Inc. v. Dravo Corp., 326 F. Supp. 863, 865-66 (W.D. Pa. 1971).

57. RESTATEMENT (SECOND) OF TORTS § 402A (1965). The great majority of States in the United States, including Illinois and Texas, have adopted the strict liability provisions of Section 402A of the Restatement, but there are many different interpretations of the Restatement's language. New York and California have adopted strict lia-

ers[58]) may be held strictly liable for furnishing products (including components) that were defective or dangerous and that caused the alleged damages.[59] Manufacturers may also be held strictly liable for insufficient manuals, comments, instructions, and warnings regarding operations, maintenance, and repairs of their products.[60] Negligence or fault on the part of the claimant will not preclude a claimant's recovery but may reduce it in an action based on defendant's strict liability.[61]

The foregoing principles of product liability law are rather unsurprising. Of more interest are the following, more controversial, issues of product liability law, not all of which have been faced in the admiralty context. These are only a few of the issues of concern, but they seem particularly relevant to commercial space activities.

B. *Standard of Care.*

Section 402A of the Restatement (Second) of Torts has been adopted by most U.S. states and, as noted above, by the general maritime law; it requires a plaintiff in a manufacturer's strict liability case to prove that the product was in a "defective condition unreasonably dangerous to the user or the consumer or to his property". This "unreasonably dangerous" requirement makes it necessary in some cases to decide whether the reasonableness of the danger is to be determined from the point of view of a consumer or a prudent manufacturer or from some other perspective. This makes no difference in most cases involving manufacturing defects and inadvertent design errors, but in cases involving alleged defects that result from conscious design choices, the outcome may depend upon how the reasonableness of the danger is assessed.

The Restatement considers a product unreasonably dangerous if the product is "dangerous to an extent beyond that which would be contemplated by

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bility, but not Section 402A. The Second Restatement of Torts was published in 1965 as a comprehensive formulation of general American tort law as it then stood and, at least with respect to strict liability, as it was expected to develop.

58. Lessors are also subject to strict liability, although an exception is usually made for "finance lessors" who act only in a financial capacity and who have virtually nothing to do with the product itself.

59. *See, e.g.*, Pan-Alaska Fisheries, Inc. v. Marine Constr. & Design Co., 565 F.2d 1129, 1134-36 (9th Cir. 1977); Jig the Third Corp. v. Puritan Marine Ins. Underwriters Corp., 519 F.2d 171, 176-77 (5th Cir. 1975), *cert. denied*, 424 U.S. 954 (1976); Lindsay v. McDonnell Douglas Aircraft Corp., 460 F.2d 631, 635-37 (8th Cir. 1972).

60. *See, e.g.*, Pan-Alaska Fisheries, Inc. v. Marine Constr. & Design Co., 565 F.2d 1129, 1136-37 (9th Cir. 1977) (post-delivery warning held insufficient).

61. *See, e.g.*, Lewis v. Timco, Inc., 716 F.2d 1425 (5th Cir. 1983); Pan-Alaska Fisheries, Inc. v. Marine Constr. & Design Co., 565 F.2d 1129 (9th Cir. 1977). *Cf.* Anthony v. Petroleum Helicopters, Inc., 693 F.2d 495 (5th Cir. 1982).

the ordinary consumer who purchases it, with the ordinary knowledge common to the community as to its characteristics."[62] In cases involving conscious design choices, this "consumer expectation" test is too subjective and can even work to the disadvantage of plaintiffs when consumer expectation has not caught up with available technology, which might well be the situation in cases involving commercial space products.

Manufacturers usually prefer that questions of reasonableness be answered from the point of view of a prudent, knowledgeable manufacturer making the design choices at issue. In other words, would a reasonable manufacturer sell a product that has certain known risks resulting from conscious design choices and trade-offs? This test would avoid the uninformed subjectiveness of the consumer expectation test and would also avoid the potential for liability that would arise just because it is almost always possible to design a product more safely.

Even in strict liability cases, determining whether or not a design was defective will, in most U.S. states, entail an examination of whether the design was a reasonable one. The involvement of intangible and difficult-to-prove factors relating to product design makes it imperative for manufacturers and their attorneys to be extremely well prepared to deal with intricate technical and economic aspects that must be balanced in each case. From the beginning of their preliminary design efforts on a particular product, manufacturers should keep these considerations in mind and should keep appropriate records of how they handle these various considerations. Staff counsel, in consultation with outside counsel, will have to be heavily involved in this preparation for future lawsuits. When those lawsuits do arise, in addition to having a full understanding of the many subtleties of product liability law, the outside trial counsel will have to be able to understand the engineering and economic factors involved, including those related to the other major battle area, causation. Of course, the same may be said of plaintiff's counsel. Whatever party he represents, a trial attorney in product liability litigation will have to make enormous investments of time and effort in order to get a complete understanding of precisely how the challenged design was decided upon and developed, and in court he will have to be prepared to deal with each alternative design that could have been utilized. This is not ever easy and may be even more difficult in cases involving advanced products being used in space.

It is not enough for a manufacturer's counsel to show that the design meets industry standards. Adherence to design and construction practices of an industry may be some evidence of reasonable prudence, but this adherence is not conclusive.[63] Neither is compliance with governmental regulations, even if the government has "certified" the design.

In aviation cases, courts have held that compliance with Federal Aviation Administration safety standards is not a complete defense to a claim that the

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62. RESTATEMENT (SECOND) OF TORTS § 402A comment i (1965).

63. The T.J. Hooper, 60 F.2d 737 (2d Cir.), *cert. denied*, 287 U.S. 662 (1932).

aircraft design was defective.[64] According to the courts, government safety regulations are intended to be minimum standards only, and compliance with government safety regulations may be considered simply as one factor bearing on whether the design was dangerously defective.

For that matter, government certification of an aircraft design is not even conclusive on the narrower question of whether the aircraft design meets all government-mandated design standards. In *Elsworth v. Beech Aircraft Corp.*,[65] the lawsuit arose from the crash of a multi-engine Beech Travel Air model 95. An investigation indicated that, prior to the crash, one of the airplane's engines had been shut down. Plaintiff heirs of the pilot and passengers alleged that the accident was caused by the airplane' undue propensity to stall and spin while operating on one engine. Despite a finding by the FAA, after conducting its own stall/spin tests, that the airplane met all safety regulations, the appellate court approved an instruction by the lower court that the jury could conclude that the FAA safety regulations were violated and that, if it did so conclude, it must further conclude that Beech was negligent *per se*.

Based on *Silkwood v. Kerr McGee*,[66] the *Elsworth* court held that "there is nothing inherently inconsistent in the proposition that, even if the Federal Government has entirely occupied the field of regulation of aircraft, a state may simultaneously grant damages for violation of such regulations." In *Silkwood*, nuclear energy regulations adopted by the Federal Government preempted the field of safety. Despite this preemption, "common law tort principles of Oklahoma were applicable to hold the defendant employer liable to an employee for compensatory and punitive damages as a result of radiation at the employer's plant."[67]

The *Elsworth* court ruled that it could find no irreconcilable conflict between Federal and state standards, and that the 1958 Federal Aviation Act expressly stated that its provisions were not intended to abridge remedies that might be available under state law. Beech, the manufacturer, petitioned the United States Supreme Court for a review of this decision, but the Court denied certiorari.[68]

Maritime law is not far behind aviation law on this question. Compliance with United States Coast Guard regulations and American Bureau of Shipping rules is given weight by the courts, but such compliance is not conclusive if it is shown that: (1) approval was obtained due to the failure of the regulatory agency or classification society to adequately inspect the vessel; (2) the regulatory agency or classification society did not abide by its own standards; or (3) a

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64. *See, e.g.*, Wilson v. Piper Aircraft Corp., 282 Or. 61, 577 P.2d 1322 (1978).

65. 37 Cal.3d 540, 208 Cal. Rptr. 874, 691 P.2d 630 (1984), *cert. denied*, 105 S.Ct. 2345 (1985).

66. 464 U.S. 238, *rehearing denied*, 465 U.S. 1074 (1984).

67. *Elsworth*, 691 P.2d at 635-36.

68. 105 S.Ct. 2345 (1985).

higher standard of care is required.[69]

Therefore, manufacturers of products designed for use in commercial space activities will probably not be insulated from liability just because they comply with governmental regulations or because a governmental authority has concluded that the product has met all safety regulations. On the other hand, as indicated above, failure to comply with the Government's regulatory standards, which are considered as minimum standards, may in fact constitute "negligence per se".[70]

C. *Government Contractor Defense.*

Where a manufacturer has designed a product to comply with requirements established by the United States government in a contract with the manufacturer, the manufacturer may be in a better position than if, in a non-governmental context, it merely complied with government regulations. It should be noted, though, that, up until recently, manufacturers who were government contractors were facing the worst of situations.

Under the Federal Tort Claims Act, the United States Government is not liable for injuries to a member of the military arising out of or in the course of activity incident to military service, and the Federal Government is also immune from a manufacturer's claims for indemnity arising out of payments made by the manufacturer for injuries to members of the military.[71] This has left government contractors with the entire burden of liability to military servicemen for defectively or dangerously designed products. Manufacturers may be held liable despite proof that their products have been substantially modified and improperly maintained by the military,[72] and even if the manufacturer suspects that its product was improperly operated, this is difficult to prove because of the confidentiality of certain information obtained through the military accident investigation process.

Manufacturers are now beginning to find some relief in a defense that argues that the allegedly defective or dangerous aspects of a product's design are the result of the product's having been designed to meet certain government specifications or requirements.[73] The doctrine is still unsettled, and there is

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69. *See In re* Marine Sulphur Transp. Corp., 312 F. Supp. 1081 (S.D.N.Y. 1970), *aff'd in part, rev'd in part*, 460 F.2d 89 (2d Cir.), *cert. denied*, 409 U.S. 982 (1972).

70. *See, e.g.*, Reyes v. Vantage S.S. Co., Inc. 609 F.2d 140 (5th Cir. 1980).

71. *See, e.g.*, Stencel Aero Engineering Corp. v. United States, 431 U.S. 666 (1977); Feres v. United States, 340 U.S. 135 (1950).

72. *See, e.g.*, Vasina v. Grumman Corp., 644 F.2d 112 (2d Cir. 1981).

73. *See, e.g.*, McKay v. Rockwell Int'l Corp., 704 F.2d 444 (9th Cir. 1983), *cert. denied*, 464 U.S. 1043 (1984); Tozer v. LTV Corp., 792 F.2d 403 (4th Cir. 1986); Hendrix v. Bell Helicopter Textron, 634 F. Supp. 1551 (N.D. Tex. 1986); *In re* Agent Orange Product Liability Litigation, 534 F. Supp. 1046 (E.D.N.Y. 1982). *But see* Shaw v. Grumman Aerospace Corp., 778 F.2d 736 (11th Cir. 1986).

insufficient space available to discuss it in detail here.[74] Basically, a manufacturer may utilize the government contractor defense, at least in a strict liability lawsuit, if it can prove that the government established or approved reasonably precise specifications for the allegedly defective product, and that the product met the government's specifications in all material respects, and that the government knew as much or more than the defendants about the hazard-causing deficiencies of the product.

Manufacturers of space products that were designed for the government may be interested in using the government contractor defense not only in cases involving injuries to military personnel, but also in cases involving injuries to civilians. To be sure, some courts have indicated that, if the government is not immune from liability to those injured, the government contractor defense may not be utilized,[75] but this requirement may be met in certain civilian situations. In any event, some decisions have suggested that courts may allow government contractor defenses to insulate defendant manufacturers against liability to civilian plaintiffs in product liability actions.[76]

D. *The Applicability of Strict Liability.*

The doctrine of strict liability may not be considered applicable in all product liability cases. For example, in *Wangeman v. General Dynamics Corp.*,[77] we successfully defended General Dynamics against claims for the wrongful death of a test pilot who lost his life in an airplane crash. Plaintiff argued that General Dynamics should be held liable for negligence, breach of implied warranty of fitness, and strict liability. Our position was that the doctrine of strict liability and implied warranty of fitness were each inappropriate because the aircraft in question was an unfinished pre-production prototype in the process of being tested and evaluated by a subcontractor even though it was after the date of formal sale to the military. Furthermore, the test pilot had been engaged in (and hired to perform) testing of the aircraft. The court found in our favor on the basis of other arguments, so it never reached our arguments on this point, but I believe that we would have prevailed on this

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74. *See* Craft, *The Government Contractor Defense: Evolution and Evaluation*, THE GOVERNMENT CONTRACTOR DEFENSE: A FAIR DEFENSE OR THE CONTRACTOR'S SHIELD 3 (J. Madole ed., A.B.A. 1986); Craft, *Manufacturers' Strict Liability for Products that Meet Military Specifications*, paper presented at the Third National Institute on Aviation Litigation sponsored by the American Bar Association (1984).

75. *See, e.g.*, Johnston v. United States, 568 F. Supp. 351 (D. Kan. 1983).

76. *See, e.g.*, Casabianca v. Casabianca, 104 Misc.2d 348, 428 N.Y.S.2d 400 (Sup. Ct. 1980). *See generally In re* All Maine Asbestos Litigation, 575 F. Supp. 1375, 1377 (D.Me. 1983).

77. 53 A.D.2d 520, 384 N.Y.S.2d 174 (1st Dept. 1976), *appeal denied*, 40 N.Y.2d 808, 392 N.Y.S.2d 1025 (1977).

issue as well.[78] Again, this case is mentioned here as a demonstration of why it simply cannot be assumed that strict liability is applicable to every product case. In space activities there may be a number of experimental (if not one-of-a-kind) products that are not being commercially distributed and should not subject their manufacturers to strict liability.[79]

E. *Damages Recoverable.*

The law relating to the recovery of property damage and economic loss in product liability actions in the United States is quite confused, and, either as a cause or as a result, so are the labels for the many categories of damage to be considered. Among the categories are physical damage to the particular product itself, physical damage to the assembly of which the product is a component part, physical damage to other property, economic loss resulting from an inability to operate the product or the assembly in which it is installed, and economic loss resulting from physical loss to other property. The courts have been inconsistent in categorizing these damages and in applying the law to the various categories. Many of the inconsistencies are primarily the result of insufficient analysis rather than the result of mere differences of opinion among the courts of the various U.S. states.

A commonplace statement is that, except under a warranty, in a product liability action economic loss is not recoverable but property damage is recoverable. However, the reason for making this distinction is not as clear as it might be, and there has been much doubt about the validity of the distinction. For example, the same courts that suggest that more direct economic loss is not recoverable also say that somewhat indirect property damage, such as where a defective part causes harm to other property, is recoverable.

In either negligence or strict liability cases, property damages are generally considered to be compensable. Physical property damage is very similar to personal injury, and it has been suggested that there is no reason to distinguish them. But there is no agreement as to the full scope of the term "property damage", physical or otherwise.

With respect to economic losses, there is disagreement among the states as to whether such losses are compensable in negligence or strict liability actions. Of course, in tort actions a tortfeasor is generally liable for all foreseeable damages proximately caused by his tort. The purpose of these compensatory damages is to restore the plaintiff to the position he would have occupied had there been no tort. While a defendant in a negligence action is not an insurer, he must nevertheless pay for the damages that he has caused. The scope of those

78. *See* Winkler v. Hyster Co., 54 Ill.3d 282, 369 N.E. 2d 606 (1977).

79. Based on the law as it then was, earlier commentators suggested that strict liability would be appropriate for rocket-caused damage only so long as rocket flights were considered ultrahazardous and that, thereafter, strict liability would give way to use of the doctrine of *res ipsa loquitur. See, e.g.*, A. HALEY, SPACE LAW AND GOVERNMENT 244-45 (1963).

damages is supposedly restricted in practice by the requirements that the damages be proximately caused by the defendant's negligence and that the type of damages be reasonably foreseeable. Another requirement is that damages be proved with a reasonable degree of certainty; they may not be contingent, conjectural, or speculative. If courts actually enforced these requirements (which they seldom do), then permitting a plaintiff to be compensated for economic loss in a tort action would not have to open the door to unlimited or unreasonable damages.

Nevertheless, it is frequently suggested in manufacturers' strict liability and negligence actions that there is a general rule, based on the decision of the California Supreme Court in *Seely v. White Motor Co.*,[80] that there cannot be recovery for economic loss alone and that a manufacturer's liability is limited to damages for physical injuries. As pointed out on other occasions,[81] the *Seely* decision should not be given too much weight, unless it is taken to mean only that the kind of economic loss not recoverable in tort actions is "pure" economic loss (including costs of repair and loss of profits) that is not accompanied by an injury to a person or property as a result of an "accident".[82]

In 1985, the Third Circuit Court of Appeals concluded that damage to the defective product itself is not recoverable in a tort action unless the defect creates an unreasonable risk of harm to persons or property other than the product itself.[83] Other decisions also did not preclude recovery of "economic loss" in product liability actions, and it is important to note that some of these decisions were in admiralty cases.[84] The latter decisions may have turned on whether the economic loss was especially foreseeable, despite the absence of physical injury or property damage.[85]

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80. 63 Cal.2d 9, 18, 403 P.2d 145, 45 Cal. Rptr. 17 (1965).

81. Craft, *La Responsabilité des Fabricants en Droit Américain*, 37 REVUE FRANCAISE DE DROIT AÉRIEN 21 (1981).

82. *See* S.M. Wilson & Co. v. Smith Int'l, Inc., 587 F.2d 1363, 1376 (9th Cir. 1978); State of Arizona v. Cooke Paint & Varnish Co., 541 F.2d 226, 228 (9th Cir. 1976) (concurring opinion); Union Oil Co. v. Oppen, 501 F.2d 558, 564-67 (9th Cir. 1974).

83. East River S.S. v. Deleval Turbine, 752 F.2d 903, 908 (3d Cir. 1985).

84. *See, e.g.*, Ingram River Equip. Inc. v. Pott Indus., Inc., 756 F.2d 648 (8th Cir. 1985) (maritime law); Miller Indus. v. Caterpillar Tractor Co., 733 F.2d 813 (11th Cir. 1984); Emerson G.M. Diesel v. Alaska Enterprise, 732 F.2d 1468 (9th Cir. 1984) (maritime law); Ales-Peratis Foods Int'l, Inc. v. American Can Co., 164 Cal. App. 3d 277, 209 Cal. Rptr. 917 (Cal. Ct. App. 1985).

85. In this way, they further liberalized the approach found in Jig the Third Corp. v. Puritan Marine Ins. Underwriters Corp., 519 F.2d 171 (5th Cir. 1975), *cert. denied*, 424 U.S. 954 (1976), where the Fifth Circuit held that the sinking of a vessel due to negligent construction or defective design was tortious in nature and thus fell within maritime tort jurisdiction. This was despite the recognized legal principle that contracts to construct ships are generally outside the maritime jurisdiction. The court reasoned "that a manufacturer's negligent design or manufacture of a product gives rise to a

But in *East River Steamship Corp. v. Transamerica Deleval, Inc.*,[86] the United States Supreme Court recently rejected the Third Circuit's and other courts' approaches and held that in admiralty a manufacturer of a defective product purchased in a commercial transaction will not be held liable for damage to the product itself resulting only in purely economic losses, except under warranty law, which is generally subject to the terms of the purchase contract. Thus, tort law theories of negligence and strict liability would not normally be available to recover for damage to the product. With respect to other "economic damages", the Court stated that it did not decide the question of whether a tort cause of action can ever be stated in admiralty for such damages.

The Supreme Court decision has thus gone a long way toward clarifying the admiralty law, and this decision may well influence court decisions regarding various states' laws as well. Nevertheless, many questions in this area remain unresolved, and their resolution is likely to have a great effect on actions for property damage and economic loss arising out of commercial space activities.

F. *Contractual Disclaimers.*

Implied warranties may be disclaimed only if the disclaimers are specific and conspicuous. Moreover, disclaimers and limitations of remedies must not be inconsistent with the express warranties. If they are inconsistent, the warranty language prevails.[87] Furthermore, a warranty limited to a particular period is enforceable only if the particular defect is not latent and undiscoverable within that period.[88]

In a contract between parties of roughly equal bargaining power, manufacturers may also disclaim negligence and strict liability, provided that the disclaimer is clear and unequivocal.[89] The manufacturer's disclaimer may also

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cause of action in tort, even where the aggrieved buyer is the economic equal of the seller and where the only damage is to the purchased chattel itself. . . ." *Id.* at 175.

86. 106 S.Ct. 2295 (1986).

87. *See, e.g.*, Consolidated Data Terminals v. Applied Digital Data Sys., Inc., 708 F.2d 385, 391 (9th Cir. 1983).

88. *Compare* Neville Chem. Co. v. Union Carbide Corp., 422 F.2d 1205 (3d Cir. 1969), *cert. denied*, 400 U.S. 826 (1970), and Wilson Trading Corp. v. David Ferguson, Ltd., 23 N.Y.2d 398, 404, 297 N.Y.S.2d 108, 112 (1968), *with* American Elec. Power Co. v. Westinghouse Elec. Corp., 418 F. Supp. 435 (S.D.N.Y. 1976).

89. *See, e.g.*, Delta Airlines v. McDonnell Douglas Corp., 503 F.2d 239 (5th Cir. 1974), *cert. denied*, 421 U.S. 965 (1975); Aeronaves de Mexico, S.A. v. McDonnell Douglas Corp., 677 F.2d 771 (9th Cir. 1982); Tokio Marine & Fire Ins. Co., Ltd. v. McDonnell Douglas Corp., 617 F.2d 936 (2d Cir. 1980); Keystone Aeronautics Corp. v. R. J. Enstrom Corp., 499 F.2d 146 (3d Cir. 1974).

protect subcontractors who did not directly negotiate with the purchaser and who were not specifically named in the purchase agreement.[90] Again, the disclaimer may not be enforced where the contractual disclaimer is not sufficiently clear and unequivocal, as when it makes no specific mention of negligence or tort liability.[91]

Disclaimers of tort liability may also be overcome by a demonstration that the limited remedies available under the contract failed of their essential purpose, usually because the manufacturer failed to live up to its obligations under the repair and replacement clause.[92]

Contractual disclaimers, limitations of remedies, indemnity clauses, and insurance clauses will obviously be important to manufacturers of products for use in commercial space activities. Equally obviously, manufacturers need to work with product liability counsel in order to maximize the effect of their disclaimers, etc. The manufacturer's customers' also need to consult product liability counsel in order to make sure that they fully understand the effect of the disclaimers, etc. Unless the contract is extraordinarily clear, an accident will no doubt generate litigation to test the nature and scope of the disclaimers, etc.

In speaking of contracts involving commercial space activities, reference must be made to the standard NASA agreements for joint endeavors and for shuttle launch and associated services. These agreements have been frequently described,[93] and there is no point in further embroidery here. The goal of these agreements is to avoid fights about fault and causation by means of a no-fault, no-subrogation, inter-party waiver of liability that will make each party responsible for the damage to its own personnel and property. The standard agreement may be attacked in various ways, and it has yet to be determined whether the agreement can effectively protect manufacturers from liability to others who are involved in the space activity and whose personnel or property were damaged by the manufacturer's product. For example, does the agree-

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90. *See, e.g.*, Airlift Int'l, Inc. v. McDonnell Douglas Corp., 685 F.2d 267 (9th Cir. 1982); Aeronaves de Mexico, S.A. v. McDonnell Douglas Corp., 677 F.2d 771 (9th Cir. 1982).

91. *See, e.g.*, Jig the Third Corp. v. Puritan Marine Ins. Underwriters Corp., 519 F.2d 171 (5th Cir. 1975), *cert. denied*, 424 U.S. 954 (1976) (maritime law).

92. *See, e.g.*, Milgard Tempering, Inc. v. Selas Corp., [Current Decisions] PROD. LIAB. REP. (CCH) ¶10,515 (9th Cir. 1985) (need for case-by-case approach to examine provisions of each contract to determine whether parties intended exclusive remedy and damage exclusion provisions to operate as separable elements of risk allocation or as inseparable parts of comprehensive risk allocation package). In other words, the court is to determine whether the default of the manufacturer is so total and so fundamental as to require its damage limitations to be expunged from the contract. *Id.*

93. *See, e.g.*, J.E. O'Brien, *NASA Joint Endeavor Agreements*, paper presented at the Second Annual Forum of the A.B.A. Forum Committee on Air and Space Law (1984).

ment's waiver apply if the plaintiff proves gross negligence or recklessness rising to the level of willful misconduct by the manufacturer? The increase in successful punitive damage claims against manufacturers in conventional cases demonstrates that this is not a farfetched question.[94] In any event, the waivers will generally not protect the parties to the NASA agreement from liability to non-parties, including members of the public.

F. *Product Liability Insurance.*

Because the amounts awarded in product liability cases can be very high, manufacturers have to insure themselves against such potential liabilities. The extent of a company's exposure to liability and the size of American jury awards, as well as a generally tight insurance market, have prompted insurers to adopt a radically different comprehensive general liability form. This is not the place to discuss the details of the changes to be effected by this form, which has not yet been approved by all of the 50 states of the U.S. For those insureds who do not already have "claims-made" coverage, (which many believe will become the only effectively available form of comprehensive general liability insurance) the principal departure of the new claims-made form from the "occurrence" form is that the claims-made policy would provide coverage for only those claims actually made during the policy period, beginning at the policy inception or some other stated retroactive date. (This may result in an interruption of coverage, although an extended reporting period endorsement will be available — at a higher cost based on the expiring premium — to provide coverage for any period of interrupted coverage preceding the effective date.)

The new policy format continues to commit insurers to defend any suit against insureds covered under the policy, but the insurers have further considered the establishment of an absolute dollar limit on the extent of their duty to defend; this may be accomplished by including defense costs within the policy limits. Insurers point to the absence of any judicial consensus on their duty to defend. Some courts have held that the duty terminates upon payment of the policy limits of liability, while other courts have required insurers to defend to conclusion all cases pending at the time the policy limit was exhausted. Insurers also complain that their costs in defending lawsuits, especially product liability lawsuits, are simply too high.

The most important thing to be mentioned about insurance coverage is its decreasing availability. There is a major shortage in capacity, both in primary coverage and reinsurance, especially in commercial lines. Thus, despite rapid rises in premiums, increases in operating income will be slow to overcome the shortage. Moreover, because reinsurers have tightened underwriting, the terms and conditions of coverage have become more restrictive. Under these conditions, outside capital is unlikely to aggressively enter the insurance market.

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94. For a discussion of punitive damages in product design cases, *see* Craft, *Design and Punishment*, ASTRONAUTICS & AERONAUTICS 15 (January 1983).

All manufacturers are encountering the increasing expense and decreasing availability of full product liability coverage. Especially hard hit will be manufacturers of products intended for commercial space activities; the enormous losses sustained over the past few years by aviation and space underwriters have caused them to reduce capacity and raise premium rates.[95] Of course, NASA customers are required by NASA agreements for joint endeavors and for launch and associated services to obtain NASA-approved liability insurance covering the customer and the United States for their third-party liability. The amount of such insurance is to be agreed upon, and no individual customer will be required to have insurance in an amount in excess of $500 million. Multiple customers who are on the same shuttle flight and are named insureds on a single policy shall not be required to have insurance in an amount in excess of one billion dollars. If NASA determines that a customer is unable to obtain adequate insurance, NASA *may* provide insurance or indemnification for a reasonable fee to be agreed upon. In any event, at no additional cost, NASA agrees to indemnify each customer for third-party liability to the extent that such liability exceeds the limits of the insurance coverage purchased by or provided to the customer.

These indemnity obligations may not be interpreted as expected. For example, unless the NASA Administrator certifies that the amount is "just and reasonable," the NASA agreements state that the United States will make no indemnity payment. In addition, the indemnity obligation appears to be subject to the statement in the agreement that the United States government's liability to the customer shall be limited to direct damages only and shall not include any loss of revenue, profits, or other indirect or consequential damages. It is not certain, then, whether the United States would indemnify customers who were found liable for third parties' indirect or consequential damages. Indemnity payments may also be limited by the AntiDeficiency Act[96] and the Adequacy of Appropriations Act.[97] thus, the indemnity/insurance provisions of the NASA standard agreements are of unclear practical effect.

G. *Legislative Reforms.*

Much recent state legislation has been aimed at reforming certain problematic aspects of product liability law; most of these reforms have benefited the manufacturers but have not eliminated the doctrine of strict liability. As of this writing, thirty-four states have recently enacted reform legislation; however, in only a third of these states are the legislative reforms very significant, and the effect of these reforms will depend much on the ways that the courts

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95. For a general discussion of space insurance, *see* STAFF OF SENATE COMM. ON COMMERCE, SCIENCE, AND TRANSPORTATION, 99th Cong., 1st Sess., INSURANCE AND THE COMMERCIALIZATION OF SPACE (Comm. Print 99-16, 1985).

96. 31 U.S.C. §1341 (1983).

97. 41 U.S.C. §11 (1965).

interpret the statutory language over the next few years.

There have also been extensive efforts aimed at a federal product liability law that would essentially pre-empt the inconsistent state laws. This effort began with a proposed draft Uniform Product Liability Act, which developed into the Model Uniform Products Liability Act, which in turn evolved into a bill sponsored by Senator Robert Kasten of Michigan. After a long and tortuous process, during which some aspects of the bill were diluted, the bill came to a vote in the Commerce Committee of the United States Senate in the spring of 1985, and it failed to pass that Committee. In its place, Senator John Danforth of Missouri announced on July 15, 1985, a new draft bill that combined uniform federal product liability standards with an alternative claims system for the recovery of damages by those injured by defective products. This draft bill was subjected to a number of amendments, and on June 12, 1986, the Senate Commerce Committee adopted an amendment in the nature of a substitute for the previously amended draft bill. The substitute bill was considered further and subjected to still more amendments, and the Committee approved and reported to the full Senate a new bill, Senate Bill 2760, which was an original bill based on the previous bills and amendments.

Public hearings were held by the Senate to investigate the advisability of adopting S. 2760, and the outcome was very much in doubt. The Committee report on this bill was not unanimous, and various members of the Committee submitted dissenting opinions. Furthermore, various senators were planning to offer additional amendments to this legislation. The Reagan Administration was also not happy about a number of provisions. While this was the leading federal bill on product liability reform, it was not the only one, for other senators had introduced or were planning to introduce other bills. Of course, even if there had been enough votes to pass a bill in the Senate, this would not have meant that the bill would become law, for the House of Representatives would also have had to pass it.

As a result of all these factors, and the lack of time to resolve them, S. 2760 was removed from the calendar of this past session. It will come up again in 1987, but it will no doubt face many of the same obstacles. All considered, the proposed legislation continues to be in a state of flux, and it seems premature to say much more about it at this point.

Barring some federal legislative breakthrough, then, United States product liability law will for the most part continue in the common law tradition. It must be recalled, though, that it was the common law, as promulgated by the courts, that introduced the concept of strict liability in this country. In most of the states, the legislatures had little or nothing to do with it.

V. *Conclusion*

The development of United States product liability law will greatly affect the development of commercial space activities, and those involved in these activities will have to work with counsel conversant with both space law and U.S. product liability law in order to monitor developments and to minimize the risks involved. Legislative action will probably also be needed, if not to

reduce risks then at least to clarify them so that they can be dealt with and covered by insurance.

WORLD METEOROLOGICAL ORGANIZATION—DEMONSTRATED ACCOMPLISHMENTS AND STRONG PLANS FOR THE FUTURE IN APPLYING SPACE TECHNOLOGY

*John A. Leese**

a. Background

The World Meteorological Organization (WMO) is a specialized agency of the United Nations which has a membership of 159 States and Territories. Three of the purposes of the organization are particularly pertinent to the topic:[1]

> —facilitate world-wide co-operation in the establishment of networks for making meteorological, as well as hydrological and other geophysical, observations and centres to provide meteorological services;
> —To promote the establishment and maintenance of systems for the rapid exchange of meteorological and related information;
> —To promote standardization of meteorological observations and ensure the uniform publication of observations and statistics.

The constituent bodies of the WMO consist of the following:

> The *World Meteorological Congress* is the supreme body of the Organization. It brings together the delegates of all Members once every four years to determine general policies for the fulfilment of the purposes of the Organization;
> The *Executive Council* is composed of 36 directors of national Meteorological or Hydrometeorological Services serving in an individual capacity; it meets once a year to supervise the programmes approved by Congress;
> *Six Regional Associations* are each composed of Members whose task is to co-ordinate meteorological and related activities within their respective regions;
> *Eight Technical Commissions*, composed of experts designated by Members, are responsible for studying meteorological and hydrometeorological operational systems, applications and research.

The *WMO Secretariat*, located at Geneva, Switzerland, is composed of an

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1. Anon., Basic Documents No. 1, *WMO No. 15*, (1983).

international scientific, technical and administrative staff under the direction of the Secretary-General. It undertakes technical studies and is responsible for the numerous technical co-operation projects in meteorology and operational hydrology throughout the world aimed at contributing to economic development of the countries concerned. It also publishes specialized technical notes, guides, manuals and reports and in general acts as the link between the meteorological and operational hydrological services all over the world.

For more than 25 years, WMO has played a continuing role in international co-ordination for the development of the network of meteorological satellites. In 1959, the Third Meteorological Congress of WMO,[2] recognizing the potential value of meteorological measurements from artificial satellites, requested the WMO Executive Council . . . "to arrange for a continuing review to be made of the uses of artificial satellites for meteorological purposes and to keep Members informed of interesting developments in this field". The Executive Council has carried out this continuing request through its Panel of Experts on Satellites.

Resolutions were adopted at the sixteenth (1961) and seventeenth (1962) sessions of the General Assembly of the United Nations on International Co-operation in the Peaceful Uses of Outer Space.[3] In particular, the General Assembly recommended that WMO study how the developments of outer space could be used to advance the state of atmospheric science and technology. The WMO responses to these resolutions led to the establishment of the World Weather Watch and also set forth the necessary conditions for the optimum use of meteorological satellite systems.

b. *Meteorological Satellites in the Context of a Global Network*

The first meteorological satellite was launched in April 1960 and the decade of the 1960's witnessed the development of the meteorological satellite as an unprecedented tool for observing broad-scale atmospheric phenomena. By the end of the 1960's, the meteorological satellite had grown to be a highly sophisticated platform which could provide global coverage of cloud observations and was beginning to provide quantitative measurements of pertinent meteorological parameters. During the 1970's there was an evolutionary development of a co-operative international network of meteorological satellites. This effort culminated in 1979 with the contribution to the Global Weather Experiment (FGGE) by a nearly complete global network of meteorological satellites. In the present decade of the 1980's, we are seeing a stabilizing of the global network of meteorological satellites in terms of sensor data and services.

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2. Anon., Third World Meteorological Congress—Abridged report with resolutions, *WMO No. 88*, (1959).

3. Anon., Resolution 1721 (XVI), Annex I, Section C and Resolution 1802(XVII), Annex II, Section III on International Co-operation in the Peaceful Uses of Outer Space.

There is now a more intensive effort in the processing and applications of satellite data in order to increase the information obtained.

The advent of meteorological satellites gives a new dimension to meteorology both from a technical viewpoint (more or less permanent watch over the globe rather than a network of individual locations) and also from a policy viewpoint through the co-ordinated free access of all WMO Members to raw or pre-processed satellite data. The operational use of these data are summarized in a WMO publication.[4]

Meteorological satellites have become a critical source of data used in the preparation of weather forecasts and warnings of severe weather over land and sea. The existing network of meteorological satellites, forming part of the Global Observing System of the World Weather Watch, regularly produces real-time weather information. This information is acquired several times a day, through direct broadcast from the meteorological satellites, by more than 1000 stations located in 125 counties.

There are two major components in the current meteorological satellite network. One element is the various geostationary meteorological satellites which operate in an equatorial belt and provide a continuous view of the weather from roughly 70°N to 70°S. At present there is a satellite at 0° longitude (operated by the European Space Agency), a satellite at 74°E (operated by India), a satellite at 140°E (operated by Japan) and satellites at 135°W and 75°W (operated by the U.S.A.). A satellite is planned to be added by the U.S.S.R. at 76°E. The Co-ordination of Geostationary Meteorological Satellites (CGMS) is an informal international body made up of countries and agencies which are operating or have firm plans to operate geostationary meteorological satellites. This presently consists of the European Space Agency (ESA), India, Japan, USA and the U.S.S.R. WMO has participated in the activities of CGMS from the first meeting in 1972. Results from CGMS have produced a network of geostationary satellites which operate in a well co-ordinated manner.

The second major element comprises the polar-orbiting satellites operated by the U.S.S.R. and the U.S.A. The "Meteor-2" series has been operated by the USSR since 1977. The polar satellite system, operated by the U.S.A., is an evolutionary development of the TIROS satellite first launched in April 1960.[5] The NOAA series, based on the TIROS-N system, has been operated by the USA since 1978. These spacecraft provide coverage of the polar regions beyond the view of the geostationary satellites and fly at altitudes of 850 to 900 km. Additionally, they are able to acquire certain data not presently available from geostationary altitude.

Together, the geostationary and polar-orbiting satellites constitute a truly

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4. WMO No. 585, "Satellites in Meteorology, Oceanography and Hydrology", (1982) (Prepared by Arnold I. Johnson).

5. A. Schnapf, "The development of the TIROS global environmental satellite system" *Meteorological Satellites—Past, Present and Future*, NASA Conference Publication 2227, (1982) p. 7.

global meteorological satellite system. Further details about these meteorological satellites and the future plans are available in WMO Publications.[67]

c. Applications in the Major Programmes

The main features of WMO's activities relating to outer space occur within the major programmes through which the work of the Organization is conducted. Information about these programmes with specific reference to their long-term goals and objectives are given in the WMO Long-term Plan.[8]

The *World Weather Watch (WWW)* serves as the basic programme of the WMO, supporting other programmes and activities of the Organization. Co-operation in operational meteorology among WMO Member nations is the cornerstone of the WWW, especially since modern developments in technology over the last 15 to 20 years have brought about some rather remarkable changes in the way weather services operate. The observation of weather by satellites and the use of electronic computers in weather-data processing and telecommunications have had a significant impact for national services on the methods of producing and exchanging weather observations and weather analyses and forecasts.

The WWW is an integrated system which functions on the global, regional and national levels. The WMO Congress decides on general directives for the structure and operation of the WWW; other appropriate bodies of the Organization are concerned with the organizational and procedural details. Planning at the national level is, of course, left to individual Members.

The primary objective of the *Tropical Cyclone Programme* is to mitigate cyclone disasters through improvements in all aspects of a tropical cyclone warning system. This Programme is being implemented partly through transfer of technology: for example, through reports prepared by small groups of experts on specific subjects such as meteorological satellites, cyclone forecasting, flood risk evaluation, storm surge prediction and community preparedness. It is also being implemented partly by means of programmes organized regionally. In the latter category, the activities are organized through four regional cyclone bodies.

The Eighth WMO Congress in 1979 established the *World Climate Programme (WCP)* and further decided that this main programme should comprise the following four components:

—World Climate Applications Programme (WCAP)

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6. WMO No. 411, "Information on Meteorological Satellite programmes Operated by Members and Organizations", (1975 with supplemental updates).

7. D. S. Johnson, Satellites Capabilities to 1995 for Meteorology and Operational Hydrology, *SAT-2; WMO/TD-No. 56*, 1984).

8. Anon., First WMO Long-term Plan, Part I: Overall Policy and Strategy 1984-1993, *WMO No. 616*, (1983).

—World Climate Data Programme (WCDP)
—World Climate Research Programme (WCRP)
—World Climate Impacts Programme (WCIP).[9]

The first two components are the primary responsibility of the WMO. The WCRP is a joint programme between WMO and the International Council of Scientific Unions (ICSU). The UN Environmental Programme (UNEP) has the primary responsibility for the WCIP.

The *WCAP* is concerned, amongst other matters, with the development and improvement of methodologies for the application of meteorological (especially climatological) information in such fields as energy, land use and human settlements, engineering and building, human well-being (especially health and disease), tourism, industry, transportation (especially on land) and communications, economic and social planning.

The purpose of the *WCDP* is to ensure timely access to reliable climate data which are exchangeable in acceptable format to support climate applications, impact studies and research. The scope of the WCDP includes climate data from the entire climate system composed of the atmosphere, oceans, cryosphere and land surface.

The main objectives of the *WCRP* are to determine to what extent climate can be predicted and the extent of man's influence on climate. The WCRP's highest priority requirement is for consistent, long time series of global data.[10] For this reason, the WCRP relies heavily on operational programmes which provide systematic observations of the atmosphere and the oceans. Meteorological satellites and the oceanographic satellites now being developed are essential elements of the WCRP in order to obtain a long series of consistent observations.

One of the objectives of the *Agricultural Meteorology Programme* is to provide Members with guidance material on satellite information that can be used in agriculture, forestry and the combat of desertification. Activities are mainly concerned with the use of remote sensing techniques for obtaining agrometeorological information and the applications of satellite techniques to agrometeorology. Present projects include (i) compilation of practical satellite applications in agrometeorology, (ii) guidance material on aspects of satellite applications to agrometeorology, and (iii) training courses on remote sensing techniques in agrometeorology. WMO has been involved since 1977 in the presentation of international training courses in satellite applications to agrometeorology and rural disaster preparedness. The courses are designed primarily for personnel from developing countries.

The *Aeronautical Meteorology Programme* has space-related activities in the following main areas:

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9. Anon., Eighth World Meteorological Congress. Abridged report with resolutions, *WMO No. 533*, (1979).

10. Anon., Scientific Plan for the World Climate Research Programme, *WCRP Publication Series No. 2, WMO/TD-No. 6*, (1984).

(i) Use of satellite data for the preparation of information required for flight operation;
(ii) Direct use of satellite imagery and other satellite data for short range weather forecasting;
(iii) Satellite support to the World Area Forecast System.

These activities are directed essentially at the efficiency and safety of air operations.

Space activities within the *Marine Meteorology Programme* occur in two main areas:

(a) The use of satellite remote-sensing instrumentation to measure a variety of meteorological and oceanographic parameters;
(b) The use of satellites in marine telecommunications for the collection of meteorological data from ships and ocean buoys and for the distribution of meteorological service products to shipping.

These activities are directed essentially at the safety and efficiency of ocean-based and ocean-dependent activities such as maritime transport, fisheries, offshore mining and related activities, coastal engineering works, marine pollution detection and control, etc.

Under the Integrated Global Ocean Services System (IGOSS), WMO and the Intergovernmental Oceanographic Commission (IOC) co-operate in formulating requirements for satellite observations of various ocean parameters and in establishing international procedures for the exchange of these data for both operational and scientific research uses.

Applications of space technology are a common feature of the *Hydrology and Water Resources Programme* and will continue having a significant impact on the activities of national hydrological services of WMO Members. The long-term objectives give priority to promoting applications of remote-sensing techniques to hydrology to cope with existing deficiencies and to meet new requirements through more extensive use of observational and communication capabilities of satellites in the design and operation of networks of hydrological observing stations, and by use of advanced interpretation techniques to derive qualitative and quantitative areal values for hydrological elements.

The successful implementation of the aforementioned programmes of WMO depend to a large extent upon the strengthening of national meteorological and hydrological services, particularly in the developing countries. For this reason, the organization's *Education and Training Programme* continues to be regarded as a matter of high priority. The transfer of knowledge in the area of management and applications of satellite data is being covered by this programme through the organization and implementation of several international training events in all of the WMO Regions. This programme has close collaboration with other agencies of the UN system and international organizations. The organization is also engaged in the preparation of syllabi and corresponding training materials for the education of meteorological personnel in satellite meteorology and in the provision of fellowships for training in meteorology and operational hydrology.

The applications of satellite technology in meteorology and operational hydrology form an important element of the *Technical Co-operation Programme* of WMO. Activities are undertaken generally with assistance either from the Voluntary Co-operation Programme (VCP) or the United Nations Development Programme (UNDP).

Each year several projects are completed under the VCP for the provision of direct satellite read-out stations. Support is also given under the VCP for training personnel in the operation and maintenance of such stations. During the period 1977 to 1985, a total of 54 direct read-out stations have been installed with the support of the VCP.

d. Considerations for Long-Term Continuity

During the last several years there has been increasing concern about the reliability and continued operation of the global meteorological satellite network. The WMO Executive Council session in 1980[11] urged Members to explore possibilities for future international or multilateral collaboration and an appropriate method for financing operational systems in order to help assure continuity of satellite data. In 1982, the Executive Council stated that the overall value of the global satellite network to operational meteorological, hydrological and oceanic services had increased to such an extent that extraordinary steps may have to be taken to assure continued operation and that the loss of one or more satellites due to economic, technical or whatever reasons should be avoided if at all possible.[12]

The question of the operational meteorological satellite system was discussed in several sections of the UNISPACE-82.[13] The Conference recommended that the WMO undertake a study on how to better assure the continuous availability of and access to meteorological satellite data.

The Ninth World Meteorological Congress[14] endorsed this recommendation. It considered that the continued operation of meteorological satellites, both polar-orbiting and geostationary, in their observation, data collection and dissemination roles is essential and must be ensured if the World Weather Watch system and the related applications are to be preserved. The Executive Council requested its Panel of Experts on Satellites to complete this study in a

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11. Anon., Thirty-second session of the Executive Committee—Abridged report with resolutions, *WMO No. 556*, (1980).

12. Anon., Thirty-fourth session of the Executive Council, Abridged Report with Resolutions of the thirty-fourth session, *WMO No. 599*, Geneva, (1980).

13. United Nations—A/Conf. 101/10, Report of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82) Vienna, (1982).

14. Anon., Ninth World Meteorological Congress. Abridged report with resolutions, *WMO No. 615*, Geneva, (1983).

timely manner for incorporation of the major results in the next WMO Long-Term Plan for 1988-1997 which is to be presented to the Tenth WMO Congress in 1987.

EVENTS OF INTEREST

A. Past Events

(a) *Reports*

1. *Review Of United Nations Work In The Field Of Outer Space In 1986.*

In presenting the annual report of the Committee on the Peaceful Uses of Outer Space (UNCOPUOS) to the 1986 session of the General Assembly, the Chairman of the Committee, Foreign Minister Peter Jankowitsch of Austria, stated that, "A definite programme for action has been presented to the Assembly and the Committee could be proud of its work, which was proof that international diplomacy in the United Nations was alive and well."

The enthusiasm expressed by the Chairman of the Committee was justified by the fact that the General Assembly, on the recommendation of COPUOS, adopted, by consensus: a set of Legal Principles relating to remote sensing of the Earth from outer space (resolution 41/65).[1] The Assembly also adopted three other resolutions (41/53, 41/64 and 41/66) on matters relating to outer space, highlighting the need to prevent an arms race in outer space and the importance of encouraging international co-operation in the peaceful uses of outer space.

I. *Remote sensing of the Earth from outer space*

The set of 15 legal principles relating to remote sensing of the Earth from outer space, which was adopted by the General Assembly in resolution 41/65, was the product of 12 years of delicate negotiations, in part, to meet concerns of States about being "sensed" without their permission, and about whether and on what basis the data so obtained would be available to them and to other States. Basically, the set of principles adopted represented, on the one hand, the right to carry out remote sensing activities, and on the other, the right of "sensed" States to receive data concerning their territories.

The text states that "Remote-sensing activities shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic, social or scientific and technological development and taking into particular consideration the needs of the developing countries."

The principles call for remote sensing activities to be conducted in accordance with international law, and not "in a manner detrimental to the legitimate rights and interests of the sensed State." It also declares that remote sensing should be used to protect the Earth's natural environment and protect mankind from natural disasters.

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[1] Identical text of the set of Legal Principles relating to remote sensing may be found in 14 J. SPACE L. 92 (1986).

A number of principles relate to aspects of international cooperation and assistance in remote sensing activities. Others relate to access by the "sensed" State to primary and processed data concerning its territory, to international responsibilities for remote sensing activity, and to regulation of disputes resulting from application of the principles.

In explaining their position after the adoption of the principles, the developing countries expressed their disappointment that the rights of the "sensed" States were not fully protected under the principles and their desire that these concerns be reflected in a further treaty on remote sensing. The Soviet Union said that only the first stage of legal regulation was over and that the second stage must be the working out of a legally binding international agreement, while the United States, with some other Western countries, felt that to make these principles into a treaty was neither necessary nor desirable.

The Scientific and Technical Subcommittee of UNCOPUOS also considered the item relating to remote sensing and reiterated its view that remote sensing should take into account the "fundamental urgent need to provide appropriate and non-discriminatory assistance" to developing countries, and emphasized the need to make remote sensing data available at reasonable cost. Because many countries have become dependent on data from operational meteorological satellites, the Subcommittee felt it was necessary to guarantee continuation and further development of such services. The Subcommittee will continue to consider matters relating to remote sensing as a priority item at its next session.

II. *Review of the Registration Convention*

An item relating to the review of the Registration Convention of 1976 was on the agenda of the General Assembly in 1986 on the basis of article X of the Convention which requested the Secretary-General of the United Nations to include in the Assembly's agenda such an item ten years after the Convention comes into force. Some discussions on the matter took place both at UNCOPUOS and at the General Assembly's Special Political Committee as well as its informal working group on the items relating to outer space. Some delegations considered that improvements could be made in the procedure for registration contained in the Convention, particularly aimed at increasing the degree of information. Canada and Sweden in particular, supported by China, France and Mexico, felt the need to improve the procedure. The United States and the Soviet Union felt that the present procedures were adequate and that the Convention is operating satisfactorily. The Assembly in the end adopted a resolution recognizing the importance of effective international rules and procedures for regulating objects launched into space and reaffirming the importance of registering all such objects pursuant to the Convention and urging all States to ratify or accede to it. The resolution also requested the Secretary-General to submit a report on the past application of the Convention for the information of Member States prior to the next session of the Legal Subcommittee in March 1987. An understanding was also reached which was put into the record by the delegate of Austria that while the matter is not specifically

inscribed on the agenda of the Legal Subcommittee, the matter would be further referred to at the next session of the Legal Subcommittee.

III. *Prevention of an arms race in outer space*

As in previous years, much attention was devoted to the prevention of an arms race in outer space and maintaining outer space for peaceful purposes, in the debates at UNCOPUOS, its two Subcommittees as well as in the Political and Special Political Committees of the General Assembly. The matter was also discussed at length in the Conference on Disarmament.

The General Assembly, in its resolution 41/53, which was adopted with near unanimity—154 States in favour, none against, and one abstention (USA)—called upon all States, in particular those with major space capabilities, to contribute actively to the objective of the peaceful uses of outer space and to take immediate measures to prevent an arms race in outer space. The Assembly also requested the Conference on Disarmament to intensify its consideration of the question of the prevention of an arms race in outer space and re-establish an *ad hoc* Committee in 1987 to undertake negotiations for the conclusion of an agreement to prevent an arms race in outer space. The Assembly also urged the Soviet Union and the United States to pursue their bilateral negotiations and called upon all States, especially those with major space capabilities, to observe existing treaties and to refrain from activities contrary to the objective of preventing an arms race in outer space.

In the voting, the United States explained its abstention on the resolution as it did not believe that there was a basis for multilateral negotiations at this time as called for by one of the paragraphs of the resolution.

Originally, four draft resolutions on this question were introduced—one by China (A/C.1/41/L.4), one by the Western countries (A/C.1/41/L.41), one by the Socialist countries (A/C.1/41/L.42) and one by the non-aligned countries (A/C.1/41/L.24). The non-aligned countries later introduced a revised version of their proposal, which satisfied the concerns of the sponsors of the other three proposals, which were then withdrawn. As a result of the revision, the non-aligned draft resolution reflected the thinking of the Socialist countries and their approach to preventing an arms race in outer space, China's basic principles that Member States should observe the international legal instruments they had ratified and that countries with space capabilities must refrain from testing and deployment of space weapons, as well as the thinking of the Western draft, which, *inter alia*, called upon the US and the USSR to further intensify their Geneva negotiations in the search for effective and verifiable agreements aimed at preventing an arms race in outer space. During the debate, all delegations, regardless of the group they belonged to, expressed fear about the dangers of the spread of the arms race into outer space. Almost all countries stressed that, while the two super-Powers continued to negotiate in Geneva, the 1972 Anti-Ballistic Missile Treaty should be strictly respected. The Soviet Union and other Socialist countries stressed that there was a serious threat arising from the possible deployment of "space strike" weapons and such programmes were the biggest obstacle to progress in nuclear disarmament

and emphasized the urgent need to reach agreement between the USSR and the US on banning space strike weapons of the "space-to-earth" and "space-to-space" types. Western countries in general emphasized strenuously that outer space should not become an arena of competition between the super-powers. By underlining the importance to certain delegations of the issue of the prevention of an arms race in outer space and its crucial role in the debates of the First Committee, in the Conference on Disarmament and bilateral negotiations, they emphasized that this item has a significant bearing on international stability. The non-aligned and neutral countries reiterated the basic principles set out in the Harare Declaration by the Heads of State or Government of the Non-Aligned Countries which, *inter-alia*, stressed the urgency of halting the development of anti-satellite weapons, of dismantling existing systems, and of prohibiting the introduction of new weapons systems into outer space, and recalled the Ixtapa Declaration by the authors of the Five Continent Peace Initiative (Argentina, Greece, India, Mexico, Sweden and Tanzania) in which they reiterated their demand that an arms race in outer space be prevented, that space not be misused and that the development of anti-satellite weapons be halted.

The General Assembly, in the resolution relating to peaceful uses of outer space, urged all States to contribute actively to the goal of preventing an arms race in outer space as an essential condition for the promotion of international co-operation in the exploration and use of outer space for peaceful purposes and requested UNCOPUOS to continue to consider, as a matter of priority, ways and means of maintaining outer space for peaceful purposes.

Varying views on what the Committee's appropriate role should be in regard to that issue were expressed. Some States felt that the Committee's work should complement work on arms control in outer space under way in bilateral and multilateral forums. A working paper (A/AC.105/L.161) submitted by a group of socialist States to the UNCOPUOS and brought by them to the attention of the General Assembly, suggested ways the Committee could work towards banning weapons in outer space, promoting international co-operation in the peaceful exploration of space, and strengthening the international legal and institutional basis for such exploration. Those countries said the Committee should also give special consideration to machinery for international co-operation in the peaceful uses of space, including establishing a world space organization. Other countries, including Western nations, said disarmament questions did not fall within the competence of the Committee. It was established practice, they averred, to discuss prevention of the arms race in the General Assembly, and to conduct disarmament negotiations bilaterally between the major Powers and multilaterally within the Conference on Disarmament. The working paper submitted by the Socialist countries could not serve as a basis for discussion as its contents were not appropriate for the Outer Space Committee's deliberations, those countries said. Other nations, including those of the non-aligned group, felt that to adopt effective ways and means of maintaining outer space for peaceful purposes, it was first necessary to halt the growing militarization and arms race in outer space. The Committee could play a supportive role in preventing an arms race in outer space by exchanging

views and making proposals on the issue, they suggested. Discussions of that nature would not weaken but rather strengthen the Committee's role in promoting international co-operation in the peaceful uses of outer space.

IV. *International cooperation in the peaceful uses of outer space*

On the questions relating to peaceful uses of outer space, the General Assembly acted on the basis of considerations and recommendations of UNCOPUOS which met from 2-13 June 1986, the Scientific and Technical Sub-Committee, which met from 10 to 21 February 1986, and the Legal Sub-Committee, which met from 24 March to 11 April 1986. The reports of these bodies are to be seen in United Nations documents A/41/20, A/AC.105/369 and A/AC.105/370 respectively. Summary Records of the proceedings of the Committee are contained in A/AC.105/SR.280-293, and the Legal Sub-Committee in A/AC.105/C.2/SR.436-450. The salient features of the recommendations of these bodies are discussed and summarized below:

A. *Nuclear power sources in outer space*: In 1986, further agreement was reached on supplementing items contained in the notification format for malfunctioning of a space object with a nuclear power source on board, which had been previously endorsed by UNCOPUOS in 1983.

The matter was discussed in a working group of the Legal Subcommittee which considered the theme of notification prior to re-entry of such a space object and on the theme of assistance to States. Among the documents before the working group was a working paper submitted by Canada containing a set of draft principles relevant to the use of nuclear power sources in outer space (A/AC.105/C.2/L.154). Following discussions, the working group recorded consensus on the text of principles relating to the above two themes which were later endorsed by UNCOPUOS.

It was agreed that any State launching space objects with nuclear power sources on board should make information available as soon as possible about malfunctioning space objects and risk of re-entry of radioactive materials to the Earth. That information, which would be updated frequently, should also be transmitted to the Secretary-General. It was further agreed that all States possessing space monitoring and tracking facilities should communicate the relevant information regarding the re-entry of a malfunctioning space object to the Secretary-General and the State concerned. The launching State should promptly offer to provide the necessary assistance to eliminate actual and possible harmful effects from the re-entry of such a space object. UNCOPUOS also endorsed the agreement reached within the Scientific and Technical Subcommittee that, in the development and implementation of new space systems, attention should be given to further enhancing the safety margin of space objects with nuclear power sources on board. It recognized a need for providing guidance to States in monitoring and taking countermeasures in case of radioactive contamination of their territory from a nuclear power source carried by a space object.

In the discussions relating to this matter, some delegations suggested that

efforts should be made in future sessions to define safety criteria to prevent accidents and noted that it was important to have norms for international liability in that area and that such liability should include direct, indirect and delayed damages.

B. *Definition and delimitation of outer space; geostationary orbit*: The variety of views expressed by Member States previously (see Journal of Space Law 1985, Vol.13,No.2,pp.183-184) on the question of definition and delimitation of outer space as well as the questions relating to the geostationary orbit were further elaborated on and reiterated during the sessions of the UNCOPUOS and its two Sub-Committees as well as during the General Assembly.

In this connection, some States, particularly the Socialist countries and some developing countries, indicated that it was necessary to have a conventionally defined boundary between air and outer space. Other States, particularly the Western countries, stated that the need for such a definition or delimitation had not yet been established. Some equatorial countries, particularly Colombia, expressed the view that the definition or delimitation of outer space would help in the solution of problems in the legal regime of the geostationary orbit. Those States felt that the Legal Sub-Committee should elaborate draft principles governing activities of States in the utilization of the geostationary orbit, while other States considered that the elaboration of draft principles on this subject was not necessary.

During the discussion of this item in the Legal Sub-Committee, it had before it the working papers submitted at previous sessions by the Soviet Union, Colombia, Ecuador, India and Kenya as well as two new working papers submitted by the German Democratic Republic (A/AC.105/C.2/L.153) and Kenya (A/AC.105/C.2/L.155).

C. *United Nations Programme on Space Applications and UNISPACE recommendations*: The UNCOPUOS reviewed the United Nations Programme on Space Applications and noted that it had been carried out satisfactorily in 1985 and 1986 and endorsed the activities proposed for 1987, which were later approved by the General Assembly. Those activities include a series of worldwide workshops, meetings, seminars and training courses on communications technology and data transmission, and remote sensing technology as applicable to various fields such as geological sciences, mineral exploration and agriculture. Under the programme, 159 persons from developing countries were training in 1986 and a similar number was expected to benefit in 1987.

The Committee, however, expressed concern at the existence of a gap between the resources needed for the new or expanded activities recommended by the UNISPACE Conference and the meagre resources available for their implementation, which had been further drastically reduced in view of the financial crisis currently facing the United Nations as a whole. On the recommendation of the UNCOPUOS and its Scientific and Technical Subcommittee, the General Assembly approved the establishment in 1987 of a working group of the whole of the Subcommittee to evaluate the implementation of the recommendations of the UNISPACE Conference, with a view to improving the

execution of activities relating to international cooperation, particularly those included within the United Nations Space Applications Programme, and to propose concrete steps to increase such co-operation as well as to make it more efficient.

V. *Other matters and future work*

UNCOPUOS and its Scientific and Technical Subcommittee also considered questions relating to space transportation, life sciences including the developments in biomedical research and the programmes in the geosphere-biosphere programme.

UNCOPUOS also had a discussion of its future role, including its working procedures, and that of its two Subcommittees. While complete agreement was not reached on its future role and working procedures, the Committee expressed its firm belief that "developments towards strengthening the role of the Committee in maintaining outer space for peaceful purposes should continue." It decided that the Committee's responsibility in that area could cover further development of international space law, including preparation of international agreements governing practical peaceful applications of space science and technology. Agreement was reached that all the subjects considered in 1986 will receive further consideration during 1987 sessions in New York of the Scientific and Technical Subcommittee (17-27 February), the Legal Subcommittee (16 March—3 April), and UNCOPUOS (1-12 June). Additionally, in view of the fact that it had completed its work on remote sensing principles, the General Assembly requested the Legal Subcommittee to consider the choice of a new item for its agenda from among various proposals made by States during the 1986 session of UNCOPUOS and the General Assembly. Agreement was also reached in adding two new items to the agenda of the Scientific and Technical Subcommittee—Planetary Exploration and Astronomy. The Subcommittee also will have as its special theme for 1987, "Space Communications for Development".

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2. *Agreement between the Government of the Republic of Chile and the Government of the United States of America concerning the Use of Mataveri Airport, Easter Island, as a Space Shuttle Emergency Landing and Rescue Site: A Report.*

On August 2, 1985, the Governments of Chile and the United States signed an agreement whereby Easter Island, a Chilean possession, can now be used as a Space Shuttle emergency landing and rescue site.

The Agreement is the result of negotiations between the two above mentioned countries, arising from a request by the United States to use the

Mataveri International Airport on Easter Island for Space Shuttle emergencies. The Agreement is within the framework of a series of Outer Space Treaties adopted by the United Nations, to which both countries are signatories.

In Article 1 Chile stipulated a series of limitations in order for a Space Shuttle to land in Mataveri. Chile authorizes the landing, in the event of an emergency, and the recovery from the Airport of any of the four Space Shuttles existing at the time of the Agreement. (The Agreement was signed before the Challenger disaster). This is the first limitation that this article imposes. Other limitations which must be considered jointly are that the Space Shuttles covered by the Agreement must be the property of the United States Government and must be operated by the National Aeronautics and Space Administration (NASA) on missions in accordance with the Outer Space Treaty. This means that any future Space Shuttle, even one which complies with all the conditions of Article 1, will not be covered by the provisions of the Agreement and thus will be unable to land at the Airport. Furthermore, any of the Space Shuttles named in the Agreement will only be able to land if they meet the above mentioned requirements and are experiencing the specific emergency conditions defined in the Agreement. Under the Agreement, an emergency is understood to be any event following the launching of a Space Shuttle which endangers its crew, so that the Shuttle can neither return to the United States nor reach Outer Space. Consequently, any emergency situation not specified in Article 1, para 2 will not obligate the Chilean Government to permit the landing of a Space Shuttle. This specific definition of emergency situations was intended to protect the interests of the Chilean Government and prevent Easter Island from becoming a Space Shuttle landing site, rather than one used exclusively for emergencies. In fact, the Agreement imposes a limitation on the number of emergency landings per year.

Article 2 directs the United States Government to notify the Chilean Government prior to each Space Shuttle mission if its orbit and place of launch could result in an emergency landing at the Airport. Not every launching of a Space Shuttle has the airport as an emergency landing place. Once again it can be seen that this rule contains a limitation, in addition to those already indicated in Article 1, regarding the specific circumstances in which the Agreement would apply.

Article 3 is devoted to the special rules established in the Agreement to cover immigration aspects. A unique regime has been established allowing North Americans to undertake the operations to prepare for the launch, as well as those of rescue and recovery of Space Shuttles, and also those concerned with the organization of its departure and the return of its crew without being obliged to follow the usual immigration procedures. The Complementary Agreement specifies the regulations covering such personnel, including: the number of personnel permitted, mode of identification, sequence of entry into the country and means of transportation to the Airport. In no case may this number exceed 23 persons during the preparatory phase of each landing for a period of no more than three weeks. In the event of a Space Shuttle emergency landing, the total number will not exceed 450 persons, for no more than 120 days, with no more than 400 persons at any one time. The various groups of

experts and specialists will enter the country to execute a specific mission and will then leave Chile to be replaced by other groups of experts and technicians who will undertake other tasks in the Space Shuttle rescue and recovery process.

In unusual circumstances, the time periods and the maximum number of persons allowed may be increased subject to the prior authorization of the Chilean Government. The personnel mentioned in the previous paragraph do not include the airplane crews transporting personnel or cargo in transit who may remain in Easter Island for up to 48 hours. The aforementioned personnel assigned to the preparatory tasks, as well as rescue and recovery, will be U.S. nationals; they will be exempt from carrying a passport and from obtaining prior consular approval or visas, and they will enter Chilean territory and proceed to the Airport with a special identification document issued by the U.S. Government. Finally, Article 3 also specified that the aforementioned personnel shall not enjoy diplomatic immunity and shall be forbidden to carry arms. They shall be exempt from all income tax and other levies established by Chilean social security laws.

Article 3 establishes a rigid code of conduct for the personnel involved in Space Shuttle activities, in order to regulate the presence of a large number of Americans on an island with barely more than 1500 inhabitants. The Americans' presence has the potential of significantly altering the inhabitants' way of life. Also, the time frames indicate clearly to the world at large that there will be no American base on the Island.

According to Article 4, the Chilean Government may establish areas of permitted access to determine areas of forbidden or restricted access for the personnel who arrive at Easter Island pursuant to the Agreement. This Article, like the preceding one, indicates the Chilean Government's concern that the presence of a large number of Americans could alter the Island's way of life. By restricting the movements of those persons, the Chilean Government hopes to control the situation.

Article 5 obligates the United States Government to extend and improve the present Airport landing strip to facilitate and enhance the safety of the operations and activities described in the Agreement. This extension and improvement are subject to the availability of appropriated funds; for the United States it is an "Executive Agreement", and therefore the funds to be committed are included in the Annual Budgets and are not subject to approval by Congress. The extension and improvement of the runway must be completed within one year from the entry into force of the Agreement, although this period may be extended for an additional year for technical reasons or force majeure.

Article 7 states that the Chilean Government shall authorize the U.S. Government to install, within the perimeter of the Airport, emergency equipment for Space Shuttle landing and recovery operations under the terms specified in the Complementary Agreement. The same authorization applies to temporary shelters which may be needed to provide lodging and board for the personnel working on the recovery. Only in exceptional circumstances and strictly as necessary, the Government of Chile may authorize the installation of equipment

outside the perimeter of the Airport in accordance with Chilean land-use regulations. In paragraph B) of the same Article, the Government of the United States is required to provide potable water required by the implementation of the Agreement, to the extent that such requirement diminishes the Island's normal water supply. This Article expresses Chile's desire to protect all the resources of the Island, which is unprepared for an influx of 400 persons and whose social and ecological environment is likely to be disturbed.

Article 11 establishes the obligation of the Government of Chile to "support" the Government of the United States in search and rescue operations and in the protection of the Space Shuttle, its astronauts, and all property and personnel involved in the operations of the Agreement. This support will be subject to limitations which tend to attenuate it. In the first place, it is support of an effort which is primarily the responsibility of the U.S. Government. Second, the obligation assumed by Chile is limited "within existing capabilities." The United States recognizes that Chile lacks the appropriate and available means and resources to undertake operations of the magnitude which an event such as an emergency, and particularly an unexpected accident, would demand. The Space Shuttle "Challenger" rescue operations illustrate the tremendous effort that is required in a situation envisaged by this Agreement. Paragraph B) of this Article stipulates that the Government of Chile shall not be held liable by the Government of the United States for any damages which may be incurred in the course of activities conducted pursuant to the Agreement.

Article 12 establishes that the Government of the United States shall bear all costs incurred in the extension and improvement of the Airport runway, the provision and installation of the necessary equipment for the Space Shuttle emergency landing and recovery operations and other equipment required under the Agreement. The United States shall reimburse Chile in accordance with the procedures established in the Complementary Agreement for all the expenses incurred and necessary for the application of the Agreement, including those caused by the augmentation of public services and utilities, transportation, energy, fuel and other supplies. This Article underlines the Chilean position of demanding reimbursement for each and every expense arising from the Agreement.

Article 13 establishes the regime of international liability that applies to the U.S. Government. Chile shall not be held liable for any damages incurred in the course of activities conducted pursuant to the Agreement.

The Government of the United States is subject to two liability regimes. The first refers to damage that occurs during the extension and improvement of the Mataveri Airport runway, or during preparatory activities conducted pursuant to the Agreement prior to the launch of a Space Shuttle that may involve the Mataveri Airport. All damages produced at this stage shall be the responsibility of the United States Government in accordance with international law. Claims presented pursuant to Article 13 must be filed within one year of the date on which the damages occurred.

The second liability regime refers to damages caused by or resulting from:

a) an emergency landing, which includes any accident in any area under

the territorial or maritime jurisdiction of Chile, and

b) the recovery and all related operations, including the rescue of the Space Shuttle, its astronauts, equipment and related personnel. This liability regime is governed by the Convention on International Liability for Damage Caused by Space Objects. According to this Convention, damage that must be compensated includes loss of life, personal injury or other impairment of health, as well as loss of, or damage to state or personal property, natural or juridical, and property of international intergovernmental organizations.

Article II of the Convention establishes a regime of absolute liability. The claims presented pursuant to this Convention must be filed within one year following the date on which Chile learned that damages had occurred. It should be noted that if claims presented through diplomatic channels cannot be resolved within one year from the date in which they were introduced, either Party can request the formation of a Claims Commission. Both Governments have agreed that the Commission's ruling shall be final and binding. Additionally, the Government of the United States shall not invoke Article 7 (B) of the Convention as a defense against the applicability of the same Convention, with reference to those foreign nationals who have been invited to attend any phase of the launch or any state thereafter and have suffered damage.

According to Article 14, the Government of the United States agrees to provide immediately all necessary assistance to restore the environment of the Island in case of ecological damage. The ecological damage produced by or as a consequence of the event of a landing or recovery of a Space Shuttle is subject to a regime of objective liability covered by "The Convention on International Liability for Damage Caused by Space Objects". For this reason, Article 14 is limited to ecological damage that occurs during the extension of the runway and the preparatory activities. It should be noted that according to Article 5 para 4 of "The Agreement Concerning the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space," whenever the Government of Chile has reason to believe that a Space Shuttle or its component parts discovered in territory under its jurisdiction is of a hazardous or deleterious nature, it may notify the Government of the United States which shall immediately take effective steps, under the direction and control of the Government of Chile, to eliminate possible danger or harm. With respect to the obligation of the United States to provide effective assistance, the threat of ecological damage or any form of contamination is not limited to the preparatory activities and the extension of the runway, but also includes all stages and operations covered by the Agreement.

Article 16 regulates the system of consultations, which can be initiated at the request of either Party, through diplomatic channels, concerning any matter related to the interpretation or application of the Agreement. This Article establishes the first stage of the procedure for the peaceful settlement of disputes. The second stage of the procedure for the peaceful settlement of disputes is regulated by Article 17 only if related to those situations not connected to the "Convention on International Liability for Damage Caused by Space Objects." Article 13 B) of the Agreement states that the Government of

the United States shall be liable for all damage caused by or resulting from a Space Shuttle emergency landing and recovery and that this liability shall be governed by the Liability Convention.

The system for the peaceful settlement of disputes is complex, since it consists of two stages. First, direct consultations are contemplated in Article 16; second, in the event that the Parties cannot resolve their differences through the abovementioned means, Article 17 directs recourse to arbitration. Arbitration is not subject either to compromise or any ulterior agreement. Either Party may unilaterally request arbitration.

Article 20 deals with rules regarding the entry into force of the Agreement, its length, amendments, etc. Para. A) provides that the Agreement shall be in force for eight years, and thereafter it will be automatically renewed for consecutive four-year periods, unless either Party informs the other of its wish to terminate. In that case the Agreement shall terminate one year after receipt of such notice. Notwithstanding the provisions of Para. A) of this Article, Paragraphs C) and D) deal with two hypotheses of immediate termination of the Agreement. In the first place if there are more than two Space Shuttle emergency landings during any year while the Agreement is in force, the Agreement is immediately terminated. Also, if within the period of time indicated in Article 5 the appropriated funds for the works described in that Article are not forthcoming, Chile may immediately terminate the Agreement.

Finally, Article 21 provides that the Agreement shall enter into force on the date on which both Governments advise each other through diplomatic channels of the conclusion of the internal procedures required by their respective legal systems, including the U.S. budgetary approvals necessary for the work referred to in Article 5. The Agreement entered into force November 6, 1985.

The main reason for this Agreement is the U.S. need for a landing point in the middle of the Pacific Ocean in case of a Space Shuttle emergency. They found the place: Easter Island. They found the Airport: Mataveri. But unfortunately it did not have the minimum length required for Space Shuttle landings. Chile did not need to extend a runway which covers its present requirements. Therefore the United States had to finance an extension of the runway, which meant dealing with many issues which otherwise would not have surfaced. Otherwise, the provisions of "The Agreement concerning the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space" would have been sufficient.

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3. *The 29th Colloquium on the Law of Outer Space, Innsbruck, October 4-11, 1986.*

The Colloquium took place during the XXXVIIth Congress of the International Astronautical Federation. The sessions of the Colloquium were held in the Stadtsaal.

The Colloquium was well attended by lawyers from all parts of the world. Among the active participants were a satisfying number of young lawyers.

The four official subjects were the following:

1. Legal aspects of maintaining outer space for peaceful purposes;
2. Legal aspects of space communications, including the geostationary orbit and services utilizing it;
3. Commercialization of space activities;
4. Space law teaching and the history of space law.

The Colloquium was devoted to one of the oldest pioneers in air and space law, *Prof. Dr.Eugène Pépin*, who is now in his hundredth year.

In opening the Congress the President enumerated the many activities of *Dr. Pépin* in the field of space law. As his Excellency *Dr. P. Jankowitsch* had obtained the position of Minister of Foreign Affairs, he was not able to chair the session. *Ambassador Dr. H. Türk*, who served at the Division of Outer Space Affairs, kindly replaced *Dr. Jankowitsch* as chairman. *Mr. W. de Vries* assisted the Chairman at this session.

The subject "Legal aspects of maintaining outer space for peaceful purposes" aroused much interest. Some speakers discussed the political and legal meanings of the common heritage of mankind. *Dr. Majorski* mentioned that the terms "common heritage of mankind" and "province of all mankind" are almost synonymous. The issue is exploration and use, not appropriation. *Mr. Tatsuzawa* thought the "common heritage of mankind" by nature does not exist. According to him it is rather a philosophical statement. *Dr. Gál* stated that ASAT weapons constitute an act of aggression as defined in article 39 of the U.N. Charter. He proposed a treaty for the prohibition of the use or threat of force in outer space.

Dr. Müller proposed a new approach on arms prevention in outer space. Instead of a prohibition on the placement of certain space weapons in outer space, he proposed a prohibition on the use/threat of force in/from outer space. A fixed boundary between air space and outer space is needed for this purpose. *Mr. Schwetje* emphasized art. 51 of the U.N. Charter which gives no delimitation as to which weapons may be used for self-defense. SDI is a research program, not a deployment program. The scope of the term "peaceful purpose" must be defined by the superpowers (no definition exists; it must be determined by the actual practice of states). *Dr. Sloup* stressed the means of verification. There is an increased chance for the adoption of the French proposal to create an International Satellite Monitering Agency (ISMA) since spot-images are freely available to everyone. These images have military significance. *Dr. Vereshchetin* observed that Art. 5 of the ABM treaty prohibits tests, and US "demonstrations" are actually tests. SDI is thus contrary to ABM and international law (equal security is accepted as a new principle by the ABM Treaty).

Dr. Cocca and *Dr. Ferrer* emphasized the positive aspects of new technological developments, positive in the sense that a social conscience must be created. They emphasized the role of scientists. *Dr. Finch* treated the "Legal Aspects of the Challenger Space Shuttle Accident."

In the discussion *Dr. Vereshchetin* observed that all Soviets agree that the Space Treaty does not prohibit all military activities. The present discussions on military/non-military are "battling against western windmills". *Dr. Gorove* observed that even in the US two opposite opinions exist; those who say that SDI is in accordance with ABM, and those who say it is contrary to ABM. *Mr. Smith* mentioned that the ABM Treaty has many ambiguities which have to be clarified if parties want to strengthen the treaty.

The second session on the subject "Legal aspects of space communications, including the geostationary orbit and services utilizing it" was chaired by *Prof. B. Bakotic*, assisted by *Mr. H. Tuinder*. *Mr. Dann*, who spoke instead of *Mr. Von Noorden*, emphasized the mixed character of INMARSAT. It embodies elements of various differing political and economic philosophies (both public/private). *Ms. Ospina* spoke about an independent assessment of WARC-ORB '85 recommendations. She emphasized the "dual planning approach". The problem of WARC-ORB '85 was that all agreements were reached in the last hours. Furthermore, the quorum was not present so that the legal validity of the agreements may be doubted. She proposed that WARC '85 should be approached positively and that good faith should reign. *Ms. Pichler* gave an overview of copyright problems surrounding satellite transmissions of programme-carrying signals in Western Europe, in particular France and Austria. *Mr. Smith* thought that the lack of results of WARC '85 was due to an unwillingness to compromise and extraneous legal/political issues (i.e. Bogota Declaration). He gave suggestions of ways on which WARC '88 could be more successful. *Mr. Wiessner* gave a very interesting paper on the geostationary orbit.

The third session on "Commercialization of space activities" was chaired by *Prof. Dr. K. H. Böckstiegel*, assisted by *Ms. T. Zwaan*. *Dr. Bourély* gave an overview of the law governing the commercialization of outer space. He emphasized that private companies have to respect international law. *Mr. Dula* described the problems of getting export licenses in the USA. He discussed the practical problems confronting lawyers dealing with commercial activities in outer space. This gave rise to concern about the profitability of activities for private enterprises. Two problems of commercial activities were described by *Ms. Sterns* and *Mr. Tennen*. The two problems were first, launch possibilities and second, liability/insurance problems. Lawyers will play a crucial role in the future. A solution might be the formation of consortia of smaller companies.

Some other topics also were treated in this session. *Mr. Collins* and *Mr. Williams* drew attention to the high density of objects in outer space and the increasing danger of collisions between space objects. Therefore space debris will become an important problem in the near future. *Mr. Kuskuvelis* spoke about the legal consequences of an aerospace plane.

In the discussion *Dr. Perek* thought that in the definition of the space vehicle, not the construction or destination of the vehicle (Challenger), but the distance where the accident took place would be decisive. *Prof. Gorove* men-

tioned that from the point of view of the Liability Convention the liability arises from the time of launching or attempted launching, whereas *Dr. Hosenball* observed that the Liability Convention might not be applicable because art. 7 excluded nationals. However, no foreigners were aboard the Challenger.

The last session on "Space law teaching and the history of space law", chaired by *Prof. Dr. S. Gorove*, assisted by *Mr. Kuskuvelis*, drew the most attention of the many scholars, who are very well acquainted with the subject. All of them gave an overview of space law teaching in their respective countries and teaching institutions. After this description they gave some personal reflections and trends on the future of space law teaching.

Several speakers emphasized the interdependency of space law teaching and the technological developments in space activities in general. *Mrs. Galloway* remarked that these technological developments created specific problems which could be solved only with a multidisciplinary approach. She therefore proposed that space law teaching has to take into account these very features of space activities. For the same reasons *Prof. Gorove* stated that space law students also have to be introduced to other fields of law which are related to space activities.

Other speakers laid more emphasis on the place of space law in international relations and general public international law. *Prof. Cocca* and *Prof. Gaggero* stressed the social changes involved with the internationalization of space law. Endeavours of humanity as a whole make it necessary to create a new conscience in order to solve the problems involved. *Prof. Bakotic* was of the opinion that space law is not yet an independent branch of law but has to be seen in the perspective of international law as a whole. The same was said by *Dr. Haanappel* who argued that the differences in the nature of space do not include a distinction of space law in itself. Space law teaching, therefore, has to be seen in the light of other branches of international law. This interrelationship was also mentioned by other speakers such as *Prof. Böckstiegel*, *Prof. Kopal* and *Prof. Matte*.

The President of the International Institute of Space Law closed the Colloquium thanking the Chairmen of the Sessions, *Ambassador Türk*, *Prof. Bakotic*, *Prof. Böckstiegel* and *Prof. Gorove* and also their assistants. She also thanked the speakers on the different subjects, the participants in the discussion and all participants for their kind attention and attendance. She mentioned that the sessions of the Colloquium had truly taken place in an atmosphere of cooperation and in an effort to reach a mutual understanding, a good tradition and the fundamental goal of our Institute.

I. H. Ph. Diederiks-Verschoor
President, International Institute
of Space Law (IAF)

4. "Commercialization of Space Activities", IAF Congress, Innsbruck, October 9, 1986.

The 16th Symposium on Economics and Benefits of Space Activities held a panel entitled "Commercialization of Space Activities" chaired by *J.S. Greenberg* and *G.K.C. Pardoe.*

The first speaker, from NASA, presented a paper by *Isaac T. Gilliam IV*, entitled "Towards Industrial Development in Space." The presentation discussed the activities of NASA's Office of Commercial Programs (OCP) which encourages private investment in commercial space activities and facilitates commercial application and transfer of existing aeronautics and space technology to the private sector.

The second speaker, *Dr. Hoffman* from INTOSPACE, spoke of the "European INTOSPACE Venture." INTOSPACE is an international company established to promote research, development and production of space activities by: reducing obstacles in the use of microgravity, coordinating user requirements with space utilization, and stimulating individual applications of space. INTOSPACE serves as a liaison between the user and the space industry, acting primarily as an agent for the users' interest, *i.e.* marketing organization for space systems. The shareholders of INTOSPACE include ninety-four companies from nine European countries. Germany is the largest supporter, although Italy also contributes substantially.

Mark Henley from General Dynamics, presented a paper by *M.C. Simon* of General Dynamics, on the "Utilization of Government Incentives to Promote Commercial Space Station Development." The presentation concentrated on the difference between government and industry space programs, in terms of program offerings and feasibility and examined the possibility of cooperation between government and private enterprise. It concluded that a profitable markets for space station services should develop in the next 10-15 years. Its reasoning stemmed from the general rationale for space commercialization which, *inter alia*, included increasing entrepreneurial innovation, heightening market responsiveness, improving efficiency with risk incentives, expanding economic growth and broadening individual freedoms. The justification for space station commercialization included the opportunity to achieve commercial benefits on a large scale, the attractive markets for many space station functions, and the zero gravity lending itself to many experiments.

The fourth speaker, *Mr. P. Q. Collins*, presented a paper written in conjunction with *Mr. D. M. Ashford*, both from the Imperial College of Science & Technology, on "Potential Economic Implications of the Development of Space Tourism." The presentation investigated the feasibility of space tourism (the provision of pleasure trips in low earth orbit to fare-paying passengers). *Mr. Collins* discussed the range of entertainments that could be provided in earth-orbiting facilities, the resulting potential demand for it, and the feasibility of providing the required services at the prices estimated to be acceptable to the public.

Dr. George A. Hazelrigg, Jr. and *Madaleine E. Hymowitz*, from the National Science Foundation, spoke on "Research in Space: Prelude to Commer-

cialization." They saw Critical Infrastructure Analysis (CIA) as providing a framework for analysis of potential commercial space activities. Commercial space activity is governed by human decision making processes, therefore rendering it impossible to utilize a rigorous framework of analysis. CIA forces one to broaden one's thinking to cover a range of disciplines, by considering the concept or need with respect to the following: favorable regulation, necessary institutional structures, adequate financing, and risk control.

Using a CIA analysis, however, they concluded that the existing infrastructure could only support research in space, not other types of commercial activities, primarily because other applications require space transportation.

Professor J.M. Logsdon of George Washington University presented a paper entitled "The Policy Framework for Space Commercialization, Rhetoric and Reality." He spoke of the basis of failure in U.S. Space Transportation Policy, primarily the failure of policymakers to readjust expectations, when the shuttle program was significantly undercapitalized in its early years. The reason for their failure was NASA's fear of cancellation and fear of a lack of approval for new projects, as well as its need to declare certain projects, such as the shuttle, a success. As a result, all warning signs with respect to the shuttle were ignored and reality caught up with rhetoric.

His presentation noted other areas of possible policy failures where reality may fail to match rhetoric: creating an available private launch industry; a space industry based on applications of microgravity; and significant commercial utilization of space stations.

With respect to a commercial ELV industry, *Mr. Logsdon* remarked that he did not think companies would be able to compete because industries have not got the money to update the ELV's unless the U.S. government pays for research and development. The launch business will, therefore, have difficulty becoming viable. With respect to microgravity, he remarked that expectations are being lowered, but are still unrealistic. Finally, with respect to space stations, *Mr. Logsdon* commented that they were oversold.

The essential question he pondered was how to avoid the gap between rhetoric and reality. He suggested that a policy that allows a variety of interests and perspectives to have influence over policy choice was necessary, as were goals and objectives to guide that policy process in making choices that advance interests broader than those of specific organizations.

Dr. Pamela T. Dennis, in collaboration with *Lawrence D. Greenwood*, spoke on "Factors in the Success of Commercial Remote Sensing: Commercial Viability and the Role of Government." The presentation explored the probable success of remote sensing as a commercial venture and then examined the issue of the relationship between government, private industry, and the scientific community in forming the necessary relationship to insure the diffusion of technology necessary for commercial systems to succeed.

First specified as crucial to fostering investment and private sector commitment to remote sensing was the strength and stability of the market. Key factors in assessing market uncertainty included: the effect of prices, the effect of data copyrighting, and the rate of market expansion. The latter factor was said to be influenced by reliable continuous systems, quality and level of image

resolution, timely access and distribution of data, expanded user base, government research and development activity levels, and an "end-user view." The end-user view went to analyzing commitments to resource contributions to ensure that all necessary activities were supported and a timely commitment was made by the space agencies to the implementation of future permanent space orbiting systems.

Next identified as important to investment was the rate of technology diffusion. The speaker found technology diffusion to be affected by five factors: the perceived relative advantage of an innovation over its predecessor, compatibility of an innovation with existing values, past experiences and needs, the perceived complexity of an innovation, the trialability of an innovation, and the observability of the results of an innovation to potential users. Also noted was the fact that research suggests that both science push and market pull are needed to diffuse a new technology and that the continuing role of government will be necessary to fund the science and participate in ventures that will transform the market for remote sensing.

The speaker noted that several other factors would be critical to the success of industry/government ventures such as EOSAT and SPOT. For example, considered essential were the understanding of end user requirements; an assurance of continuity of data; sufficiency of economic and technical need to warrant the investment; maturity of the science so as to minimize technical risk and foster continued product development; and the continuation of product development support by the government.

The speaker stressed that only with the management of certain challenges, such as the uncertainty of the market and, the problems with technology diffusion, would remote sensing become commercially viable. In order to cope with the complexities of the market, continued industry/government relationships will be necessary, with full government support. Finally, it was noted that if these factors were examined, one could begin to understand the uneven role of remote sensing diffusion and the complications for future commercial development.

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5. *Review Meeting on Communication with Extraterrestrial Intelligence, IAF Congress, Innsbruck, Austria, October 9-10, 1986.*

Fifteen years ago, an international review meeting on a fresh topic—prospects and ways of interstellar communication and detection of intelligent extraterrestrial signals—was held for the first time during the 23rd International Astronautical Congress of the IAF in Vienna, Austria, 1972. Since then, review meetings on this subject have been one of the regular features of astronautical congresses. In 1974, a special Committee on Communication with Extraterrestrial Intelligence (CETI) under the chairmanship of *Pro-*

fessor Rudolf Pesek of Czechoslovakia, initiator of these discussions, was established by the International Academy of Astronautics (IAA) for a thorough consideration of this subject. *Dr. J. Billingham* (USA) later became co-chairman of the Committee.

The review meeting on CETI held in Innsbruck, Austria, 1986, was the fifteenth specialized gathering of this kind which, however, brought about one essential innovation. While previous meetings dealt mostly with astronomical, biological and technical aspects, the Innsbruck meeting, consisting of two sessions, dedicated the first of them to the legal, political and social implications of the detection of an extraterrestrial intelligent signal, thus enabling an exchange of views on what should be done from the societal standpoint when such detection becomes a reality.

Nine papers were presented during this particular session and though reflecting different approaches, all of them were useful in composing an adequate picture of what could be expected in this area in the short and long term future. Naturally, this brief account of the meeting will concentrate on legal aspects; nevertheless, at least some thoughts expressed by representatives of other disciplines should be recalled first because their views were also echoed in the legal contributions submitted.

Thus, *Dr. Peter B. Boyce* from the American Astronomical Society, Washington, D.C., underlined the central importance of elaborating the procedure for verifying the reality of our first extraterrestrial intelligence (ETI) signal, the certainty of which may be doubtful. He also recommended a rapid and open dissemination of observations among the scientific community that would spur attempts by other scientists to confirm them.

Ben Finney, from the Department of Anthropology of the University of Hawaii, drew attention to the difficulties inherent in establishing meaningful communication with ETI over distances and considerable transmission times, between life forms with unique biological and cultural characteristics and evolutionary histories.

Mary M. Connors, from NASA Ames Research Center, Moffet Field, CA, explored the personal and social effects associated with the search for and detection of a signal indicating ETI. She concluded that three social groups are expected to be particularly impacted by the discovery of ETI, namely, scientists, religious leaders, and political leaders. The important role of the mass media in all phases of this process was also emphasized.

The mode chosen to announce the first signal and the context in which that signal would be placed by the announcing authority were discussed in the paper of *John M. Logsdon* and *Catherine Anderson* from George Washington University, Washington, D.C.. They furthered the idea of engaging a wide range of people in a discussion now, in advance of any detection, in order to aim toward some form of agreement.

Finally, *Donald Goldsmith* from Interstellar Media in Berkeley, CA, raised the question of who will speak for Earth in the event that a signal from an extraterrestrial civilization is detected. He also considered it appropriate to create an international structure to prepare a response to a signal from ETI and opined that the content of the message might prove less controversial than

the identity of those broadcasting it.

Under the scope of this session three papers dealing *ex professo* with legal aspects of the topic were presented and though their authors represented different legal schools, they expressed comparable and complementary views.

The first of these speakers, *Allan E. Goodman* from Georgetown University, recommended developing now an international code of conduct with extraterrestrial life on behalf of the Earth for the purposes of sharing and extending knowledge. The principles of such a code should provide that information from an extraterrestrial source should be freely and publicly announced; responses should be formulated by international consultation; any visiting extraterrestrials should be entitled to diplomatic protection; and should the extraterrestrials pose a threat to human health or peace, no nation would act without first consulting the Security Council of the United Nations.

The second legal paper was presented by *Vladimir Kopal* from the United Nations Outer Space Affairs Division. He examined whether the present law of outer space, including the United Nations treaties and other legal documents, provides a satisfactory basis for search of and communication with ETI. In this respect, he concluded that at least some of the space law principles and norms in force provide guidelines that are also applicable to these activities though the directives given by them have remained rather general. Further, the speaker considered the impact that the detection of an ETI signal might have on the present body of space law and how to deal with legal problems arising from such an event. A possible role for the United Nations in this field was explored and a timely interest of the world body in this subject furthered. However, it was emphasized that a law-making process relating to this problem should only be started when the boundary between possibilities and well-established realities was crossed. This, however, does not exclude discussions on clarification of the legal aspects involved and consolidation of the views and positions of scientists and lawyers relating to this subject.

The third legal paper was presented by *Ernst Fasan* of Austria, Honorary Director of IISL, who outlined the characteristics of ETI, as well as some common interests that all races in the Universe may have regarding their own persistence. According to him, these interests are: to preserve and continue their own life, to protect this life from damage and intrusion, and possibly to expand the realms of their living space. In conclusion, the following legal-philosophical principles were formulated by the speaker: 1. Principle of non-violation; 2. Principle of equality; 3. Principle of recognizing the will to live and the living space of any intelligent race.

During the discussion that followed the presentation of this group of papers, different questions were touched upon, *e.g.* regarding the application of the right of self-defense in relation to ETI, possible similarities and differences in the status of astronauts and envoys of ETI, etc.. However, most of the emphasis was given to the suggestion of elaborating the principles of a code of conduct during these activities. This was particularly evidenced in contributions made by *Professor Stephen Gorove* from the University of Mississippi Law School and *Professor Aldo Armando Cocca*, President of Consejo de Estudios Internacionales Avanzados, Buenos Aires. The latter speaker particu-

larly emphasized the need to answer the detected signals on behalf of mankind as a whole.

Dr. Jill Tarter from the University of California in Berkeley, who effectively served as convenor of this session, recommended that the IAA CETI Committee in co-operation with the IAA-IISL Scientific Legal Liaison Committee initiate the drafting of an International Code of Conduct, a set of moral principles that would govern activities in the search of and communication with ETI. This idea was later endorsed by the CETI Committee and shaped in a recommendation addressed to the International Academy of Astronautics (IAA).

This report on the CETI review meeting in Innsbruck would not be complete without a brief note on its second session which was dedicated to "traditional" aspects of the topic, i.e. to scientific and technological questions and to search of appropriate strategies for these activities. Much of the information provided and several of the thoughts expressed during this part of the meeting were also relevant to those interested in legal, political and social implications. For example, the idea of distinguishing searches for advanced civilizations from searches for emerging civilizations with a preference for the latter was presented in the paper of *David Schwartzman* from the Department of Geology and Geography, Howard University in Washington, D.C.. Another example that deserves to be quoted is *Jill Tarter's* paper in which attention was drawn to radio frequency interference as one of the most significant technological challenges to any ground-based programme of search for evidence of artificially generated signals. There seems to be merit in the conclusion made by this speaker, "If we delay too long, it will necessarily drastically increase the costs of any future programme by requiring high earth orbit or lunar farside facilities."

Vladimir Kopal
Chief, Outer Space Affairs Division
United Nations

6. *Governance in Space Societies: First Principles—A Conference at the National Air and Space Museum, December 4-6, 1986.*

The National Air and Space Museum of the Smithsonian Institution and the Center for Democracy of Boston University have undertaken a cooperative program designed in part to help commemorate the Bicentennial of the United States Constitution. In order to examine the possible applicability of the values and principles which underlie the American constitutional heritage to the developing United States manned space program, the Center and the Museum initiated a series of conferences to discuss and, if appropriate, formulate a "Declaration of First Principles for the Governance of Space Societies." The actively involved Steering Committee members for the undertaking include major leaders of industry, journalism, the arts and government.

The first conference took place December 4-6, 1986 at the National Air and Space Museum in Washington, D.C. It consisted of a working group of

approximately thirty participants representing a relatively broad spectrum of disciplines related to the establishment of space communities, such as law, life sciences, sociology, psychology, bio-ethics, philosophy, history, political science and conflict resolution. They considered the wisdom of drafting such a declaration, as well as the substantive principles that might, or ought, to be included in such a declaration, based upon the values and principles subtending the American Constitution and other appropriate concepts and models drawn from democratic societies.

With a disparity of interests, disciplines, and levels of knowledge represented, the first conference was, in fact, enlightening to some and frustrating to others. In many respects, it characterized the initial gathering of our founding fathers two hundred years ago in Philadelphia at which most of the delegates arrived with different levels of expectations. A feeling was developed among the participants of having shared a diversity of concerns, hopes, fears, knowledge and ignorance relating to how American citizens and other individuals subject to United States jurisdiction in long-duration and permanent space habitats should survive in the context of social order principles. It was generally felt that any Declaration of First Principles ought to be, but did not necessarily have to be, consistent with charters of individual and societal rights formulated by other civilizations and governments, either nationally or under the auspices of regional organizations or the United Nations.

The paticipants felt that a Declaration, if there is to be one, should embrace the views of a significant portion of United States citizens regarding what they believe all Americans must enjoy in the way of inalienable rights for space existence, regardless of the ideology, economics or politics inherent in the Earth-based public or private organizations that support those individuals, or which only interact with them now or in the future. It also was felt that a Declaration of First Principles must be consistent with those space-related treaties of which the United States is a signatory and which are now the law of the land . . . as long as those treates are, in fact, themselves consistent with the provisions of the U.S. Constitution.

Some of the issues undertaken for consideration by the conference participants include whether space societies should be allowed self-governance or have the right to self-determination; if private ownership of property should be one of the inalienable rights; whether individual responsibilities, as well as rights, should be included in any Declaration of First Principles; whether a declaration should embrace specifically the types of principles included in the U.N. Declaration of Human Rights, including an emphasis on human dignity; if right to privacy should be an inalienable human right in space; and what the characteristics of due process might be as it relates to the proposed right of space inhabitants not to be deprived of life, liberty or property without that process.

During the first few weeks of 1987, it is intended that a draft Declaration of First Principles for the Governance of Space Societies will be formulated and distributed widely among universities, legal, and other professional associations, including those organizations involved in the Bicentennial Commemoration, for comment and suggested revisions. By the Spring of 1987, a

second meeting of the participants is planned to consider the response of the public to the document, and to discuss, amend, and even reaffirm or ratify all or parts of the draft Declaration of First Principles. In the process, it is hoped that a broad national audience will gain awareness of the degree to which the Declaration incorporates the living Constitutional heritage of Americans. The Declaration and the process are intended also to be significant teaching tools, vehicles to focus attention of American citizens on their Federal Constitution.

If a third meeting is determined by the participants to be feasible and wise, it will probably take place in the Fall of 1987, two hundred years after the U.S. Constitution became effective. The meeting would consist of fine-tuning a Declaration of First Principles for the Governance of Space Societies, and then its submission to American leaders. It is intended to be a grass-roots petition by United States citizens to their Government seeking explicit inalienable rights for their sons and daughters living and working in space.

George S. Robinson
Associate General Counsel,
Smithsonian Institution

(b) *Comment/Note*

7. *A Positive Vision for the American Space Program: The Report of the National Commission on Space—A Commentary.**

In the aftermath of the *Challenger* accident, many Americans have been doubtful about the future of the American space program. However, the report of the National Commission on Space, *Pioneering the Space Frontier*, published in May, 1986, by Bantam Books, takes a different view and offers a new vision of the American role in space.

Unfortunately, because the country has been preoccupied with immediate issues such as how to get the shuttle program back on-line, the insights and implications of the Commission's report only now are being understood and appreciated.

Chartered by Congress and appointed by the President in 1985, the Commission was chaired by *Dr. Thomas Paine*, a former Administrator of NASA. As instructed by the President, the Commission focused on America's long-term future in space, formulating a "bold agenda to carry the nation into the 21st Century." The Commission included one of the authors (*George Field*), Nobel Prize winner *Luis Alvarez*, astronauts *Neil Armstrong* and *Kathryn Sullivan*, aviation pioneer *Chuck Yeager*, former U.N. ambassador *Jeanne Kirkpatrick*, and space settlement advocates, such as *Dr. Gerard K. O'Neill.* The Commission heard from thousands of Americans via open forums, and by mail and telephone, and was briefed by experts at numerous meetings.

Ultimately, the Commission agreed that the only appropriate response to the President's directive was a systematic, step-by-step program to explore and settle the solar system, thus beginning to establish a new civilization in space. The Commission concluded that the technical means of achieving this goal could be developed within a generation, utilizing solar power and non-terrestrial materials to establish permanent human settlements throughout the inner solar system, "from Low Earth Orbit to the plains of Mars." To do so, the nation would be required to commit about one half of one percent of its GNP to the space program, as compared to about .3% today and one percent during the Apollo period.

The Commission advanced many reasons for the United States to undertake such a mission, including the advance of science, the "pulling through" of new technology, and the development of innovative commercial enterprises. Beyond these reasons, the Commission debated whether the impact of space exploration on the human spirit might be its most important contribution to humanity, and whether it might especially be a fundamental aspiration of the American people. Many of the Commissioners felt that failing to exert leadership on the space frontier would be a denial of basic traditions that lie close to the heart of our Republic.

One of the authors of this report (*Frank White*), who had worked informally to support the Commission's efforts, attempted to articulate the Commission's beliefs in a way that would be acceptable to the nation as a basis for a reinvigorated and enduring space program. Following a Commission forum held at Boston's historic Faneuil Hall (also known as "the Cradle of Liberty" because of the meetings held there during the American Revolutionary period), he drafted a set of basic principles that might be used as the rationale for establishing a new civilization in space. The principles were later incorporated into a "Declaration for Space," part of which was included in the commission's final report. Having established this framework, which could also be the foundation of a constitution for a space-based political order, the Commission's report goes on to describe in detail how its fifty-year vision could become a reality. The plan includes a vigorous space science program, development of a technology base to support the overall effort, and the support of private initiatives in space.

The American space program is undergoing a painful period of readjustment. However, the Commission found in its many hours of listening to testimony that the spirit of our young people has not flagged, and that they want a strong new space program in which all citizens have an opportunity to participate.

As NASA and the nation have examined the underlying causes of the *Challenger* accident, many observers have pointed to the lack of a set of long-range goals for our space program as one of the fundamental problems. The Commission report can be seen as a major step in providing that necessary

foundation. The Commission hopes that citizens will debate the report, modify it and, through Congress, support a vigorous new space program that will help to create the new civilization in space.

*George Field***
Member, National Commission on Space
and
*Frank White****
Writer and Consultant

8. *California v. Ciraolo and Dow Chemical v. U.S.—A View From Above: Is It Ever Private?*

In two recent decisions, *California v. Ciraolo*[1] and *Dow Chemical v. United States*,[2] the Supreme Court held that warrantless aerial observation or photography does not violate the fourth amendment's prohibition against unreasonable search and seizure. While both cases involved the use of conventional aircraft flying in public airspace, and conventional methods of observation, the decisions may have broad implications not only in the area of aerial observation, but in regard to information received via satellites engaged in earth remote sensing (ERS).

In *California v. Ciraolo*, the Santa Clara, California police received an anonymous phone tip that respondent was growing marijuana in his residential backyard. Upon investigation, the police discovered that their ground-level view of respondent's backyard was blocked by a six-foot outer fence and a ten-foot inner fence, both completely enclosing the yard. Later that afternoon, the police officers assigned to investigate secured a private plane and flew over respondent's house at an altitude of 1,000 feet, well within navigable airspace. The officers readily identified marijuana plants growing in the yard and photographed the area with a standard 35mm camera. A search warrant was issued on the basis of an affidavit describing the anonymous tip and the aerial observations. The warrant was executed and seventy-three plants were seized. After the trial court denied a motion to suppress the evidence of the search, respondent pleaded guilty to a charge of cultivation of marijuana. The California Court of Appeal reversed on the ground that the warrantless observation of respondent's yard violated the fourth amendment.[3] On certiorari, the Supreme

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** George Field, is Professor of Astronomy at Harvard University and Physicist at the Smithsonian Astrophysical Observatory. He is co-author with Eric Chaisson of The Invisible Universe, published by Birkhauser-Boston in 1985.

*** Frank White is author of *The Overview Effect*, an analysis of astronauts' experiences in space, to be published by Houghton Mifflin in the fall of 1987.

[1] California v. Ciraolo, 106 S. Ct. 1809 (1986).

[2] Dow Chemical Company v. United States, 106 S. Ct. 1819 (1986).

[3] Ciraolo v. California, 208 Cal. Rptr. 93 (1984), *rev'd* 106 S. Ct. 1809 (1986).

Court, *held*, reversed. The fourth amendment was not violated by the warrantless aerial observation of an area within the curtilage of respondent's home.

In *Dow Chemical Company v. United States*, enforcement officials of the Environmental Protection Agency (EPA), with Dow Chemical Company's consent, made an on-site inspection of two power plants at Dow's 2,000-acre facility manufacturing chemicals at Midland, Michigan in 1978. After a second EPA request for inspection was denied, EPA did not seek an administrative search warrant, but rather employed a plane with a standard floor-mounted, precision aerial mapping camera to take photographs of the facility from altitudes of 12,000, 3,000 and 1,250 feet. At all times, Dow maintained elaborate security around the perimeter of the complex, barring ground-level public view, and took steps to investigate any and all low-flying aircraft that passed over the facility. Upon learning of EPA's aerial photography, Dow brought suit in the District Court for the Eastern Division of Michigan alleging that EPA's action violated the fourth amendment and was beyond EPA's statutory investigative authority.[4] Granting summary judgement for petitioner, the district court permanently enjoined EPA from taking aerial photographs of Dow's facility and from disseminating, releasing or copying the photographs already taken. The Court of Appeals for the Sixth Circuit reversed.[5] On certiorari, the Supreme Court, *held*, affirmed. The use of aerial surveillance was within EPA's authority due to the broad enforcement and investigatory powers granted it by Congress. EPA's warrantless aerial photography of Dow's Facility was not a search prohibited by the fourth amendment.

Any fourth amendment analysis of aerial surveillance involves a two-part inquiry: first, a subjective expectation of privacy must be manifested by the individual; second, society must be ready to recognize that expectation as reasonable.

The two instant cases represent the first time that the Supreme Court has addressed the fourth amendment implications of aerial surveillance. Lower courts have found that subjective expectation of privacy can be manifested by barriers or other measures taken to prevent observation. In determining whether the expectation was reasonable, courts have considered the altitude and speed of the aircraft involved, the intensity of the surveillance, the frequency of other aircraft flights through the area and the use of equipment during the aerial observation. Several decisions have relied on the plain view exception to the search warrant requirement. Other decisions have relied on the approach that open fields, unlike curtilage, are not entitled to fourth amendment protection.

The Supreme Court applied similar reasoning in the two instant cases. The double fence enclosing the yard in *Ciraolo*, and the elaborate security

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[4] Dow Chemical Company v. United States, 536 F. Supp. 1355 (E.D. Mich. 1982), *rev'd*, 749 F. 2d 307 (6th Cir. 1984), *aff'd*, 106 S. Ct. 1819 (1986).

[5] United States v. Dow Chemical Company, 749 F. 2d 307, 312-23 (6th Cir. 1984), *aff'd* 106 S. Ct. 1819 (1986).

measures taken around the perimeter of the complex in *Dow* were both held to meet the subjective element of the test. However, the Court reasoned that the expectation of privacy from all observation was not reasonable because the measures employed barred only ground-level intrusions. In neither case had steps been taken to prevent aerial surveillance from public airspace. The Court found that society was not willing to recognize that those measures taken manifested an expectation of privacy of constitutional dimensions. In addition, the Court stated that the open areas of the industrial complex in *Dow* were more akin to an open field than to a curtilage.

Dissents were filed in both cases expressing the view that the fact that the airspace is open to all persons for travel in airplanes should not deprive citizens of their privacy interest in outdoor activities within an enclosed curtilage.

In its discussion of the commercial mapping camera used to take the offending photographs of the Dow Chemical Company plant, the Court indicated, "that surveillance of private property by using sophisticated surveillance equipment not generally available to the public, such as satellite technology, might be constitutionally proscribed absent a warrant."[6] In view of this the Supreme Court "might" find warrantless satellite surveillance to be in violation of the fourth amendment. In cases of aerial surveillance, the higher the altitude the less probable it was that the search would be found unreasonable. In addition, while not dealing with the fourth amendment and governmental intrusion, future commercial satellite systems such as LANDSAT may raise commercial privacy issues, including anti-trust and trade secret violations by satellite surveillance. In this respect new legal guidelines or the adaptation or innovative application of those now existing may be needed.

*Sarah C. Jubb**
Staff
Journal of Space Law

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9. *Colloquium on "Commercial Use of Space Stations: The Legal Framework of Transatlantic Cooperation", Hanover, June 12-13, 1986.*

The aim of this international colloquium was to assess the legal and institutional issues currently associated with the establishing of a transatlantic Space Station cooperation, as well as with the commercial uses of future Space Station facilities. As its predecessor, the 1984 symposium on "Space Stations: Legal Aspects of Scientific and Commercial Use in a Framework of Transatlantic Cooperation", held in Hamburg,[1] this colloquium was organized by *Profes-*

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[6] Dow Chemical Company, 106 S. Ct. at 1826.

* J.D. candidate, University of Mississippi School of Law, December 1987.

[1] The Proceedings of the 1984 Colloquium have been published as Volume 5 of the "Studies in Air and Space Law" Series, edited by the Institute of Air and Space Law, University of Cologne, 1985.

sor Böckstiegel, Director of the Institute of Air and Space Law, Cologne University, and hosted by the German Society of Air and Space Law (DGLR), the Federal Ministry of Research and Technology (BMFT), and the German Aerospace Industries Association (BDLI).

The first session highlighted the ongoing U.S./European Space Station debate. *Loosch*, director of international affairs at the BMFT and head of the European negotiation team, stressed Europe's desire to achieve a fair partnership in all phases of the development, construction, and operation of the envisaged international Space Station. In order to safeguard "maximum legal security" of this largest international space cooperation attempted so far, a treaty or a Congressional executive agreement with the United States is deemed necessary. *Michaud*, special assistant for space policy at the U.S. State Department, was less specific when outlining the U.S. position. He was convinced, however, that the unprecedented challenges posed by President Reagan's invitation to join in the U.S. Space Station program could be satisfactorily dealt with in view of the past successful space cooperation with Europe, Canada, and Japan. *Wolff*, Dornier System, Inc., had doubts as to whether the ambitious negotiation goals could be met, given the persistent fundamental differences between the parties over their future Space Station roles and responsibilities.

The following session focused on the applicable law for international Space Station cooperation. *Professor Gorove* of the University of Mississippi, *Professor Kuribayashi* of the University of Tokyo, and *Professor Diederiks-Verschoor* of the International Institute of Space Law discussed jurisdiction and control implications. They advocated special contractual agreements for a uniform legal Space Station regime as far as overall management and safety operations are concerned, as well as separate regulations for individual operation and usage of internationally contributed Space Station elements. *DalBello*, Office of Technology Assessment, drawing from a recent OTA background paper on "Space Stations and the Law: Selected Legal Issues", provided a comprehensive overview of the various alternatives for establishing a legal regime for an internationally constituted Space Station.

The remaining session dealt with a number of more specific issues pertaining to industrial Space Station development contracts (*Ersfeld*, MBB/ERNO, Inc.), technology transfer (*D. Burnett*, Benner, Burnett & Coleman, and *G. Lafferanderie*, European Space Agency), space manufacturing (*Egan*, Coopers & Lybrand), and patent and intellectual property law (*Kempf*, NASA).

The complete proceedings of the colloquium will be published later this year. A third Space Station related colloquium is planned for May 1988 at the University of Cologne.

Dr. Wulf von Kries
Head, Washington Office
German Aerospace Research Establishment/DFVLR

10. *Meeting of the ILA International Space Law Committee, Seoul, Aug. 23, 1986.*

The International Space Law Committee of the International Law Association (ILA) examined two topics at the Seoul meeting. *Professor Karl-Heinz Böckstiegel* of the University of Cologne referred to the Committee's involvement in the drafting of a Convention on the Settlement of Space Law Disputes. The proposed Convention was first considered at the meeting in Montreal in 1982 and again in Paris in 1984. The draft has been under review. However, delays have been experienced. *Professor Böckstiegel's* appointment as President of the Iranian-American Claims Tribunal has limited the time available to him as the principal architect of the proposed Convention. The subject will remain on the Committee's agenda for the next two years.

The principal substantive issue before the Committee was disarmament and arms control in outer space. Participants had before them a paper written by *Professor D. Goedhuis*, Committee Chairman, entitled "On the Latest Efforts to Strengthen the Present Rules Aimed at Arms Control in Outer Space," which was supplemented by a "Postscript". The participants also were provided with a paper written by *Professor Carl Q. Christol.* It was entitled "International Space Law, Basic Principles and New Directions".

Professor Nicholas M. Matte presided in the absence of *Professor Goedhuis.* He asked *Professor Christol* to summarize *Professor Goedhuis'* paper. It was noted that the paper focused on the 1972 ABM Agreement and the development of defensive weapons in outer space. A detailed assessment was made of the meaning to be ascribed to "research", "development", "testing", including "field testing", "deployment", and "weapons" based on "other physical principles" than those pertaining to ABM-type weapons. *Professor Goedhuis* referred to the views of American presidents on verification and on the testing of Anti-Satellite Satellites (ASATS). Congressional expressions were also reviewed. An appraisal was also offered of public statements of Soviet leaders as well as the conclusions arrived at in NATO, namely, that the 1972 ABM treaty does not prohibit research on defensive weapons in space.

Professor Goedhuis concluded that there was a need for the United States and the Soviet Union to clarify and strengthen the 1972 Treaty. He expressed pessimism about an early agreement on the meaning of "research". He favored imposing limits on the development and deployment of ASAT weapons. In his "Postscript" dated August, 1986 reference was made to recent proposals put forward by both countries aimed at reaching a compromise on the development and deployment of defensive weapons in space. He noted, if there were to be a transition from a strategy of offense to one of defense, that the U.S. and its allies would have to reach an accord with the Soviets. In his view, the drawing of a line between laboratory and applied research will prove to be extremely difficult and an early agreement on this issue was not to be expected.

Professor Christol's paper focused on space law and policy. He stated that these issues needed to be brought into sharper focus. Substantive matters competing for attention were commercial and military uses of the space environment. Bilateral and multilateral forums were hosting negotiations. Competition

existed between the 1972 and 1979 SALT I and SALT II agreements and the 1967 Space Principles Treaty and the 1979 Moon Agreement. Of special importance was the contest between the military doctrines, *e.g.*, the older offensive doctrine of mutually assured destruction and the newer defensive doctrine of ballistic missile defense or strategic defense (SDI). He noted that each of these asks the question: How can strategic stability be best achieved?

He identified the role open to international lawyers in the formulation of space law and policy. On substantive issues, they can help to identify and clarify competing outlooks. They can assist in determining whether prohibitory or regulatory norms should be established. They can assist in the formulation of treaty terms with special attention being given to the current trend of providing meaningful definitions in international agreements.

Professor Christol analyzed factors involved in the choice of forums for space law negotiations. With effectiveness perceived as an important element, the problem of universal as opposed to bilateral meetings was assessed. It was noted on the subject of arms control and disarmament that the United States and the Soviet Union had favored bilateral negotiations between experts and heads of state in Geneva, and that the policies fixed by the superpowers would be largely determinative on all countries. It was also pointed out that all U.N. members had considered these topics to be well suited for their full consideration, that the Group of 77 had also perceived such topics as falling within their domain, and that with regard to verification, a number of States had taken a special interest in the formation of an International Satellite Monitoring Agency.

He also called attention to the differences in the internal organizational structures of the United States and the Soviet Union, with the former bound by the constitutional principle of separation of powers. He noted that partial arms control provisions of the 1967 Space Principles Treaty and the 1979 Moon Agreement and the debate that had been engendered over the meaning of "peaceful" and "military" uses of the space environment. He called for the closing of this debate with a new focus on specific "do's" and "don'ts" relating to verification and definitions of "research", "development", "testing", "deployment", "use", and "other physical principles".

He concluded by urging the formation of policies requiring the total prohibition of mass destruction weapons in the space environment and the reduction by the United States and the Soviet Union of ABM and ASAT capabilities. He suggested that it was not necessary to engage in a race for a formal international agreement for its own sake; but, that such an agreement should memorialize long-term practices which had emerged from well understood expectations. This would facilitate the careful crafting of formal agreements. He urged the importance of secret bilateral negotiations and the avoidance of the media theater and propaganda aspects of earlier endeavors.

A limited but lively discussion took place in which reference was made to the importance of verification procedures, the need to establish definitions of critical treaty terms, the political nature of the American-Soviet negotiations, and the constructive role open to lawyers in this field.

Attention was given to the future work of the Committee. It was agreed

that the legality of remote sensing and national responsibility for the introduction of pollution and debris into the natural environment of outer space should be examined.

Carl Q. Christol
Professor of International Law
and Political Science
University of Southern California

11. *"Law and Life in Space"—an Institute held at the University of North Dakota, Sept. 11-12, 1986.*

This impressive and engaging two-day institute was truly broad and interdisciplinary. On the first morning *Dean John D. Odegard* of the Center for Aerospace Sciences set the tone for this wide-ranging conference with his observations on the indispensability of interdependence and interdisciplinary cooperation. He emphasized that law and life in space was the integrating theme of the conference because space represents a very practical and necessary arena for interdisciplinary applications.

The first morning session covered the whole gamut of space law with *S. Neil Hosenball*, then Director of the Center for Space Law and Policy at the University of Colorado, and his paper on "Privatization of Space: Legal Issues," *Eilene Galloway*, Honorary Director of the International Institute of Space Law, and her overview of the evolution and current state of "Congress and Outer Space Development," and *Carl Q. Christol*, Professor of Law and Political Science at the University of Southern California, and his presentation on "International Outer Space Law." Of particular note was *Eilene Galloway's* stress on the need for a reorganization of the government in order to achieve an aggressive, coherent, and well-managed space program of the sort designed in the original NASA Act and recently recommended by the National Commission on Space.

During the luncheon of the first day *Mr. Ralph Chipman*, Assistant to the Deputy Chief of the Outer Space Affairs Division in the United Nations Secretariat, outlined "The Role of the United Nations in Outer Space Development." After lunch, *Harold M. (Hal) White, Jr.*, Visiting Professor of Law, Ethics and Policy at the University of North Carolina at Chapel Hill, spoke on "Metalaw and Astrolaw: First Principles of Space Jurisprudence." He provided details of an upcoming conference series entitled "Governance in Space" to commemorate the Bicentennial of the U.S. Constitution.

The first day's broad focus on space law was continued by *Peter Haanappel* of the Institute for Air and Space Law at McGill University, who delivered a paper on the specifics of "Canadian American Cooperation in Outer Space Development," followed by *Martia Smith*, Specialist in Aerospace Systems in the Congressional Research Service, who spoke on another kind of cooperation, both potential and actual. Her talk was entitled "Humankind in Space: USSR/USA Pathways."

The afternoon session ended with a panel on "Developing a Legal System

for Commercialization of Space." Moderated by *Peter Haanappel* and consisting of *Ralph Chipman, Carl Christol, Eilene Galloway, Neil Hosenball* and *Hal White*, the panel concentrated on issues of property ownership and resource exploitation in space as well as on models for extension of civil jurisdiction and self-government to communities in space.

The morning session of the second day began with *B.J. Bluth* of the NASA human factors program and her talk on "The Colonization of Space: A Sociological Perspective." She was followed by *Stephen E. Doyle*, Director of Advanced Planning for Aerojet Corportion, who spoke on "Space Communications and the Global Village," with a particular focus on international space communications law and policy. The morning session ended with a particularly stimulating presentation on "The Columbus Dilemma: An Ethical Problem of Extra-Galactic Space Exploration" by *Robert Baum*, Director of the Center for Applied Ethics in the Professions at the University of Florida.

David Webb, Chairman of the Space Studies Program at the University of North Dakota, electrified the second working luncheon with an impassioned challenge of the current absence of commitment by the United States to lead the free-world and the human race into space. In "Creating a Global Infrastructure" he seriously questioned our ability to project human rights and a democratic culture into space without a strong civil presence there and warned of the U.S. becoming the "Portugal of the 21st Century."

The final afternoon session began with a particularly thought-provoking presentation on "Dimensions of Health: A View From Space" by *Martha Rogers*, Professor Emeritus of Nursing at New York University. Professor Rogers highlighted the post-modern paradigm shift from linear, fragmentary, reductionist patterns of thought and investigation to multidimensional, inductive, integral patterns.

The final session was rounded out by *Kenneth A. Medlin* of Rockwell International and his presentation on "Satellite-based Navigation" and by *John H. McElroy*, Director of Special Projects in the Space and Communications Group of Hughes Aircraft Corporation, who spoke on "Remote Sensing and Weather" and the generally fascinating topic of global resource management.

Harold M. White, Jr.
Visiting Professor of Law
University of North Carolina

12. *Other Events*

"The First Lunar Development Symposium" combined with "The First U.S. Maglev Transportation Conference" was held on September 22-24, 1986, in Atlantic City, New Jersey. The topics discussed included commercial exploitation of space resources, lunar bases, and lunar transportation systems.

The Brookings Center for Public Policy Education hosted a forum on

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[1] *See* Report No. 6 on the "Governance of Space Societies. . .", *supra*.

"The U.S. Space Program: Directions for the Future" on October 1, 1986, in Washington, D.C.. The issues addressed included balancing future civilian and military space objectives, pursuing international cooperation and competition in space, the future role of NASA, and sorting out public and private roles in the U.S. space program.

The American Branch of the International Law Association held a panel discussion on "International Telecommunications" on Nov. 1, during the annual meeting in New York City.

Space Business News sponsored a forum on "The Crisis in Space Transportation: An Industry Update" on November 17-18, 1986, in Arlington, Virginia. The topics discussed included U.S. launch policy, launch vehicles, launch users, and the international launch scene.

"The Strategic Defense Initiative: 'Star Wars' in the Space/Law Aviation Law Curriculum—International and Domestic Constitutional Aspects and Issues" was the topic of a panel discussion of the Aviation and Space Law Section of the Association of American Law Schools during the latter's annual meeting in Los Angeles, on January 6, 1987.

The IAF/COSPAR Symposium on Space Communications for Development was held on February 17-18, 1987 at the U.N. Headquarters Building in New York City.

13. *Brief News*

A quasar, the most distant known object in the universe, was discovered in a galaxy that is 20 billion light years away from the Earth. . . .The widow of Challenger pilot, Michael Smith, has filed a fifteen million dollar claim against NASA, while the widow of Ronald McNair has filed a suit against the manufacturer of the solid rocket boosters. . . .Japan to develop and launch an unmanned outer space laboratory. . . .Soviets to launch an Indian remote sensing satellite in September of 1987. . . .Space Services, Inc. has contracted with NASA to launch the first of three space tombs in late 1987. . . .The Congressional Budget Office reports that there is no need to replace the Challenger. . . .Austria, France, West Germany, and all eastern bloc countries are to participate in the Soviet Union's Martian Phobos project. . . .NASA sets up a space flight safety panel. . . .A second Soviet-French joint space mission is to take place between August and October of 1988. . . .The Chinese and British agree to an exchange of satellite technicians in 1987. . . .Austria has become a member of ESA on January 1, 1987. . . .A recent study of astronomers suggests that planetary systems capable of supporting life are much more common than had been previously assumed. . . .The Soviet Union offers substantial discounts to less developed nations when putting spacecraft in orbit on their behalf. . . .Veteran astronauts with previous experience in space flight were named to fly on the next shuttle mission expected to take place in February 1988. . . .Bulgarian, French and Syrian cosmonauts, after being trained in the Soviet Union, are to visit the Soviet Mir space station. . . .Four of the families of the Challenger astronauts (Scobee, McAuliffe, Onizuka, Jarvis) are to receive more than $750,000 per family from the government in settlement of

their claims arising out of the Challenger accident.

B. *Forthcoming Events*

The American Society of International Law will sponsor a discussion on "The U.S./International Space Station—Aspects of Technology and Law" on the morning of April 11, 1987 in the Boston Park Plaza Hotel, Boston, Massachusetts. Panelists from NASA, ESA, Canada, Italy and Japan are expected to participate.

A Symposium on "Commercial Opportunities in Space: Roles of Developing Countries" is planned for April 19-24, 1987 in Taipei, Taiwan.

The 8th Biennial SSI/Princeton Conference on Space Manufacturing is scheduled to be held on May 6-9, 1987, in Princeton, New Jersey.

The next IISL Colloquium on the Law of Outer Space will be held in Brighton, England, October 9-16, 1987. The subjects to be discussed in four sessions are: 1. Maintaining outer space for peaceful purposes; 2. Legal aspects of outer space environmental problems; 3. Legal aspects of commercialization of space activities; 4. The United Nations and legal principles of remote sensing.

Mezhdunarodnoe kosmicheskoe pravo (International Space Law), edited by A.S. Piradov, Moskva, "Mezhdunarodnye otnocheniya" (Moscow, published by "International Relations"), 1985. Pp. 204.

Teaching of space law has been attracting growing interest in recent years, both at national and international levels. This was evidenced by a lively discussion held under the auspices of the 29th IISL Colloquium on the Law of Outer Space in Innsbruck, 1986, which devoted one of its sessions to this important subject.

Nonetheless, the number of textbooks published for this particular purpose thus far has remained limited, for most of the books on space law are more suitable for a detailed examination of the specific problems involved rather than for the general goals of education.

The publication under review is one of the first works explicitly called a "textbook" and approved as such by the USSR Ministry of Education for university students specializing in the field of international law. It was written by a team of authors from three Moscow institutions: the Diplomatic Academy of the Ministry of Foreign Affairs, P. Lumumba University and the Institute of State and Law of the USSR Academy of Sciences. *Professor A.S. Piradov*, head of the chair of international law of the first of these institutions, led the team which also included *Professors I.P. Blishchenko, V.S. Vereshchetin* and *Y.M. Kolossov*. Besides the introduction, *A.S. Piradov* himself drafted the first chapter of the book illustrating the history of the international law of outer space and also including a brief outline of the development of space law doctrine. He reminds us that the first attempt at grasping international space law as a whole was made in 1974 when a work by the same name was published in the USSR. The present book, however, is a new work, structured in a different way and reflecting new developments that have arisen during the recent period of time. The study reflects an optimistic belief in a great future for the doctrine of international space law, due to the latter's interrelation with the scientific and technological progress of space exploration and the applications of its achievements for the practical needs of mankind (*cf.* p.19).

In three concise chapters drafted by *Professor Blishchenko*, most of the theoretical basis of the book is laid down: namely the notion, substance and peculiarities of international space law, as well as its sources in chapter I, international personality and subject of this law in chapter II and responsibility in international space law in chapter VIII. *Blishchenko's* approach to these problems arises from the assumption that an inseparable interconnection exists between the legal régime of outer space and the legal regulation of activities relating to the uses of outer space (p.22). However, he also opines that no exclusivity of the substance of societal relations in this new sphere of human endeavour can be derived from an analysis of space activities (p.23). He concludes that the international law of outer space is based on the same idea of peace and peaceful coexistence between states having different social, economic

and political system as contemporary general international law as a whole, and that both these legal entities include principles and norms of the same generally democratic nature (p.25).

Among the ideas raised in chapter II, the most important seems to be that of defining the subject of international space law, the central element of which is the notion of space activities. Space activities include not only activities in the outer space environment but also operations affected on earth in connection with the launching of space objects, their guidance and return (p.35). As stated in the book, the Soviet doctrine is based on the assumption that space law shall regulate the activities of states concerning the exploration of outer space affected anywhere (p.36). Consequently, the problem of defining outer space cannot be solved separately from the element of activities relating to its users (p.38).

In chapter VIII of the book, *Professor Blishchenko* outlines the issues concerning responsibility in international space law. He correctly distinguishes between the international responsibility of states for violations of principles and norms of international law and the liability for damage caused by space activities that, in fact, do not contravene any principles and norms. However, the dividing line between these two kinds of responsibility is not quite clear. Also, the recent development of the doctrine, as recorded during the consideration of State responsibility in the International Law Commission, is not reflected in this part of the book.

Chapter IV of the book, dealing with the legal régime of outer space and the legal status of cosmonauts and space objects written by *V.S. Vereshchetin*, is, in my opinion, one of the best parts of the book. Based on a reasonable interpretation of the freedom of outer space for all nations, which, however, cannot be considered as unlimited, (p.40) and the step-by-step emergence of the principles of the uses of outer space for peaceful purposes (p.44), the author thoroughly examines the problems of registration of space objects and the rights and duties of space crew members. His observations concerning the interpretation of Articles V and VIII of the 1967 Outer Space Treaty and some future problems in this area should be particularly noted.

Chapter V, though written by the same author, has a different character. Proceeding from a short analysis of the juridical content of the principle of international cooperation which is considered one of the fundamental principles of international space law, the author takes a general view of the implementation of this principle in the multilateral and bilateral agreements concluded by the USSR with other nations. In addition, he discusses the cooperation of states within present international organizations dealing with outer space matters. Though mostly descriptive, this chapter presents some interesting characteristics and assessments; of particular note are those relating to the nature and work of "Interkosmos", on the one hand, (p.63 *ff.*) and the international organizations of telecommunications (p.76 *ff.*), on the other.

Chapter VI and VIII deal mostly with present day problems of a highly political nature which are subject to sharp struggles between the main groups of nations of the contemporary world. The problem of the prevention of an arms race in outer space is examined in the first of these chapters and a de-

tailed picture of problems relating to the codification and progressive development of international space law is the subject of the other chapter, both written by *Professor Kolossov.*

Chapter VI is mostly devoted to an analysis of the instruments in force limiting the military uses of outer space and the new initiatives developed by the USSR in this field in recent years. In this context, however, attention is also paid to some general problems, as is the juridical meaning of "peaceful space activities". According to *Kolossov,* no generally recognized definition of this notion exists so far and this notion is differently understood both in the practice of states and in the doctrine of international law (p.108). Therefore, it would not be correct to use the term "peaceful" to characterize the present régime of outer space (p.110); the non-aggressive military activities in outer space are limited, but not prohibited (p.111).

Among the main trends in the further development of international space law which are examined in Chapter VII, the section concerning direct broadcasting by satellites (DBS) and that concerning the delimitation of air and outer space deserve particular attention. Here, the author not only summarizes and explains the Soviet stances relating to these issues but also brings new elements to the discussion thereon.

In an annex, the texts of the most important sources of international space law are printed: namely, the 1963 Treaty banning nuclear weapon tests in the atmosphere, in outer space and under water; five United Nations treaties on outer space; and two General Assembly resolutions including the 1963 Declaration of Legal Principles and the 1982 Principles on DBS.

As a whole, the publication should be welcome by those having an interest in space law and the problems of its teaching. Of course, it is a book written for Soviet students which reflects, as often explicitly stated, the Soviet legal doctrine relating to space and defends positions held by USSR delegations at different international levels of discussion in which most of the authors substantively participated.

It is possible to observe some differences in style and, to a certain degree, in approaches to individual problems which were not completely unified during the editorial work. Similarly, a better balance in the extent of individual chapters could have been sought. These comments, however, cannot diminish the essentially positive aim of the authors to create a solid basis for education in the field of international space law in the USSR by providing a concise and readable textbook.

Vladimir Kopal
Chief, Outer Space Affairs Division
United Nations

Aspects of Space Law, by E.H.C. van Bogaert (Kluwer, Deventer, 1986), pp. 307.

The author, Honorary Professor of International Law at the Free University of Brussels and Professor at the State University of Ghent, has lately come under the spell of space law and its rapid progress. His longtime experience in international public law is clearly apparent from his comments on this young branch of the law. The scope of his book is wider than the title indicates. His observations reflect a wide-ranging and penetrating knowledge of the field of international law, and this is the outstanding value of the book; space law has been placed in the wider context of international law.

In a short preface the author points out the importance and significance of space law for lawyers specializing in international law. In six chapters he deals with the basic concept of space law, the legal status of outer space, the status of astronauts and space objects, the liability for damage caused by spatial activities, the exploitation of outer space, and international cooperation in matters relating to space law. Special attention is given to the freedom of space (p. 25-66), the return of and jurisdiction over space objects (p. 125-158), communications (p. 191-223), and, in particular, to direct broadcasting by satellites (p. 223-239).

Of great interest are the passages in the book devoted to a comparison between air law and the law of the sea (p. 130) where the author analyzes issues of nationality.

One point on which the book remains silent is the method of treaty making in the field of space law and the preliminaries involved in it. The consensus method, which is usually applied, may work slowly, but it has the advantage that the parties will actually honor their obligations, once an agreement has been reached.

An extensive bibliography and an index are useful complements to the book. The accompanying notes contain detailed information which are valuable for profound studying.

The author's work, written in an attractive style, offers a clear picture of the position of space law in a wider field. In doing so, it fills an ever-widening gap arising from present-day developments in terms of spatial activities and their legal consequences.

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American Enterprise, The Law, and the Commercial Use of Space (National Legal Center for the Public Interest, Washington, D.C., 1986), vol. I, pp. 114, vol. II, pp. 152.

This publication initiated a project of the National Legal Center intended to bring national attention to the rapid growth of space commercialization. It

is a collection of expert commentaries on various topics concentrating on the development of domestic law regulating commercial use of space. The study is divided into two volumes. Volume I is an analysis of treaties, legislation, regulation and political scenario. The second volume consists of opinions on the current status of regulation of remote sensing and telecommunications.

In volume I, the initial comment, "Domestic Commercialization of Space: The Current Political Atmosphere," by *George S. Robinson* and *Pamela L. Meredith*, concerns the political environment surrounding the private entrepreneur and risk capitalist in his quest for space exploration. *Gries Curron Aoclin*'s comment on "Going to Work in Space: A Survey of Presently Available Launch Systems," provides a detailed description of existing launch services. In the final segment of the volume, "Star Wars or Star Peace: The Impact of International Treaties on the Commercial Use of Space," *Professor Adolph deSeife* provides insight into the meaning of existing treaties as to their impact on private entrepreneurship in outer space.

Volume II contains four different commentaries on remote sensing and telecommunications. These articles trace the history of the regulation of international cable and satellite facilities and address the various legal issues that will affect these facilities in the future.

The initial article of Volume II, "From Landsat to Mediasat: The Development of Remote—Sensing Technology and the First Amendment Right of the Press to use that Technology for News Reporting," by *Robert J. Aamoth* focuses on the role of remote sensing for journalistic purposes. *Aamoth* concludes that the first amendment guarantees media rights to serve remote sensing for news purposes. He further declares that any possible conflict with governmental interest in protecting national security could be resolved by a mutually acceptable regulatory regime. *Paul P. Uhlir*'s article "The Public International Law of Civilian Remote Sensing: On Overview," is an attempt to introduce the reader to the nontechnical aspects of remote sensing. *Uhlir* observes trends of international action and commercialization of remote sensing operations. He concludes that the United States should maintain its leadership role in the international legal arena and promote an open skies policy for remote sensing technology.

Dr. Frederick B. Henderson, III in his article, "Private Sector Satellite Remote Sensing: Barriers to Commercialization—A User Prospective," concentrates on the private sector's use of remote sensing. He observes certain barriers to private use of remote sensing such as national security and foreign policy interests. However, *Dr. Henderson* concludes that these barriers can be overcome with good planning. The following article on "FCC Regulation of International Telecommunications Satellites and Cables;" discusses the regulatory history of International Satellite Communications. The authors suggest that for the benefit of the public, the FCC should allow greater entry of private international facilities, deregulate Comsat and phase out circuit loading requirements.

The views expressed in the two Volumes are not intended to influence legislation but rather to present a variety of expert analyses worthy of consideration.

Envoys of Mankind—A Declaration of First Principles for the Governance of Space Societies, by George S. Robinson and Harold M. White, Jr. (Smithsonian Institution Press, Washington, D.C., 1986), pp. 292.

The authors of this book set forth the concept that people who inhabit and explore space should represent all of mankind rather than being bound by national allegiance. Likewise, they contend that laws governing the social structure of space inhabitants be created by self governed societies in space. The conceptual foundation for a Space Constitution is proposed. It is suggested that such independent governance encompass concepts of metalaw, which require the alien intelligences be treated as equals.

In order to set the stage for their futuristic conception of space law *Robinson* and *White* provide a synopsis of human evolution and man's struggle for self governance. They also offer information concerning the changes which space living bears upon the human psyche.

Although divided into eight chapters the work is best described as containing three segments. The initial part provides analysis of the evolution of mankind into the space frontier. It discusses topics ranging from space philosophy to the changing nature and role of astronauts. The second broad topic is that of problems associated with man's transition to a space dwelling species. The myriad of biomedical, social, and psychological differences between earth and space living is its concern. Such topics as the necessity of designing minimum stress environments for space inhabitation are discussed. Furthermore, there is substantial treatment of the lessons of U.S. and Soviet space missions, bearing on the subject of man's ability to endure the space environment.

Discussion of astrolaw and space law is the final, and consummate, topic of *Envoys of Mankind*. The two bodies of law are distinguished as such; "Astrolaw contemplates the practice of law in outer space. . . . The direct subjects of Space Law are sovereign nations; the direct subjects of Astrolaw are natural and legal persons in space. . . ." The authors anticipate that astrolaw will become space-indigenous within a generation or two and prior to such occurrence a patchwork of international, intergovernmental, and contractual law will serve to fill the void. Analogy to past "frontier justice" is drawn and current space law in the form of international treaties and agreements is analyzed in detail. As to the future, only time will tell whether the authors' visionary projections will be borne out.

U.S. Congress, Office of Technology Assessment, *Space Stations and the Law: Selected Legal Issues—Background Paper* (OTA-BP-ISC-41, Washington D.C., U.S. Government Printing Office, 1986), pp. 76.

This document consists of three sections: an executive summary, a background paper, and a report on workshop proceedings. Its purpose is to identify and analyze legal consequences of establishment and operation of an international space station such as that now proposed by the United States, ESA, and Japan. Special attention is given to issues of jurisdiction, tort law, intellectual

property (patent) law, and criminal law as they pertain to multinational individuals living and working together in space. Development of the report was requested by the Senate Committee on Commerce, Science, and Transportation.

The Executive Summary begins by identifying jurisdiction over a space station or its component parts as the single most important issue of multinational space station law. Jurisdiction over space objects is necessarily divided into two components, a State's right to prescribe rules of law and its power to enforce them. Four alternatives for jurisdiction over an international space station are identified. They are: 1) jurisdiction and control by one country 2) joint multinational control 3) control over individual modules by their owner nation 4) control by an international organization similar to INTELSAT.

The Background Paper section continues the discussion of jurisdiction. The case of *United States v. Cordova*, 89 F. Supp. 298., is used as an example of how important it is for law makers to provide definite statements of judicial jurisdiction over extraterritorial controversies. In *Cordova* the court asserted a lack of jurisdiction to try the perpetrator of an assault on board a U.S. flag airplane over international waters. It seems that Congress had theretofore neglected to provide for jurisdiction over such a contingency even though it had power to do so. The lesson of *Cordova* permeates the issue of jurisdiction over space objects and is given due emphasis in this report. The federal-state law jurisdictional dichotomy is also discussed.

It is presented as a fact that most experts believe the United States should not attempt to develop a "space code" to cover all space station activities. However, a great deal of attention is given to the question of just how much new law is necessary prior to the development and operation of a joint space station. The workshop panelists fell into two categories in that regard, those for responsive legislation and those for preventive legislation. The responsive legislation group felt that domestic laws and international agreements developed in advance of real problems would tend to restrict future options. They also assert freedom of parties to contract to protect their legal interests in support of this view. The preventive legislation group, led by private sector investors, stressed the importance of "certainty" or at least of "predictability" and pointed out that courts can set aside contractual arrangements. Concern over how much new domestic and international legislation is desirable in anticipation of a multinational space station is the primary thrust of this publication and is given substantial treatment therein.

The authors identify analogy of future space station law to maritime and air law as an important concern. Particularly, they point out that if a "responsive" body of law is desired a federal common law similar to that in admiralty could be developed. Caution against overreliance upon analogy is warned due to "radical differences" between environments.

The impact of existing international treaties (*i.e.*, the Outer Space Treaty, Liability Convention, Registration Convention, *etc.*) upon space stations is discussed in detail. Hypothetical situations of jurisdiction, registration, and operation of a space station are used to illustrate the need for development of a body of law applicable to multinational space stations.

Criminal, tort, and patent law are each given separate treatment as well. Despite the segmented nature of the publication, it is concise, easy to read, and informative in setting the stage for Congressional action regarding space stations.

From Telecommunications to Electronic Services, by Robert Bruce, Jeffery Cumard, and Mark Director (Butterworths, 1986), pp. 597.

This book was produced by the International Institute of Communications (IIC). It is the final report of the IIC following extensive study of worldwide telecommunications issues. The study was necessitated by the rapid rate of changing conditions which threaten to destabilize traditional international telecommunications systems arrangements.

The IIC concentrated its efforts on analysis of current and anticipated problems within eight major industrialized nations. The report is intended to be of use to government policy makers, service providers and users who must decide how to best respond to dramatic technological and economic changes within the telecommunications field.

In depth analysis of the technological and regulatory infrastructure of each of the countries studied is undertaken. Attention is also given to the impact of international regulatory schemes upon national telecommunications enterprise. The nations which are studied are: the United States, Canada, Japan, the United Kingdom, Finland, France, West Germany, and Italy.

Permanent Presence—Making It Work, edited by Ivan Bekey (American Astronautical Society, San Diego 1985), pp. 177.

This book sets forth the proceedings of the twenty-second Goddard Memorial Symposium. It offers a preliminary view of the United States Space Program emphasizing the following topics: missions, architecture and infrastructure, productivity, and technology. The contents of fourteen papers are reproduced within the above framework.

Under the topic of "Space Missions" two papers are presented. The first deals with commercial prospects of the Space Station, and the second concentrates on phamaceutical production. Within the "Architecture/Infrastructure of Space Systems" section the works of four authors are presented. These works address the following topics: architecture of the space station, program operations, logistics, and Space Station/platform configurations.

Chapter 3 "Productivity in Space" provides information on the roles of future space systems workers and anticipated extravehicular activity capabilities. The final section entitled "Space Technology" sets forth five papers. The topics discussed pertain to both the Space Station itself, *i.e.* its electrical, thermal control, and life support systems, and to production technologies such as "spherical shell" applications and development of container materials for low gravity alloy processing.

The entire publication, especially the final chapter, is illustrated using both schematic drawings and photographs.

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RATIONALE FOR EXPLORING AND SETTLING THE SOLAR SYSTEM

(From Pioneering the Space Frontier,
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Our Vision: The Solar System as the Home of Humanity

The Solar System is our extended home. Five centuries after Columbus opened access to "The New World" we can initiate the settlement of worlds beyond our planet of birth. The promise of virgin lands and the opportunity to live in freedome brought our ancestors to the shores of North America. Now space technology has freed humankind to move outward from Earth as a species destined to expand to other worlds.

Our Purpose: Free Societies on New Worlds

The settlement of North America and other continents was a prelude to humanity's greater challenge: the space frontier. As we develop new lands of opportunity for ourselves and our descendants, we must carry with us the guarantees expressed in our Bill of Rights: to think, communicate and live in freedom. We must stimulate individual initiative and free enterprise in space.

Our Ambition: Opening New Resources to Benefit Humanity

Historically, wealth has been created when the power of the human intellect combined abundant energy with rich material resources. Now America can create new wealth on the space frontier to benefit the entire human coummunity by combining the energy of the Sun with materials left in space during the formation of the Solar System.

Our Method: Efficiency and Systematic Progression

In undertaking this great venture we must plan logically and build wisely. Each new step must be justified on its own merits and make possible additional steps. American investments on the space frontier should be sustained at a small but steady fraction of our national budget.

Our Hope: Increased World Cooperation

In his essay, Common Sense, published in January of 1776, Tom Paine said of American independence, "'Tis not the affair of a City, County, a Province, or a Kingdom; but of a Continent....'Tis not the concern of a day, a year, or an age; posterity are virtually involved in the contest, and will be more or less affected to the end of time, by the proceedings now." Exploring the Universe is neither one nation's issue, nor relevant to our time. Accordingly, America must work with other nations in a manner consistent with our Constitution, national security and international agreements.

Our Aspiration: American Leadership on the Space Frontier

With America's pioneer heritage, technological preeminence, and economic strength, it is fitting that we should lead the people of this planet into space. Our leadership role should challenge the visions, talents, and energies of young and old alike, and inspire other nations to contribute their best talents to expand humanity's future.

Our Need: Balance and Common Sense

Settling North America required the sustained efforts of laborers and farmers, merchants and ministers, artisans and adventurers, scientists and seafarers. In the same way, our space program must combine with vigor and continuity the elements of scientific research, technological advance, the discovery and development of new resources in space, and the provision of essential institutions and systems to extend America's reach in science, industry and the settlement of space.

Our Approach: The Critical Lead Role of Government

As formerly on the western frontier, now similarly on the space frontier, Government should support exploration and science, advance critical technologies, and provide the transportation systems and administration required to open broad access to new lands. The investment will again generate in value many times its cost to the benefit of all.

Our Resolve: To Go Forth "In Peace for All Mankind"

When the first Apollo astronauts stepped onto the Moon, they emplaced a plaque upon which were inscribed the words, "We came in peace for all mankind." As we move outward into the Solar System, we must remain true to our values as Americans: To go forward peacefully and to respect the integrity of planetary bodies and alien life forms, with equality and opportunity for all.

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STEPHEN GOROVE

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* * *

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