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Announcement

The first eight articles of Vol. 6 No. 2 deal with Cosmos 954 and related issues of liability for damages caused by fallen space objects. The final two articles deal with other topics in the area of Space Law.

REENTERING SPACE OBJECTS: FACTS AND FICTION+

S. E. Doyle *

There is a great deal to be learned from an analysis and discussion of the topic of reentering space objects and their legal implications. A great many questions can be asked and perhaps the experts contributing to this Symposium will be able, for the first time to my knowledge, to offer some considered and creditable answers. There has been a great deal of speculation, interpretation and misinformation in the press in recent months on this subject. Hopefully, this Symposium will help to clear our vision and clarify our thinking on this fascinating and important subject. This presentation will begin with some technical, factual information and a brief explanation of the mechanics of reentry.

When trying to describe an unfamiliar subject it is always useful to try to begin with a reference to something familiar. A few statistics which will follow, if not widely known, are very pertinent to our topic.[1] They represent facts with which familiarity is a prerequisite for an understanding of the subject matter.

The total number of man made objects which have been placed in orbit about the earth up to March 31, 1978 is 10,791. This number includes satellites, rockets, pieces of shrouds and other nonfunctional debris. If an object is in earth orbit, it will eventually come down. The higher the orbit and the greater the speed of an object the longer it will remain aloft, but eventually it will come down. For the 10,791 objects that have been placed in space, a box score as of March 31, 1978 is indicated in the Table infra:

The following statistical data are known because the United States Air Force North American Air Defense command (NORAD) conducts space tracking operations which permit discovering and monitoring the status of all objects launched into space, whether by the United States or by another country. Among other functions, the NORAD Space Defense Center also compiles predictions for satellites, rockets and other pieces of debris that are likely to survive burnup in the friction of atmospheric reentry.[2] These predictions are updated periodically and provided to interested government agencies.

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*Deputy Director for International Affairs, NASA, Washington, D. C.

+ This article is an elaboration of a paper presented on behalf of the author by Neil Hosenball at the University of Akron School of Law, May 2, 1978. The views expressed in this paper are those of the author and are not necessarily connected with any organization of which he is a member.

[1]The statistical data, including the tables (figures), herein contained are taken from The Satellite Situation Report for March, 1978 issued by NASA's Goddard Space Flight Center, Greenbelt, MD.

[2]It does not formulate such predictions on smaller fragments that are assured of burning up on reentry.

COUNTRY	OBJECTS IN ORBIT	DECAYED OBJECTS
Australia	1	1
Canada	8	0
ESA	5	9
France	53	27
France/Germany	2	0
Germany	9	3
India	1	0
Indonesia	2	0
Intelsat	23	0
Italy	1	4
Japan	31	0
NATO	4	0
Netherlands	0	4
PRC	5	17
Spain	1	0
United Kingdom	11	4
US	2997	1549
USSR	1447	4572

Before returning to the topic of predicting—particularly predicting reentry time and place—it may be convenient to look briefly at some famous, well-known and, hopefully, familiar space objects that have reentered and will be reentering our atmosphere. The relevant tables (figures) follow at the end of this presentation.

In Figure 1 the descent profiles of the Apollo command module, as it reentered the atmosphere, and the forthcoming Space Shuttle, now being tested for a first flight next year are compared. This figure shows range distance plotted against altitude. One can note in passing how much like a blunt lifting body the unpowered Shuttle performs in the reentry portion of its flight. Another important similarity should be noted, *viz,* both of these spacecraft have crew on board, with computers, and both have three-axis stabilization systems which permit the crew to "fly" the reentering object.

In briefly examining a mission profile of Shuttle flight it may be seen that after vertical launch, as a rocket, the vehicle jettisons its two solid outboard motors for ocean recovery, and proceeds with main engines burning to approach orbital velocity. Just prior to orbital insertion, at about 60 nautical miles, the large external fuel tank is jettisoned and that empty, crewless shell begins immediately to decelerate so that by the time it reaches 80 nautical miles altitude gravity has taken over and the tank begins to fall back into the atmosphere. The orbiter proceeds into space, completes its mission, and eventually reenters the atmosphere and comes to earth to be refitted, refurbished, and relaunched.

Looking at a typical early return pattern for a Shuttle landing on the West Coast (Figure 2), the several critical points on the ground track at which reentry actions occur may be seen. The deorbit burn is made midway across the southern Indian Ocean. The post-burn maneuver, to place the orbiter in position to encounter the atmosphere, is made while approaching Australia's west coast. Descending across Indonesia and above the Pacific Ocean the orbiter continues to fall.

The prime entry interface is at about 76 miles altitude. Communications blackout extends from about 50 miles to 25 miles and TAEM interface, that is the point at which Terminal Area Energy Management begins, occurs at about 16 miles altitude. From that altitude (about 80,000 feet) the pilot and computers carefully control and direct the rate of descent, to bring the orbiter to an unpowered landing in California at Edwards AFB, on the Mojave Desert. This same sequence is shown in a cartoon of the return profile in Figure 3 .

When the final few miles of altitude are plotted in scale against the ground distance travelled, as shown in Figure 4 it is clear that functioning as a glider without power, the orbiter is actually flown down range to its predetermined landing place. From the passing of TAEM interface at 16 miles altitude, the orbiter travels about 56 miles down range to touchdown.

All of this is only to show that when we know where we are, what we are, where we are going, and how we are getting there, although without power and falling fast, we can control reentry relatively well.

Returning to that large external tank that we left falling freely after its release at 60 nautical miles altitude, it may be seen that the tank proceeds on a ballistic curve to a height of 80 nautical miles and then falls. Regardless of the angle of inclination to the equator of a Shuttle launch, the antipodal point, where or near where every east coast launched Shuttle orbit crosses, lies at about the geographical center of the Indian Ocean. External tank release is planned so that the impact point of that tank is approximately at the antipodal point in the Indian Ocean. This is shown in Figure 5. The hemispherical curve to the west of the antipodal point and the two fan-line curves to the east are the areas of possible debris impact of the surviving elements of the jettisoned external tan.

Coming to the point of all these descriptive graphics, Figure 6 must be considered. As the tank falls back into the atmosphere, at an altitude of about sixty miles the tank is tumbling and begins to heat up. First tank rupture is expected at about 50 miles and primary break-up occurs at about 45 miles altitude. Secondary break-up of debris continues and debris begins to burn up in the atmosphere below forty miles with some pieces of debris surviving to the surface.

As shown in Figure 7 , the predicted external tank impact point is very close to or on the antipodal point. However, there are a number of uncertainties involved such as:

(1)precise trajectory uncertainty,
(2)effects of the atmosphere,
(3)aerodynamics of the tumbling tank,
(4)altitude at rupture and break-up,
(5)attitude at break-up

and other technical factors such as weight and shape of debris pieces. Taking all these elements into account, knowing the size, shape, weight and direction of travel of our tank, our best ability to project impact is to identify a strip extending 868 nautical miles up range and 859 nautical miles down range, more than 1700 miles of ocean, 50 miles wide, in which the debris will fall with a high degree (greater than 97%) of certainty.

If, in contrast to this situation, one considers a space object of unknown size, weight, shape, material composition, etc. approaching the atmosphere at many thousands of miles an hour and considers that it can skip, hop or dive as it encounters the atmosphere and that it can break into many pieces and scatter over a large area, then one may have a case like the USSR's satellite Cosmos 954. Then one can understand why, on the morning on which it reentered above Canada our NASA/NORAD last best prediction was that it would enter near Hawaii and, at about the same time, the Russians were predicting reentry near the Aleutian Islands. Then one will also understand why, considering the mechanics and uncertainties of unprogrammed reentry, it is a practical impossibility to predict in advance where or when a satellite will come down, or its pieces will come down, after an unprogrammed reentry.

Figure 1

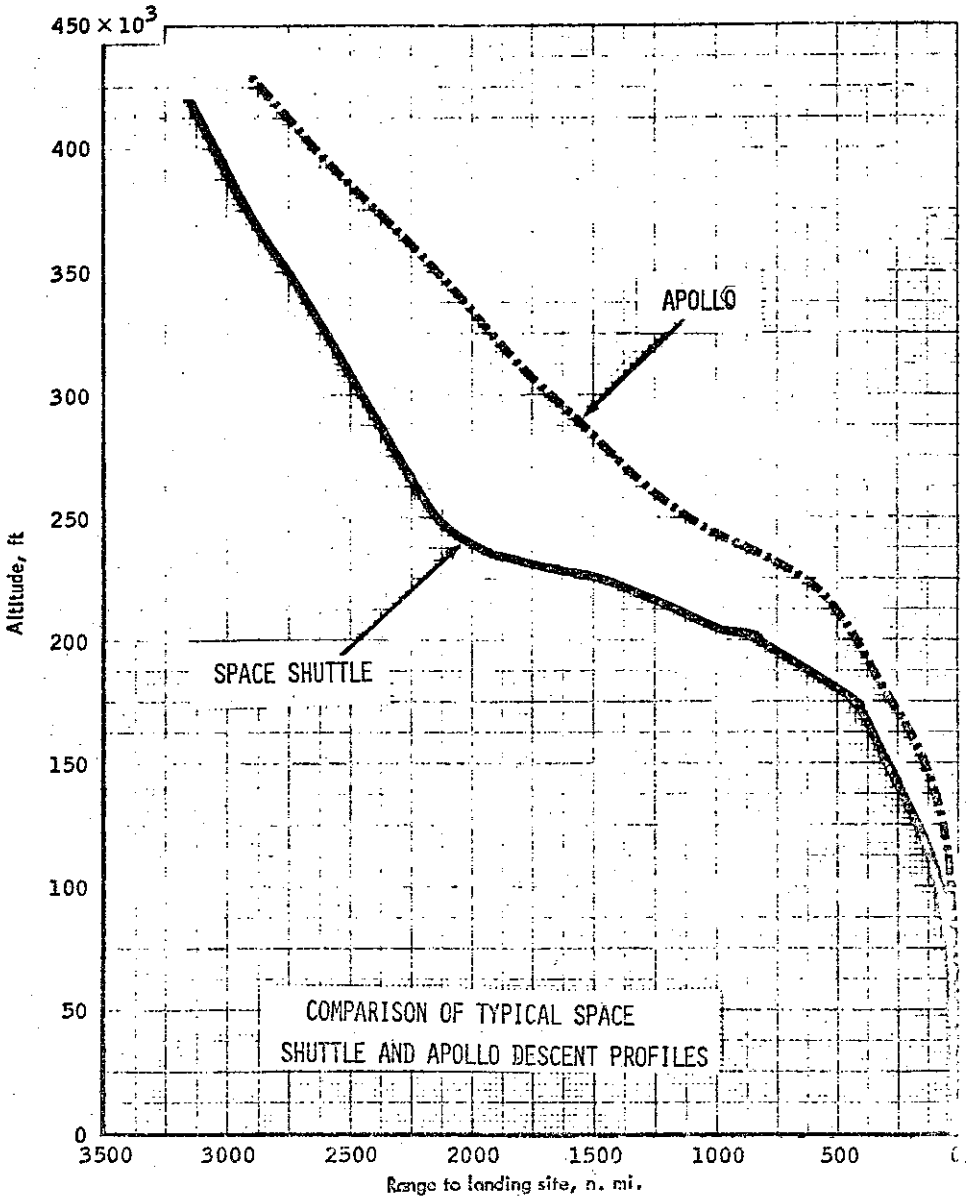
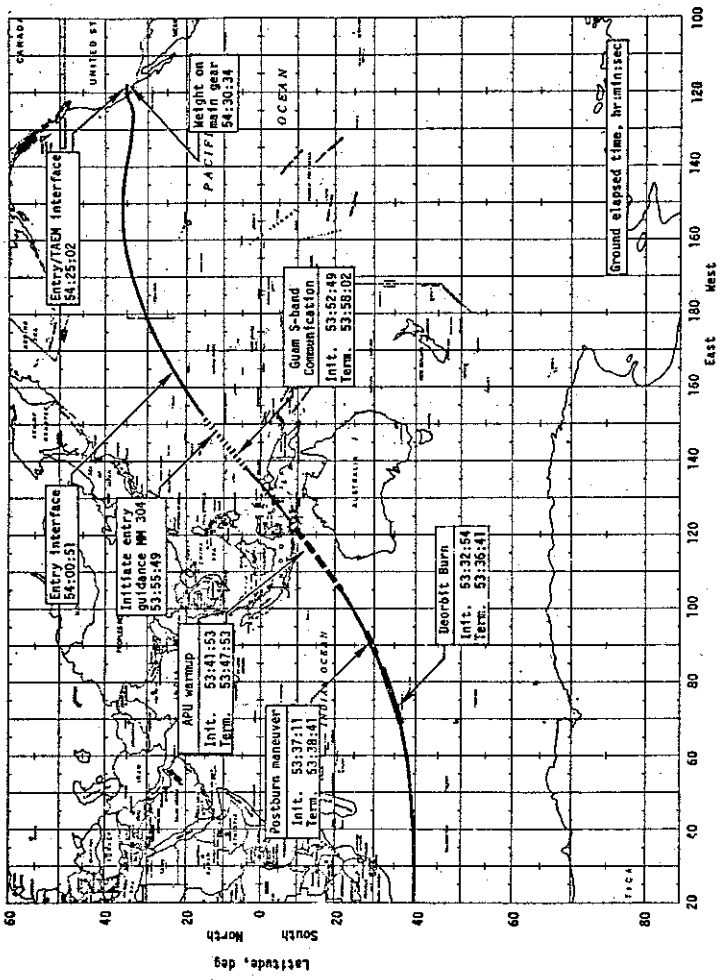

450 × 10³
400
350
300
250
200
150
100
50
0
Altitude, ft
APOLLO
SPACE SHUTTLE
COMPARISON OF TYPICAL SPACE
SHUTTLE AND APOLLO DESCENT PROFILES
3500
3000
2500
2000
1500
1000
500
Range to landing site, n. mi.

Figure 2



OFT DEORBIT-THROUGH-LANDING GROUNDTRACK

Figure 3

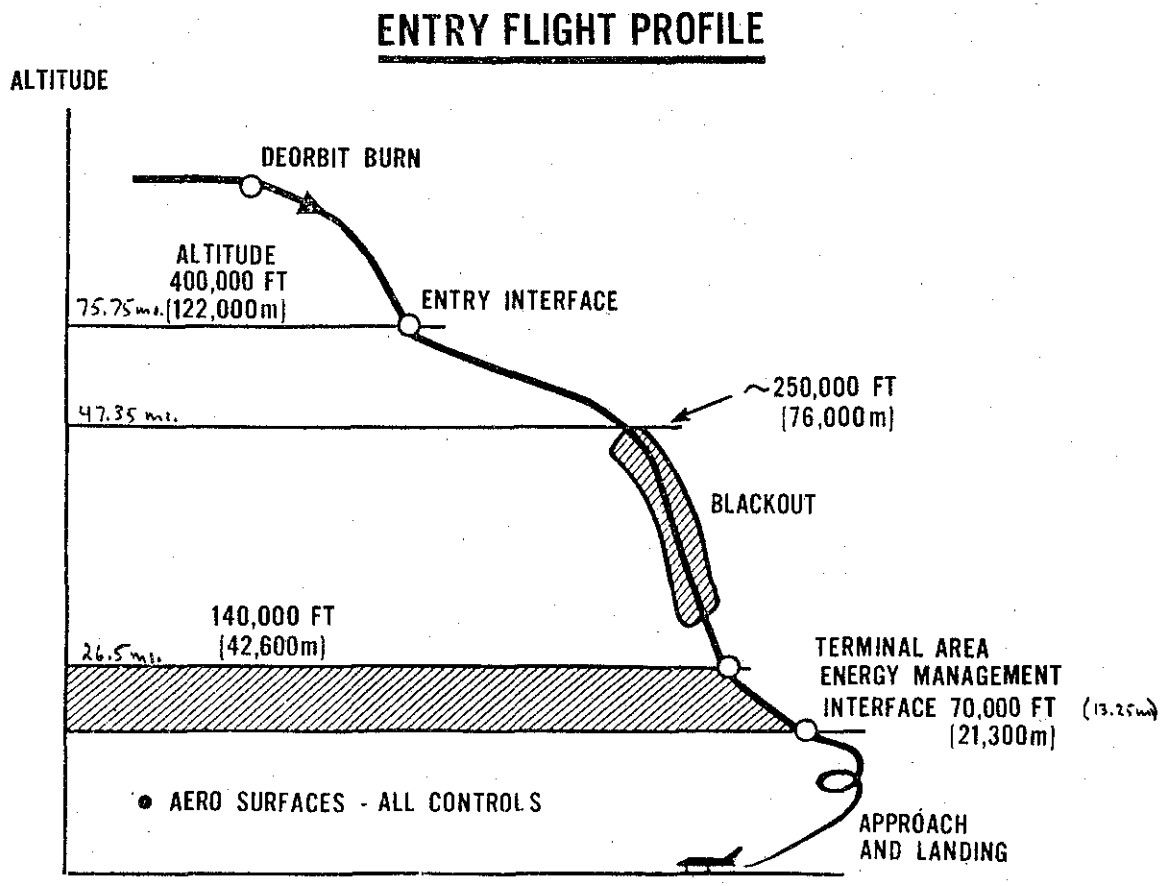
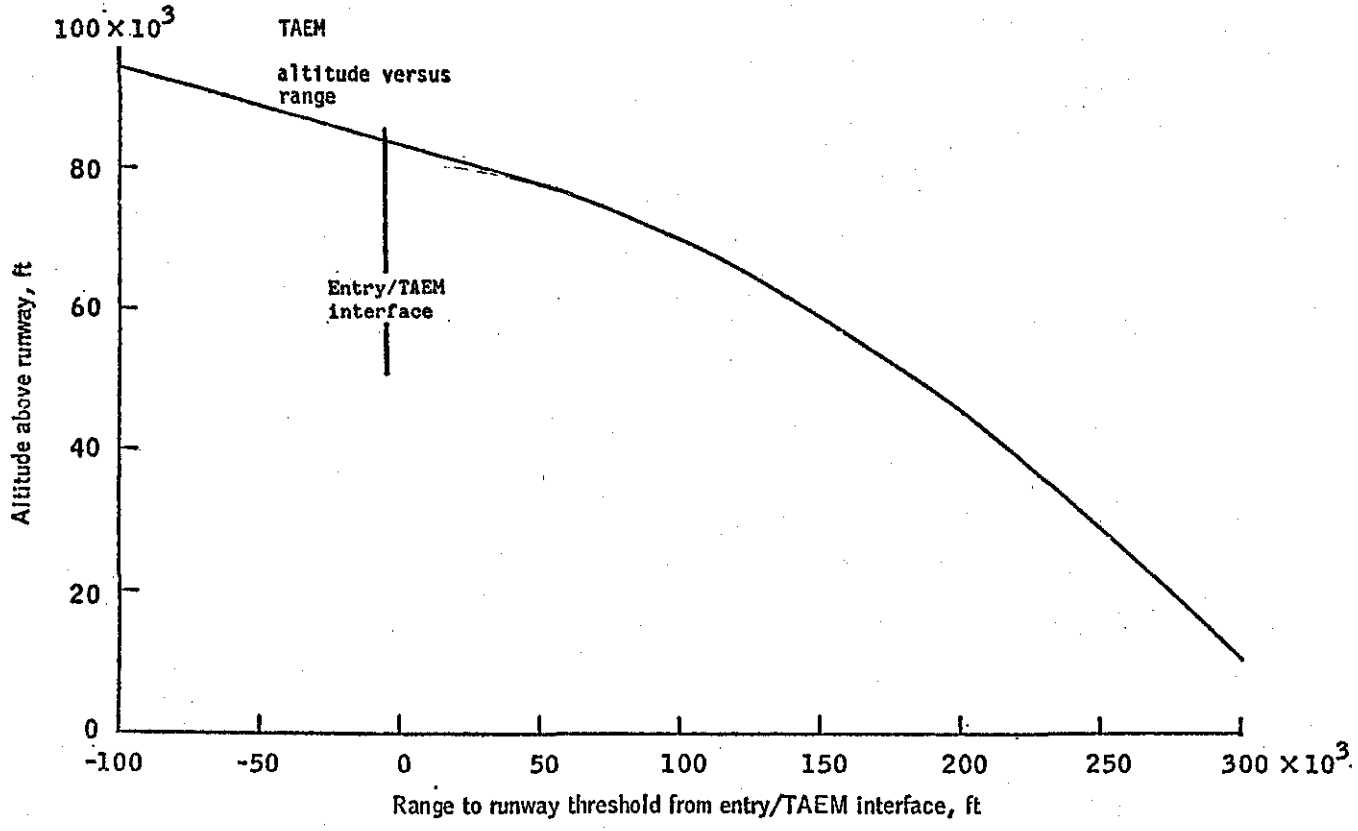

ENTRY FLIGHT PROFILE
ALTITUDE
DEORBIT BURN
ALTITUDE
400,000 FT
75.75mi.(122,000m)
ENTRY INTERFACE
~250,000 FT
(76,000m)
47.35 mi.
BLACKOUT
140,000 FT
(42,600m)
26.5mi.
TERMINAL AREA
ENERGY MANAGEMENT
INTERFACE 70,000 FT (13.25mi)
(21,300m)
AERO SURFACES - ALL CONTROLS
APPROACH
AND LANDING

Figure 4



- Altitude versus range at entry/TAEM interface.

Figure 5

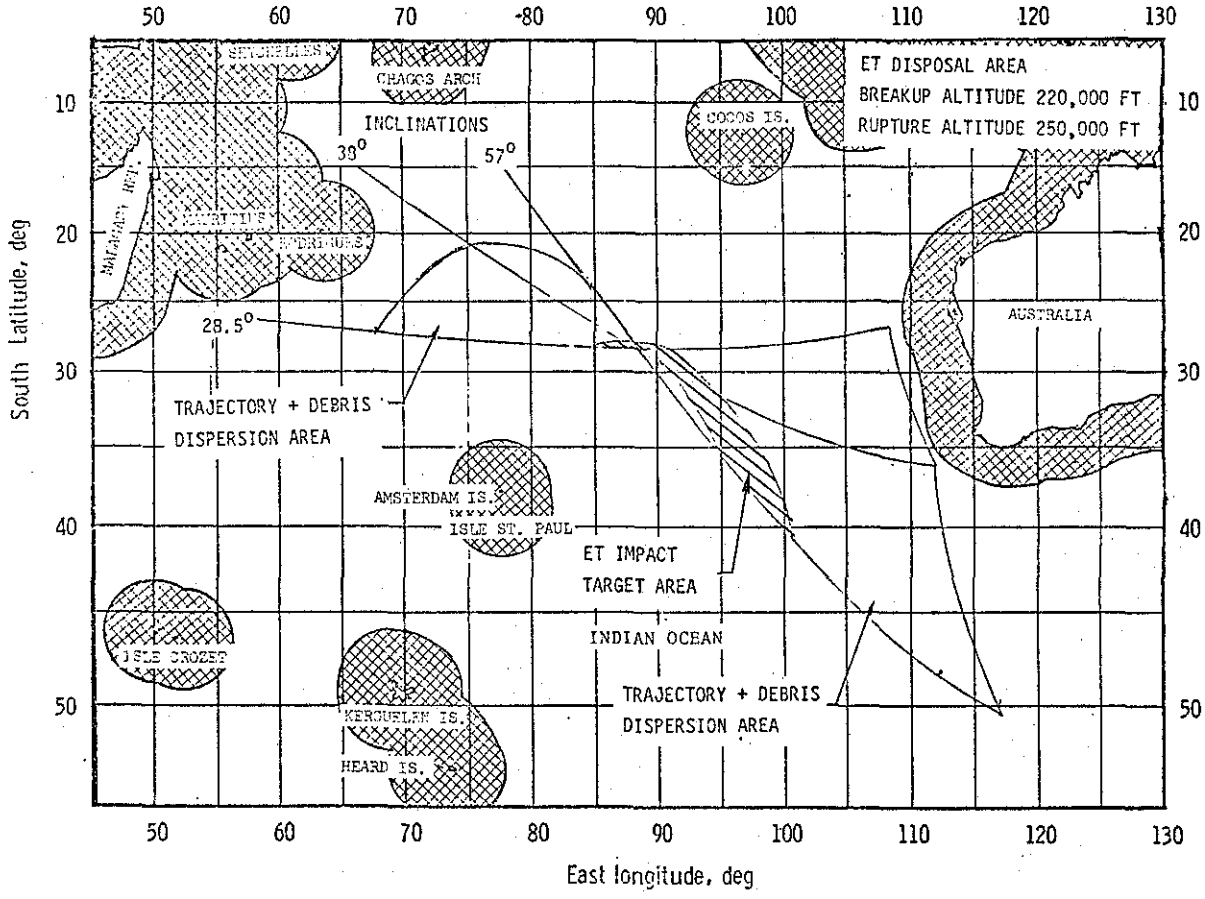

ET DISPOSAL AREA
BREAKUP ALTITUDE 220,000 FT
RUPTURE ALTITUDE 250,000 FT
INCLINATIONS
39°
57°
28.5°
CHAGOS ARCH
COCOS IS.
AUSTRALIA
TRAJECTORY + DEBRIS
DISPERSION AREA
AMSTERDAM IS.
ISLE ST. PAUL
ET IMPACT
TARGET AREA
INDIAN OCEAN
ISLE CROZET
KERGUELEN IS.
HEARD IS.
TRAJECTORY + DEBRIS
DISPERSION AREA
South Latitude, deg
East longitude, deg
50
60
70
80
90
100
110
120
130
10
20
30
40
50

Figure 6

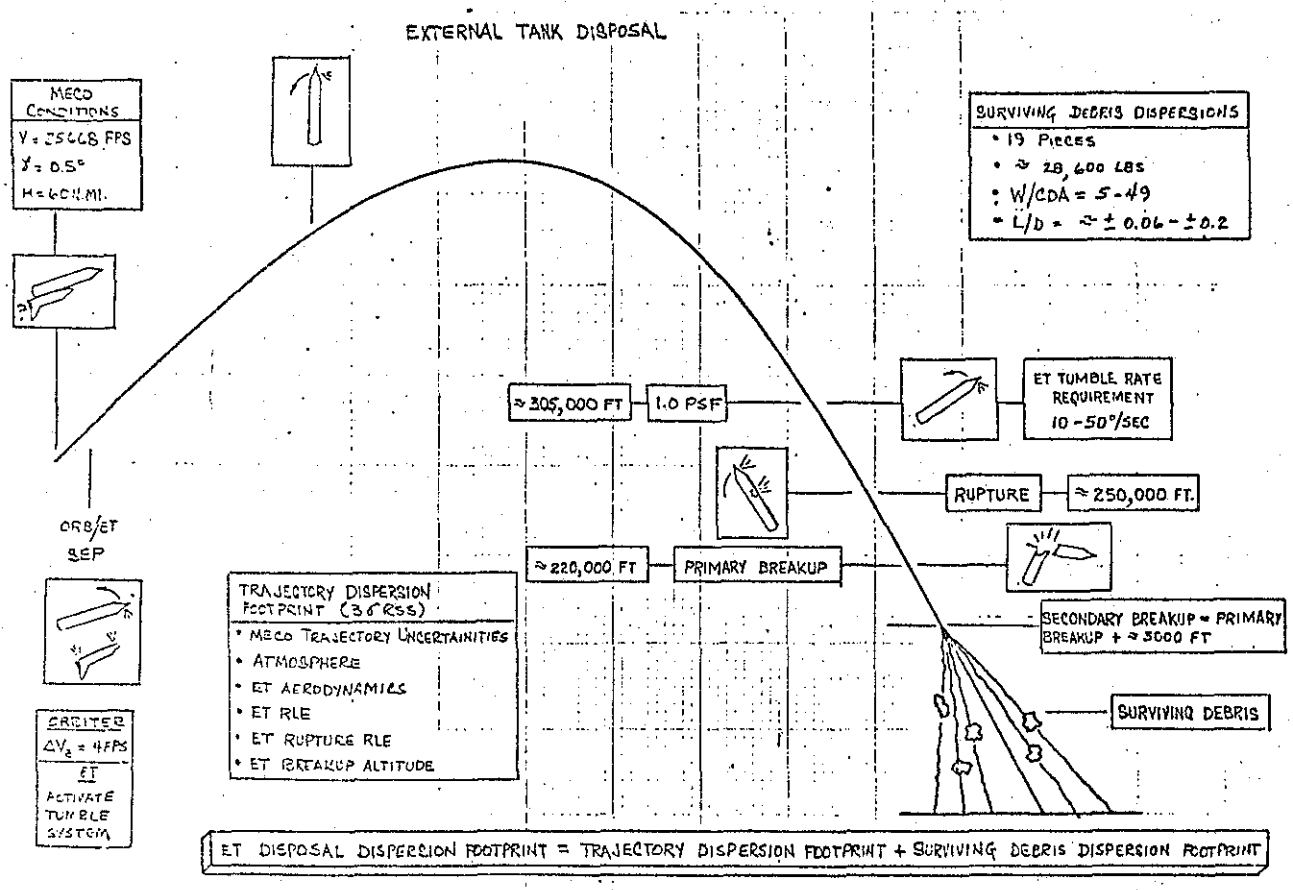
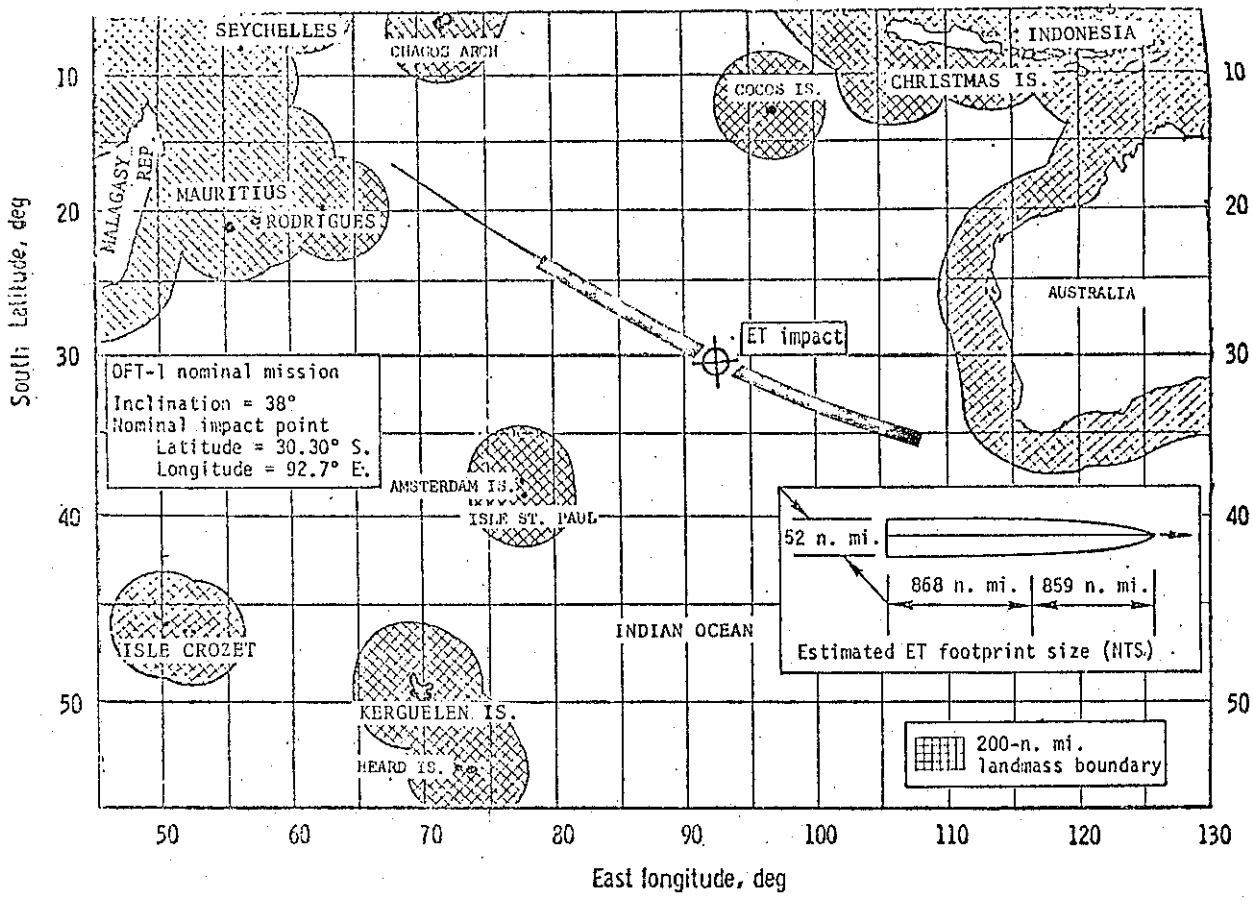

EXTERNAL TANK DISPOSAL
MECO CONDITIONS
V = 25468 FPS
γ = 0.5°
H = 60 N.MI.
ORB/ET SEP
ORBITER
ΔV = 4 FPS
ET
ACTIVATE TUMBLE SYSTEM
SURVIVING DEBRIS DISPERSIONS
• 19 Pieces
• ≈ 28,600 LBS
• W/CDA = 5-49
• L/D = ≈ ± 0.06 - ± 0.2
≈ 305,000 FT
1.0 PSF
ET TUMBLE RATE REQUIREMENT
10 - 50°/SEC
RUPTURE
≈ 250,000 FT.
≈ 220,000 FT
PRIMARY BREAKUP
SECONDARY BREAKUP = PRIMARY BREAKUP + ≈ 3000 FT
SURVIVING DEBRIS
TRAJECTORY DISPERSION FOOTPRINT (3 σ RSS)
• MECO TRAJECTORY UNCERTAINITIES
• ATMOSPHERE
• ET AERODYNAMICS
• ET RLE
• ET RUPTURE RLE
• ET BREAKUP ALTITUDE
ET DISPOSAL DISPERSION FOOTPRINT = TRAJECTORY DISPERSION FOOTPRINT + SURVIVING DEBRIS DISPERSION FOOTPRINT

Figure 7



NOMINAL ET IMPACT AND DISPERSION AREA

NUCLEAR POWER SOURCES IN OUTER SPACE+

*S. Neil Hosenball**

The total number of objects which have been or are as of now in Earth orbit since Sputnik I was first launched October 4, 1957, is 10,791.[1] Of this number there are still 4,601 objects orbiting the Earth, the remaining 6,190 objects having decayed and reentered the Earth's atmosphere. Excluded from this number are objects in lunar, planetary or solar orbits, or objects on a deep space trajectory.[2]

Of 4,546 U.S. objects that were or are now in Earth orbit, 2,997 are still in orbit and 1,549 have decayed. For the Soviet Union, of 6,019 objects that were or are now in orbit, 1,447 objects still are in orbit and 4,572 objects that were in orbit have decayed. Percentage wise, 33 ⅓% of the U.S. space objects have reentered the atmosphere as opposed to 75% of USSR space objects having decayed and reentered the atmosphere. Others having objects in orbit are France with 53 of which 27 have decayed; Intelsat 23 of which all are still in orbit (this is most likely due to the fact they are in geostationary orbit at an altitude of 25,000 miles, and the orbit decays at a very slow rate, centuries rather than years); Japan with 31, none of which has decayed (probably due to their comparatively recent entry into space activities). The balance of space objects that now are in orbit is scattered among Australia (1), Canada (8), European Space Agency (5), FRG/France (2), FRG (9), India (1), Indonesia (2), Italy (1), NATO (4), PRC (5), Spain (1), and UK (11).[3]

Of the space objects which were or are now in orbit, 2,186 are payloads rather than debris; and of this number 953 are still in orbit and 1,233 have decayed. The size of a space object listed in the box score would range from a Skylab payload to a fragment of a Delta launch vehicle which is approximately 127 centimeters in diameter. The large majority of objects burn up on reentry into the Earth's atmosphere or impact in an ocean area (ocean areas represent approximately 70% of the Earth's surface). Of the 6,190

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*General Counsel, National Aeronautics and Space Administration, Washington, D. C.

+ This paper is an elaboration of the author's address at the University of Akron School of Law, May 2, 1978. The views presented are those of the author and not necessarily of any organization of which he is a member.

[1]The statistical data included in this article is based on information acquired by the author from NASA's Goddard Space Flight Center and upon information furnished by Air Defense Command (NORAD).

[2]The term "object" is used because the number is a mixture of payloads and debris, and the term "debris" describes non-functional parts put into orbit in connection with payloads (*e.g.*, spent stages, shroud coverings, pieces resulting from in-space disintegration of objects, etc.).

[3]See *supra* n. 1.

decayed objects (payloads and debris), an extremely small number (less than 100) have produced fragments that have survived reentry to land on the Earth's surface and been found.[4]

The likelihood or probability of injury or damage to person and property is very small. Dr. Frosch, the Administrator of NASA, when asked recently what are the chances being struck by a falling piece of satellite said: "We can't compute the hazard exactly but we can compare it to similar hazards. And we think that the possibility of being hit by a piece of Skylab is smaller than the probability of being hit by a meteor." Dr. Frosch indicated there are but two confirmed cases in the last 200 years of anyone being struck by a meteor.[5] Notwithstanding the small probability of injury or damage, NASA started taking steps, prior to the Cosmos 954 incident and not as a result of it, to extend the orbital life of the Skylab to provide sufficient time to either reboost the Skylab or deorbit it into planned ocean reentry.

Sputnik I was launched on October 4, 1957. One year later on December 13,1958, the United Nations by UN General Assembly established the Ad Hoc Committee on the Peaceful Uses of Outer Space.[6] The following year, the General Assembly established a standing Committee on the Peaceful Uses of Outer Space which was requested, *inter alia,* to "study the nature of legal problems which may arise from the exploration of outer space."[7] The membership of the Committee has more than doubled in size from an initial membership of 18 countries on the Ad Hoc Committee to its current membership of 47. The member nations on the Committee are fairly representative of UN membership as a whole having African, Asian, Latin American, Western European, Mid East, First World and Third World countries, and countries in every stage of development from the US and USSR to Benin and the United Republic of Cameroon.

The Committee established two subcommittees—a Scientific and Technical Subcommittee and a Legal Subcommittee—the membership of the Subcommittees being the same as on the full committee. All three bodies operate on the principle of consensus. There is no voting, and any one member under this consensus procedure can prevent any matter being reported out of a subcommittee to the committee or from the committee to the UN General Assembly.

The Legal Subcommittee has compiled an outstanding record of achievement. It has produced four treaties and may be close to agreement on a fifth. In 1967 agreement was reached on the Treaty on Principles Governing the Activities of States in the

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[4] *Ibid.*

[5] Communications received by the author from the indicated source.

[6] G.A. Res. 1348 (XIII) (1958).

[7] G.A. Res. 1472 (XIV) (1959).

Exploration and Use of Outer Space, Including the Moon and other Celestial Bodies.[8] More than 70 countries are now Parties to this Treaty. It is universally and justly regarded as the "Mother Treaty" of all of the law of outer space that has been developed to date. The three other multilateral treaties are the Agreement on the Rescue and Return of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, which entered into force in 1968,[9] the Convention on International Liability for Damage Caused by Space Objects, which entered into force in 1973;[10] and the Convention on Registration of Objects Launched into Outer Space, which entered into force in 1976.[11]

The Cosmos 954 incident occurred shortly before the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space was to meet at the United Nations in New York, and the matter received a great deal of attention in that Subcommittee.[12]

The U.S. Delegation presented to the Subcommittee a complete illustrated description of U.S. use of nuclear power sources in space. The U.S. Delegation explained the technical differences and different safety implications of nuclear reactors, on the one hand, and radioisotope thermoelectric generators and other scientific use of such smaller amounts of nuclear material in spacecraft, on the other hand. It also explained the differing reasons for and implications of the placement of nuclear sources in low Earth versus higher Earth orbit and distant space trajectory.[13] These technical distinctions involve important safety implications, and the U.S. supported a study by competent technical experts on the question of nuclear power sources in space.[14] The radioisotope power systems for U.S. spacecraft (the U.S. does not use nuclear reactors)

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[8]The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (hereinafter referred to as the Outer Space Treaty) was signed on January 27, 1967 and entered into force October 10, 1967, 18 U.S.T. 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205.

[9]Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space, April 22, 1968, [1968] 19 U.S.T. 7570, T.I.A.S. No. 6599, 672 U.N.T.S. 119 (hereinafter cited as Rescue and Return Agreement or Rescue Agreement).

[10]Convention on International Liability for Damage Caused by Space Objects, March 29, 1972, [1973] 24 U.S.T. 2389, T.I.A.S. No. 7762 (hereinafter cited as Liability Convention).

[11]The Convention on Registration of Objects Launched into Outer Space (hereinafter referred to as Registration Convention) was opened for signature on Jan. 14, 1975 and entered into force on Sept. 15, 1976; T.I.A.S. No. 8480.

[12]U.N. Doc. A/AC. 105/216 (1978).

[13]U.N. Doc. A/AC. 105/C.1/SR. 202, para. 9-10, 12-13 (1978).

[14]U.N. Doc. A/AC. 105/C.1/SR. 191, para. 36-39 (1978).

are designed to release no radioactivity under normal conditions and only inconsequential amounts under the most severe accident conditions. Our radioisotope power sources systems are launched only after a detailed and thorough national multi-agency safety and environment review, and such reviews are made public. Every nuclear power system must be personally approved by the President prior to launch.

Canada and most of the other delegations, including the United States, wanted to establish a working group of the Subcommittee to do the fact-finding to support a competent international study of the use of nuclear power sources in space. Following completion of the fact-finding inquiry, discussion and negotiation of a binding multilateral regime could proceed. The U.S. Delegation to the Scientific and Technical Subcommittee identified three principal elements of such a regime:

> "First—Establishment of safety requirements, including the publication of a safety analysis statement by the launching state and the opportunity for other states to comment on that statement. Also setting of standards for nuclear power sources in space, including exposure standards on the basis of risks determined throughout the entire mission.
>
> "Second—The establishment of requirements for notification. Possible aspects of this proposal could include (a) notice of a launching state to the UN of the launch of a nuclear power source, (b) provision of private notice by the launching state to affected countries of the re-entry of a nuclear power source, and (c) notice by any states with relevant information to the affected states of the fact of impact of a nuclear power source upon the territory of the affected states.
>
> "Third—Providing assistance in locating debris, its cleanup and emergency treatment of affected persons, including: (a) a requirement, in addition to existing obligations, that launching states have the capability to provide assistance, and do so upon request by an affected state; (b) the use of suitable existing international organizations to coordinate assistance efforts if requested by an affected state; and (c) the appropriate handling of costs of search and cleanup."[15]

Because of the lack of a consensus in the Scientific and Technical Subcommittee, the proposal to establish a fact-finding working group was not adopted.

The subject of nuclear power sources in space was also debated in the meeting of the Legal Subcommittee which ended on April 7, 1978. However, procedural objections limited the topic to statements in the general debate, a reference to the subject in the final report of the Legal Subcommittee, and the introduction of a working paper co-sponsored by Australia, Belgium, Chile, Colombia, Egypt, Iran, Italy, Japan, Kenya, Mexico, Sierra Leone, Sweden, and the United Kingdom.[16] Basically, it proposed that the Legal Subcommittee begin a substantive discussion on the legal aspects of the use of nuclear power sources in outer space, in particular on those issues of notification, and

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[15] *Ibid.*

[16] Doc. A/AC. 105/218 (April 13, 1978), Annex IV.

emergency assistance, which do not require special scientific and technical study.[17] It also suggested that the subject of safety measures be examined with appropriate follow-up action and that nuclear power sources in space be placed on the agenda of the Legal Subcommittee.[18]

At the time of this paper, the parent Committee on the Peaceful Uses of Outer Space had not considered this subject. It meets June 26 to July 7 in New York. The subject of nuclear power sources in space will certainly be raised again in the Committee, and it is this writer's personal view it will be added to the agenda of both Subcommittees.

[17] *Id.*, p. 2.

[18] *Id.*, p. 1.

SOME REFLECTION ON THE LIABILITY CONVENTION FOR OUTER SPACE+

Herbert Reis *

The Outer Space Liability Convention,[1] completed in June of 1971, proved to be the result of one of the most difficult and lengthy treaty negotiations since 1945.

The Soviet Union orbited the first man-made earth satellite in October 1957 during the International Geophysical Year. The United States followed with Explorer I in January 1958. In 1959 the United States proposed that among the problems arising from space activities which merited priority attention was the question of international liability for damage caused by the launching, flight and re-entry of payloads and associated launch vehicles.

At the first meeting of the United Nations Outer Space Legal Subcommittee in the spring of 1962, the United States proposed a set of substantive principles on liability and subsequently, it reached agreement with the USSR to include in a General Assembly Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space the generalized statement that "Each State which launches or procures the launching of an object into outer space, and each State from whose territory or facility an object is launched is internationally liable for damage to a foreign State or to its natural or juridical persons by such object or its component parts on the earth, in air space, or in outer space."[2] It is essentially this statement that has been codified in Article VII of the Outer Space Treaty.[3]

However, even as the Outer Space Treaty was being negotiated, the United States and other Western and non-aligned countries recognized that a principle of international legal responsibility and financial liability of so high a level of generality, however useful, could not secure the objective of assuring to a person suffering damage

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+ This article is an elaboration of the author's address at the University of Akron School of Law May 2, 1978. The views herein expressed are those of the author and do not necessarily represent the views of any organization with which he is connected.

[1]Convention on International Liability for Damage Caused by Space Objects, March 29, 1972 [1973] 24 U.S.T. 2389, T.I.A.S. 7762 (hereinafter cited as Liability Convention).

[2]U.N.G.A. Res. 1962/XVIII (1963).

[3]The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (hereinafter referred to as the Outer Space Treaty) was signed on January 27, 1967, and entered into force October 10, 1967. [1977] 18 U.S.T. 2410, T.I.A.S. 6347, 610 U.N.T.S. 205.

on the surface of the Earth as the result of another country's space activities a reasonable prospect of prompt and fair compensation. While the United States would have had no hesitation in presenting an international claim under the generalized provision of the Outer Space Treaty, the expectation of securing compensation would have been at best obscure and at worst slim. For this reason the United States in 1963 introduced in the United Nations Outer Space Legal Subcommittee the first proposal for an international convention on liability for space vehicle damages.

We at first found it difficult to engage the serious attention of the Soviet Union, which, indeed, preferred throughout the following eight years of negotiation not to put forward proposals under its own name but instead to rely upon Hungary. A review of formal liability proposals during the years of 1962 through 1971 would thus center on United States[4] and Belgian texts,[5] a series of Hungarian proposals[6] and, particularly in the later years, proposals by a number of highly interested and competent third world countries. Even today there might have been no liability convention but for the efforts of the Government of India which took the initiative of trying to overcome a critical impasse by hosting informal discussion in New Delhi in March 1969 with the United States, Belgium, the Soviet Union and Hungary. A second major contribution was made by Austria through the person of Ambassador Heinrich Haymerle, then Chairman of the United Nations Outer Space Committee. His creative and insistent involvement in the details of the Liability Convention is a model of what can be accomplished in multilateral negotiation by a sensitive and activist diplomat.

In the United States' view during the 1960's, a meaningful liability treaty had to comprise at least four principal elements. First, the treaty would have to articulate the rule that liability should not require a showing of fault. Plainly, neither a victim nor the State which advanced a victim's claim would have any practical possibility of showing that a particular injury was sustained due to negligence on the part of a launching authority. Second, the agreement would have to advance a meaningful statement as to the standards to be applied to evaluate losses suffered and the amount of compensation to be paid. Ideally, to the extent that money can ever adequately compensate for injury, the objective must be to restore a claimant to the condition existing prior to the injury. Third, the traditional international rule requiring a claimant to exhaust judicial or administrative remedies available in the State that caused the loss would have to be explicitly denied. Fourth, there would have to be a way to insure that compensation negotiations between a claimant and the launching authority would not continue for an unreasonable period of time, and that a dissatisfied claimant would have the possibility of obtaining impartial advice from an international claims commission to be constituted on an *ad hoc* basis for this purpose.

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[4]Doc. A/AC.105/C.2/L.8/Rev. 3.

[5]Doc. A/AC.105/C.2/L.7 and Corr. 1, 2 and 3; WG. II/27.

[6]Doc. A/AC.105/C.2/L.10/Rev. 1.

An analysis of the early Eastern European proposals concerning the liability convention project shows the size of the gap between Western and Communist notions of State responsibility and fair compensation for damage. The Hungarian draft agreement, while apparently calling for an absolute liability standard, included an unexplained, and unexplainable, exception for so-called natural disasters.[7] Hungary urged that the law of the launching State should govern the character and amount of compensation to be paid to a foreign victim.[8] This made no sense but demonstrated clearly Eastern European distrust of foreign tort law concepts common in the non-Communist world. In a reflection of their political campaign aganist national observation of the earth from space, they proposed that whatever rules of exoneration might be contained in the convention, these should have no application to damage caused by a so-called "unlawful activity."[9] Their treaty proposal also reflected their distrust of international mediation and arbitration; they proposed that a dissatisfied claimant State should be able to appeal to a so-called committee of arbitration composed, as they said, "on a basis of parity."[10]

This exemplification of but a few of the differences between various national positions will help explain why the negotiations for the liability convention went on for almost a decade. The conclusion drawn by this writer that the Liability Convention signed on March 29, 1972, in London, Moscow and Washington successfully fulfilled the basic goals the United States Government set for itself may have to be discounted by the fact that this writer served as chief United States negotiator from 1967.

To reiterate, our fundamental purpose was to do what could then be done to assure the payment of prompt and fair compensation to United States citizens who might be injured as a result of the re-entry of fragments of a foreign man-made space payload or launch vehicle. There remained a number of relatively exotic questions which the liability convention did not try to answer, and which, if a treaty were to be completed in a timely manner, had to be excluded from the negotiations. To give one example, the Convention does not deal meaningfully with problems that may arise when injuries are sustained in the environment of space or on a celestial body. The negotiators recognized that it may eventually prove desirable to have a separate additional treaty on space-sustained damage when the presence of human beings in space becomes frequent and numerous.

But the Convention does plainly state the rule of absolute liability. It overrules the traditional requirement for the exhaustion of local remedies. It establishes a full

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[7] *Id.*, Art. III.

[8] *Id.*, Art. II.

[9] *Id.*, Art. V.

[10] *Id.*, Art. XI.

compensation standard by requiring that compensation shall be paid "in accordance with international law and the principles of justice and equity, in order to provide such reparation in respect to the damage as will restore the person. . .on whose behalf the claim is presented to the condition which would have existed if the damage had not occurred."[11]

The Convention enables a claimant who has not been offered adequate compensation the possibility, without seeking the agreement of the other party, of taking the matter to an impartial three-member conciliation commission.[12] It establishes the principle of joint and several liability as between co-participants in a joint space activity, each participant being fully liable and the claimant State being entitled to proceed against any single co-participant.[13]

The Liability Convention serves a variety of purposes. It secures, to the greatest degree practicable at the outset of the 1970's, maximum assurance that a launching State which has ratified the convention will pay a just claim. The Convention encourages international cooperation because it offers to countries not engaged in national space activities the good prospect that space powers, who need the cooperation of the whole international community, will not deal arrogantly with justified damage claims. It constitutes a useful contribution to helping to achieve the exclusively peaceful, nonaggressive use of outer space, a goal yet to be attained.

As demonstrated by the reentry of Cosmos 954, objective appraisal of the adequacy of any treaty instrument in the light of subsequent events can be useful and instructive.

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[11]Art. XII.

[12]Art. XIV

[13]Art. V.

COSMOS 954 AND THE SPACE TREATIES+

*Paul G. Dembling**

In one of the most spectacular accidents of the space age a five-ton Soviet surveillance satellite with an atomic power-plant abroad burned up in the atmosphere over the remote reaches of Canada's Northwest territory on January 4, 1978.[1] The 110 pounds of uranium that fueled the power-plant—and the radioactive strontium, cesium, and iodine that were the fission products of the uranium—burned with the satellite in the atmosphere and were scattered to Earth. The Soviet spacecraft began its plunge into the atmosphere at 6:50 a.m. Eastern Standard Time over Queen Charlotte Island off the west coast of Canada. It disintegrated three minutes later into countless fireballs over Great Slave Lake, near the mining towns of Yellow Knife, Fort Radium, and Uranium City.

The Canadians immediately sent out search parties to look for debris. In the United States, the U. S. Air Force dispatched an instrumented KC135 jet from McClellan Air Force Base and a high flying U-2 aircraft from Beale Air Force Base to sample the air over Western Canada. The planes carried filters to trap radioactive fallout from the upper atmosphere. Later, these filters were analyzed for radioactive isotopes like strontium-90, cesium-137, and iodine-131 that are fission products of any nuclear chain reaction.

The Soviet satellite was described by the White House and Congressional sources as "an ocean-surveillance satellite" that uses radar to locate warships of the United States Navy in the major oceans. This satellite was the first of 16 ocean-surveillance satellites to meet with an accident in the last six years.

The satellite which was called Cosmos 954 by the Soviet Union was launched from its Cosmodrome near Tyura Tam on September 18, 1977. It had followed into orbit a sister satellite known as Cosmos 952 which left the Cosmodrome two days before on September 16. Both satellites had been flying 150 miles above the Earth in a northeasterly direction following a path that took them roughly over two-thirds of the Earth every two weeks. Their surveillance covered an area from the edge of the Antarctic in the southern hemisphere to the edge of the Arctic in the northern hemisphere.

On December 25, 1977, Cosmos 952 was fired out of its 150-mile orbit and raised to where it circled the earth at an altitude of more than 600 miles, where it is no longer

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+ This article is an elaboration of the author's presentation at the University of Akron School of Law, May 2, 1978.

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[1] This event has been reported in the press all over the world and references to it would be much too numerous to cite in the ensuing factual summary.

operational. The same maneuver had been performed on 14 earlier surveillance satellites to take them and their atomic reactors far enough from Earth to keep them in space for hundreds of years. According to accounts, in the six years the Soviets have had their ocean-watching satellites in space, they have always had two on patrol at the same time. The longest any has stayed in the 150-mile orbit has been 74 days. Generally they stay in orbit no more than two months before being lifted to the higher orbit making them no longer operational.

A few days after Christmas the same orbit-raising maneuver was tried on Cosmos 954. The satellite failed to go into the higher orbit forcing the five-ton spacecraft into a tumble that brought the satellite out of orbit. The Soviet News Agency, TASS, said the satellite was sharply depressurized for reasons yet unknown on January 6 this year, with the result that the satellite began to come down in an unplanned regimen. This would suggest that the satellite fuel tank had been exhausted either by a leak or some kind of explosion that did not allow the satellite's engines to fire. The leak or explosion could have given the satellite a downward thrust that took it out of orbit. At this time the North American Air Defense Command in Colorado Springs began to notice that the Cosmos 954 was in trouble. Radars operated by NORAD saw the Soviet satellite fall from 150 miles to 100 miles in 10 days at which time warnings were flashed to countries which lay below the satellite's route.

It has been generally known that the Soviet's ocean-surveillance satellites obtain their power from nuclear reactors. Accounts of the accident indicate that the reactors hold 110 pounds of highly enriched uranium which is the same kind of fuel used in atomic submarines and the same type of uranium used to make nuclear bombs. That amount of uranium produces 100 kilowatts of electricity. This is enough to power an active radar system that could penetrate clouds to identify surface ships. It could distinguish between targets such as an aircraft carrier or a surfacing nuclear submarine.

The satellite's nuclear power-plant, according to accounts, was turned on shortly after the satellite left the Earth last September. It was kept on at least until December 25 when it was due to be taken into a higher orbit. If that is the case, the satellite's reactor would have produced about 100,000 curies of fission products like strontium-90 and cesium-137. These are poisonous wastes of nuclear power. These wastes were either burned up with the satellite over Western Canada at such high altitudes that they were taken by upper air winds and carried all over the globe where they may stay for years to come or they settled down toward Earth with rain and snow which brought them to rest on Western Canada.

The fission product called iodine-131 is the first one that is looked for in the fallout of an atmospheric bomb test. The significance of this is that the iodine settles in pasture grass and then is lodged in the thyroid glands of cattle eating the grass. The milk of cows which have grazed on such contaminated grass has often been destroyed after an atomspheric bomb test.

Cosmos 954 was not the first satellite with atomic fuel abroad which has met with a mishap. The United States has had three accidents involving nuclear fuel satellites, only one of which involved the burn-up of radioactive debris. That incident took place in 1964 when a Navy transit satellite burned up in the atmosphere unloading 17,000 curies of radioactive plutonium into the upper air. The plutonium had been used as a heat source by the satellite.

Since then two other satellites with radioactive heat sources have plunged back into the water along with pieces of the satellite that took them away from Earth. Both were recovered intact by Navy frogmen. One was the radioactive source aboard the Apollo-13 spacecraft that was aborted. The other was aboard a Nimbus weather satellite that failed to go into orbit and fell into the Santa Barbara Channel off the coast of California.

The Canadian Defense Minister, Barney Danson, said the debris from the Soviet nuclear-powered surveillance satellite was pinpointed near Baker Lake, a remote outpost in the frozen tundra of North-central Canada less than 100 miles south of the Arctic Circle. The entire uranium core of the Soviet satellite contained at least 1,000,000 curies of alpha, beta, and gamma radiation. One million curies of radiation would be roughly equivalent to the radiation in a small atomic explosion, somewhat smaller than that caused by the bomb detonated in 1945 at Hiroshima. The source of the radiation is not the 110 pounds of uranium in the power-plant, but the radioactive fission products like strontium-90 and cesium-137 that have built up as uranium fuel burned itself up. There is also a small amount of plutonium in the spent fuel as well.

Having summarized the events surrounding the crash of Cosmos 954, much of which has been reported all over the world, the question arises: how do the outer space treaties come into play? The Outer Space Treaty of 1967[2] in Article VII provides that the States which are parties to the agreement shall be internationally liable for any damages caused by a space object. A State which launches such a space object is liable for its consequences.

Paragraph 1 of Article 5 of the Agreement on the Rescue and Return of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space[3] imposes a duty on a Contracting Party to notify the launching authority and the Secretary General when it discovers that a space object or its component parts has come down in its territory. In the case of the Cosmos 954, the Canadians did so inform the Soviet Union.

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[2]The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (hereinafter referred to as the Outer Space Treaty) was signed on January 27, 1967 and entered into force October 10, 1967 , [1967] 18 U.S.T. 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205.

[3]Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space, April 22, 1968, [1968] 19 U.S.T. 7570, T.I.A.S. No. 6599, 672 U.N.T.S. 119 (hereinafter cited as Rescue and Return Agreement or Rescue Agreement).

Paragraph 4 of that Article 5 provides that if a Contracting Party has reason to believe that a space object or a component part which it discovers is hazardous or deleterious it may request the launching party to take immediate and effective steps to eliminate any possible harm or danger. The launching party may be required to remove the entire object, for example, if removal from the territory of the Contracting Party is the only way in which the danger can be eliminated.[4]

The Canadians did not request the Soviets to take any steps to assist or to eliminate the possible danger or harm. In fact, it is my understanding that the Canadians refused the assistance proferred by the Soviet Union in this regard.

Paragraph 5 of Article 5 provides for payment by the launching authority of expenses incurred by a Contracting Party in recovering and returning a space object or component part, if requested by the launching party.

The Treaty states that the expenses arising in connection with the recovery and return of space objects and their components "shall be borne" by the launching authority. Such an obligation is understandable since the benefit from the recovery and return may be in the millions of dollars. (It is to be noted that the Agreement speaks of "expenses" and not "reimbursement." This was deliberate on the part of the drafters since it was felt that negotiations would take place prior to any steps to recover or return the object or its component parts.) Since the expenses incurred by the Contracting Party must be borne by the launching state, a launching authority's request for such recovery and return is a condition of this obligation.

It is my understanding that the Soviet Union did not request the recovery or the return of Cosmos 954 or of any of its components.

In 1972 the Convention on International Liability For Damage Caused by Space Objects was opened for signature.[5] This agreement codified Article VII of the Outer Space Treaty. The parties involved in the Cosmos 954 accident were the Soviet Union and Canada both of whom have signed the Liability Convention and therefore are bound by its provisions. That Convention says "A launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the Earth. . ."[6] and defines "damage" as meaning "loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons. . ."[7]

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[4]See Dembling and Arons, The Treaty on Rescue and Return of Astronauts and Space Objects, 9 Wm. & Mary L. Rev. 630, 656 (1968).

[5]Convention on International Liability for Damage Caused by Space Objects, March 29, 1972, [1972] 24 U.S.T. 2389, T.I.A.S. No. 7762 (hereinafter cited as Liability Convention).

[6]Art. II.

[7]Art. I.

The question arises as to whether Cosmos 954 caused damage as defined by the Convention. Interpreting the definition strictly, an argument may be made out that there was no such damage since there was no loss of life, no personal injuries involved, or other impairment of health. However, it could be argued that the radiation did result in damage to Canadian property and therefore the Soviet Union is liable.

It is not clear what precautionary measures taken by a contracting state are covered under the Convention. However, such actions which may be taken may mitigate eventual resulting damage and perhaps should be considered.[8]

While the Liability Convention provides for exoneration from absolute liability "to the extent that a launching State establishes that the damage has resulted either wholly or partially from gross negligence or from an act or omission done with the intent to cause damage on the part of the claimant State, or of natural or juridical persons it represents"[9] that does not appear to be the case here. It does not appear that Canada did anything with regard to this accident which would exonerate the Soviet Union from its liability. The Convention also provides that "a State that suffers damage. . .may present to a launching State a claim for compensation for such damage."[10] Canada under the Convention therefore may present such a claim to the Soviet Union. The claim must be presented through diplomatic channels[11] not later than one year following the date of the occurrence of the damage.[12] While the relevant article provides a one-year time limit,[13] it also privdes that if the full extent of the damage is not known, the claimant State is entitled to revise the claim and submit additional documentation "until one year after the full extent of the damage is known" or "in no event [to] exceed one year following the date on which the State could reasonably be expected to have learned of the facts through the exercise of due diligence."[14] The Convention also provides that the launching State shall be liable to pay damages so that the claimant will be restored to the condition which existed if the damage had not occurred[15] and that the compensation will be in the currency of the claimant State.[16]

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[8]Also, there are other treaties or conventions which may cover the situation, *e.g.*, the Vienna Convention on Nuclear Liability; however, their discussion is not within the scope of the presentation.

[9]Art. VI.

[10]Art. VIII.

[11]Art. IX.

[12]Art. X.

[13]Art. X, Para. 1.

[14]Art. X, Paras. 2 and 3.

[15]Art. XII.

[16]Art. XIII.

Canada and the Soviet Union have one year in which to settle the claim after Canada files its claim. If no settlement is made, a Claims Commission would be established at the request of either party.[17] The Convention goes on to specify that the Claims Commission will be composed of three members, one each appointed by the claimant State and the launching State, and the third member who will serve as chairman, to be chosen by the parties jointly. If no agreement is reached on the choice of the chairman within four months of the request for the establishment of the Commission, then either party may request the Secretary-General of the United Nations to appoint the chairman. He has a further period of two months in which to do so. [18] The Claims Commission would then decide the merits of the claim for compensation and determine the amount of compensation payable, if any.[19] The decision of the Commission is final and binding if the parties have so agreed. If the parties have not so agreed, the Commission will render its recommendations which the parties shall consider in good faith.[20] This decision will be made public.[21] The drafters of the Convention hoped that the public disclosure of the recommendations of the Commission would serve as pressure on the parties to accept the Commission's findings and determinations.

It may be recalled that the President of the United States offered to the Canadians assistance in locating the debris and to aid in the determination of any of the radioactive fallout. This assistance was accepted by the Canadians. Similarly, the Soviets also offered to render the Canadians assistance in this area. As stated previously, it appears that the Canadians refused this offer.

Another article of the Liability Convention provides that "if the damage caused by a space object presents a large scale danger to human life or seriously interferes with the living conditions of the population or the functioning of vital centers, the States 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."[22] In this case the Canadians chose to accept the United States offer and turned down the offer of assistance from the launching State, the Soviet Union. The fact that the Canadians turned down the offer from the launching State does not excuse the Soviet Union from liability for the damages which the claimant sustains. Compensation could also be claimed if any radioactive substances were given off and caused injury to

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[17]Art. XIV.

[18]Art. XV.

[19]Art. XVIII.

[20]Art. XIX, Para. 2.

[21]Art. XIX, Para. 4.

[22]Art. XXI.

personnel or damage to the ground. Although the Department of State, through its spokesperson, stated that early tests showed no indication of any radioactivity, it is presumed that the Canadians will wait to see what the eventual damages are in order to submit their claim. There again, the Convention provides that the claimant State "has one year following the date on which it could reasonably be expected to have learned of the facts through the exercise of due diligence."[23] It is believed that though early indications were that there was no radioactivity, later tests have shown the situation to be contrary.

The question of depletion of the Earth's ozone layer has also been raised. There have been no determinations made under the Liability Convention or the Outer Space Treaty with regard to this kind of damage and there is no general agreement that damage under Article II of the Liability Convention embraces the kind of damages caused by ozone depletion. According to the State Department, ozone depletion was not the type of damage contemplated by the drafters of the Liability Convention.[24] The type of damage caused by depletion of the ozone layer is inconsequential in nature as opposed to direct or approximate to come within the scope of the Convention's coverage according to the State Department.[25] Since ozone depletion would probably not be permanent in any one spot, it would be difficult to prove that a particular incident depleted the ozone layer to such an extent as to cause damage on the Earth's surface. It is noted that the difficulty of attributing liability to States for damages resulting from some specified event is a well recognized problem in international law. When dealing with such problems, international tribunals usually speak of "proximate cause" and tend to disallow damages which are "remote," "speculative," or not proximately caused by the specific event in question. Whatever particular damages will be allowed depends on the particular circumstances of each case.[26]

Article XII of the Liability Convention provides that compensation for damages under the Convention must be determined "in accordance with international law and the principles of justice and equity." In this regard, it has been recognized that where a State's conduct of activity, though lawful *per se*, entails environmental effects in the territory of another state, the affected State is entitled to compensation where there is clear and convincing proof of material damage.[27]

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[23]Art. X.

[24]This communication was received by the author from the Office of Legal Adviser on Treaty Affairs in the Department of State.

[25] *Ibid.*

[26]See W. Friedman, International Law 846 (1969); 3 Whiteman, Damages in International Law 1765-1767 (1943), and Restatement (Second) of Torts §§ 430 and 431.

[27]See the Trail Smelter Arbitral decision (*United States v. Canada*), 35 Am. J. Int'l L. 684 (1941).

The *Trail Smelter* case stated that clear and convincing proof of material damage is a precondition of the polluting State's liability to the affected State. In this respect various authorities have pointed out that the limited amount of space activity by States has not provided a sufficient basis for determining the conditions which would impose liability for any such resulting pollution.[28]

It is clear that any rights and obligations arising under the Liability Convention from pollution of the Earth's atmosphere by chemical emissions from the space object would have to be determined based on an assessment of the specific facts which must include findings concerning the existence of material damage. Verifiable scientific data is needed as evidence of any such material damage to the Earth's environment and the acquisition of such data by the claimant State.

[28]See 69 Am. J. Int'l L. 50, 69 (1975); 4 J. Space L. 23, 30-31 (1976).

COSMOS 954: ISSUES OF LAW AND POLICY +

Stephen Gorove *

It is unlikely that the circumstances surrounding the recent crash of Cosmos 954 over Canadian territory would have been the subject matter of a hypothetical case involving questions of liability resulting from activities in space. Situations that life produces frequently surpass the wildest imagination of man.

The facts which have been widely reported in the press[1] reveal that parts of a Russian Satellite, identified as Cosmos 954, which was believed to have been on a naval reconnaissance mission, carrying a nuclear reactor with highly radioactive materials to provide power for its remote sensing and communications systems, crashed on January 27, 1978 over a remote area in Canada. Due to an apparent malfunction, Soviet flight controllers were unable to send the satellite into a higher and at least temporarily safer orbit or to direct it to re-enter over some desolate ocean area.[2]

The Soviet program counted on the satellite burning up and disintegrating high in the atmosphere, where its radioactive cargo could presumably disperse harmlessly. However, the accident in Canada revealed that some dangerous material could reach the ground.

While there was radiation emitted from the discovered debris, there were no reported cases of injury to persons or specific damage to property.[3] Nonetheless, the risk of potential danger and public health hazards prompted certain precautionary measures by the Canadian government involving a large number of scientists, technicians and military personnel and about a dozen aircraft—many of them from the United States—in search and recovery operations relative to the Russian satellite.[4]

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+ This article is an elaboration of the author's presentation at the University of Akron School of Law, May 2, 1978, and at the 21st Colloquium on the Law of Outer Space, Dubrovnik, October 5, 1978.

[1]See, for instance, issues of the N.Y. Times, January 25, 26 and 27, 1978.

[2]*Id.*, April 2, 1978, p. 10-L.

[3]U.N. Doc A/AC.105/217; N.Y. Times, April 2, 1978, p. 10-L.

[4]*Id.*, February 5, 1978, p. 6-L; *id.*, April 2, 1978, p. 10-L.

Canadian officials estimated that the costs of the search operations had already exceeded several million dollars, not including the expense of a significant number of American scientists and engineers who had taken part.[5]

The Canadian government indicated that it would seek reimbursement for some of the costs from the Soviet Union.[6] Though the Soviet Union has acknowledged that a satellite, Cosmos 954, dropped out of the sky over Canada, the Russians have not been anxious to concede ownership of the fragments that have been discovered.[7]

The real significance of Cosmos 954 is that this was the first nuclear-related crisis involving space activities. As such, the accident started people to think more seriously about the problem of the control of nuclear energy particularly in space. At the same time, the accident brought up questions pertaining to liability. Should a nation be internationally liable for any costs which may be incurred as a result of precautionary measures taken by governments in connection with potential threats of atomic radiation? More specifically, would the costs of scouting for radioactive contamination, involving the deployment of a number of planes by Canada and the expenditures in connection with the use of scientific and other personnel be a basis of a damage claim? Should Canada be entitled to compensation or reimbursement from the Soviet Union for such costs? Should Canada be obligated to return to the Soviet Union any parts of the satellite which were recovered? Should there be new international agreements concluded governing the use of atomic energy in space?

Whatever answers may be given to the above questions, it has been observed that the mounting costs of the complicated effort, involving logistical problems made worse by the sub-Arctic cold, make the question of liability and the extent of damages much more intricate.[8]

The Soviet Union has indicated its willingness to pay for the damages resulting from the fall of the satellite, but it was said there was more at issue than just the question of damages.[9]

Obviously, the Soviet incident may also raise some hypothetical questions. What if the Russian satellite had landed close to a big, populated city and massive hysteria developed requiring hospitalization of people for shock or mental anxiety? What if

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[5] *Id.*, April 2, 1978, p. A-10.

[6] *Ibid.*

[7] N.Y. Times, January 25, 1978, p. A-11.

[8] *Id.*, January 31, 1978, p. A-11; *id.* February 8, 1978, p. A-9.

[9] *Id.*, February 15, 1978, p. A-7.

some radiation injury had occurred requiring subsequent and extensive precautionary measures? Would the cost of such measures be covered in addition to damage for radiation injuries?

In response to these questions, first of all the applicable law should be examined to determine the question of liability. Second, if it is found that the existing law is inadequate in whole or in part, the policy options ought to be reviewed in relation to what the law should be or the type of measures that ought to be taken in order to fill the gap or reduce the uncertainty in the legal framework.

I. COSMOS 954 AND THE "LEX LATA"

There are at least four international conventions with respect to which the question of liability arising out of the crash of Cosmos 954 requires analysis: the Liability Convention,[10] the Outer Space Treaty,[11] the Rescue and Return Agreement[12] and the Vienna Convention on Civil Liability for Nuclear Damage.[13]

1. Liability Convention

Under the Liability Convention the launching state is liable for damage caused by its space object.[14] The definition makes it clear that there are three elements which must be proved before recovery can be had. First, there must be damage; second, there must be a space object; and third, the damage must be caused "by" the space object. Proof of negligence is not required since the launching state is absolutely liable—irrespective of any fault on its part—for damage caused on the surface of the earth or to aircraft in flight.[15]

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[10]Convention on International Liability for Damage Caused by Space Objects, March 29, 1972 [1973] 24 U.S.T. 2389, T.I.A.S. 7762 (hereinafter cited as Liability Convention).

[11]The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (hereinafter referred to as the Outer Space Treaty) was signed on January 27, 1967, and entered into force October 10, 1967. [1967] 18 U.S.T. 2410, T.I.A.S. 6347, 610 U.N.T.S. 205.

[12]Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space, April 22, 1968 [1968] 19 U.S.T. 7570, T.I.A.S. 6599, 672 U.N.T.S. 119 (hereinafter cited as Rescue and Return Agreement or Rescue Agreement).

[13]Art. I(a) of the Convention.

[14]Art. II.

[15] *Ibid.*

a. The Meaning of Damage

There are a number of questions which may appropriately be raised in connection with damage under the Liability Convention. First, what is the meaning of "damage"? How broadly or narrowly is the term interpreted? Does it only include direct or also consequential damage where the damage does not flow directly and immediately from the act, but only from the consequences of such act? Does it cover damage caused by atomic radiation? Particularly does it cover costs arising out of precautionary measures taken to prevent actual damage to people and property? Furthermore, does damage cover only physical injury or also injury affecting mental or social well-being? Specifically, does it include mental anguish, pain and suffering and other types of nonphysical damage?[16]

While the Liability Convention does not in itself give a clear answer to any of these questions, it does provide some general guidelines with respect to the meaning of damage when it equates the latter with "loss of life, personal injury or other impairment of health" on the one hand and "loss of or damage to property of states or of persons, natural or juridicial, or property of international intergovernmental organizations" on the other hand.[17]

The broad phrase, "loss of life,, personal injury or other impairment of health" may mean not only physical injury but also injury affecting mental as well as social well-being. In support of this position attention may be called to the definition used by the World Health Organization, which describes health as "a state of complete physical, mental and social well-being."[18] Viewed against this definition, the phrase "other impairment of health" seems broad enough to cover personal injury resulting in the impairment of mental faculties.[19] If health in such a sense is directly affected, recovery may be had.

Injury or damage caused by atomic radiation or fallout emanating from man-made atomic power sources—while not separately covered—would appear to be covered by the general phrase of "loss of life, personal injury or other impairment of health" and the additional phrase "loss of or damage to property." At the same time, loss of the use of property may be regarded as covered by the phrase "loss of or damage to property" if broadly interpreted.[20]

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[16]S. Gorove, Studies in Space Law: Its Challenges and Prospects 124 (1977).

[17]Art. I.

[18]Preamble to the Constitution of the World Health Organization. For a text, see WHO, Off. Rec., No. 2, pp. 100-9.

[19] *Op. cit. supra* note 16 at 125.

[20] *Id.* at 128.

b. Space Object and its Meaning

A space object may be defined as any man-made object originating from the Earth which is designed for use in outer space.[21] An atomic power source launched for use into outer space would be a space object. There can be little doubt that Cosmos 954 and its nuclear reactor, including component parts, were such space objects. Therefore, if such objects caused damage the launching state would be liable.

c. Damage Must be Caused "by" the Space Object

The phrase in the Liability Convention that the damage must be caused "by" the space object[22] means that there must be proximate causation between the damage and the activity from which the damage resulted. Additionally, the word "by" could also imply that the damage must be caused directly by the space object in the sense of physical damage or impact. It could also be interpreted to mean that consequential damage where the damage does not flow directly and immediately from the act, but only from the consequences of such act, under normal circumstances would not be covered by the Convention.[23] Strictly speaking, the Soviet satellite did not cause direct injury to people or damage to property. What makes the determination of liability particularly difficult is the fact that in view of the potential threat of atomic radiation steps were taken which appear to have been reasonably necessary under the circumstances to prevent or mitigate damages. While domestic courts may be inclined to award damages—in line with the rule of mitigation of damages and commensurate with the cost of reasonably necessary precautionary measures—it is doubtful that such costs could be recovered under the Liability Convention.

One could perhaps almost categorically state that there was proximate causation between the precautionary measures taken and the potential threat of harm from atomic radiation. If the rule of mitigation of damages were followed in such situation, which domestic courts perhaps might be more inclined to do, recovery could be had. The only problem with this conclusion is that the Canadian expenses were incurred not in connection with the mitigation of actual damages but in connection with potential damages which could have occurred by reasonable expectation but which actually did not occur. Therefore, it appears doubtful even in domestic law that recovery could be

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[21]The requirement that the space object "originate" from the Earth seems necessary if the definition is to be in line with the space treaties currently in force. This becomes apparent from Art. 5, par. 1 of the Rescue and Return Agreement which speaks of a space object's "return to Earth" and an object must have been on Earth before it could return.

Insofar as parts of a space object are concerned Art. 1(c) of the Liability Convention makes it clear that the phrase "space object" includes "component parts of a space object as well as its launch vehicle and parts thereof."

[22]Art. II.

[23] *Cf.* U.S. Sen. Comm. on Aeronautical and Space Sciences, 92nd Cong., 2d Sess., Report on Convention on International Liability for Damage Caused by Space Objects 24 (Comm. Print, 1972).

had in such a situation and it is even more doubtful that recovery could be had under the Liability Convention.

d. Justice, Equity and Restitution

The case of Cosmos 954 and the question of Liability may also be approached from the viewpoint of the Liability Convention's provision involving the principles of justice, equity and restitution. The relevant provision states that the compensation which the launching state is "liable to pay*for damage*" (emphasis added) under the Convention is to be determined "in accordance with international law and the principles of*justice* and *equity*, in order to provide such reparation in respect to the *damage* as will *restore* the person . . . to the condition which would have existed if the *damage* had not occurred."[24] (Emphasis added).

While a perfunctory reading of the foregoing provision may give the impression that the principles of justice and equity (in the sense of fairness) should determine whether or not relief would be granted and that restitution is the purpose of such relief, a closer scrutiny clearly indicates that the occurrence of actual damage is the precondition of the invocation of the principles of justice and equity as well as of the eventual restitution. This is not to say that the principles of justice and equity may or ought not be used to settle claims of a controversial nature. It just means that, at present, there is no such requirement under the Liability Convention unless there has been some actual damage in the sense of loss of or damage to property.

2. The Outer Space Treaty

There are two provisions in the Outer Space Treaty which have to be considered in connection with the question of liability. The first one stipulated that the launching state is internationally liable for damage by a space object or its component parts.[25] This provision which is contained in Article VII is couched in much more general terms than the Liability Convention and in a way constitutes *lex generalis* in contradistinction to the Liability Convention which is, to a extent, an elaboration of the principle of liability enunciated in the Outer Space Treaty much the same as the Rescue and Return Agreement is, to a great extent, an elaboration of the principles incorporated in the Outer Space Treaty concerning the rescue and return of astronauts and the return of space objects.[26]

It is doubtful that the Outer Space Treaty could be regarded as imposing more liability than the Liability Convention. This becomes quite apparent from the fact that

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[24] Art. XII.

[25] Art. VII.

[26] *Cf.* Arts. V and VIII.

the Treaty does not mention absolute liability[27] which is incorporated in the Liability Convention with respect to damage on earth or to aircraft in flight.[28] Also, the three essential elements, namely that there must be damage, that is must be done by a space object and that there must be proximate causation are equally important under the Outer Space Treaty. In addition, the Liability Convention, unlike the Outer Space Treaty, refers to principles of justice and equity in determining the compensation which the launching state is liable to pay for damage in order to provide such reparation as will restore the person on whose behalf the claim is presented to the condition that would have existed if the damage had not occurred.[29] Therefore, it is hard to see how a claimant would be better off by basing its claim on Article VII of the Outer Space Treaty rather than on the Liability Convention. Possibly, if one invoked general principles of justice and equity in the sense of fairness a case could be made out for recovery, much the same as it could under the Liability Convention if one disregarded the provisions pertaining to the requirement of actual damage. Apart from this, it may also be argued that since the Outer Space Treaty contains no definition of damage, the latter could be interpreted to include costs incurred in connection with precautionary measures against potential hazards.

Another provision which might be considered is Article VI of the Outer Space Treaty stipulating that states bear international responsibility for national activities in outer space and for assuring that such activities are carried out in conformity with the provisions of the Outer Space Treaty.

The law of international responsibility of states for national activities would certainly extend to tortious activities. However, also in such case, proof of actual damage would most likely be required.

3. The Rescue Agreement

Another convention which may be considered is the Rescue and Return Agreement. Under the provisions of this agreement there are two situations in which expenses associated with the recovery and return of space objects would have to be borne by the launching authority: first, if that authority requested the recovery of its space object and second, if the launching authority requested the return of its space object.[30] If either or both of these conditions are met, the launching authority is required to pay the expenses associated with the recovery and return.[31]

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[27] *Cf.* Art. VII.

[28] Art. II.

[29] Art. XII.

[30] Art. 5, pars. 2 and 3.

[31] Art. 5, par. 5.

4. Vienna Convention

Finally, it may be noted that under the Vienna Convention on Civil Liability for Nuclear Damage the operator of the nuclear facility or device is liable for damage upon proof that such damage has been caused by a nuclear incident.[32] If the fall of a space object or debris on a nuclear installation is instrumental in bringing about a nuclear incident on earth, the resulting damage may be covered under both the Liability Convention and the Vienna Convention. It should be noted, however, that proof of damage in the sense of direct damage rather than consequential damage or precautionary measures taken to avert potential damage would also appear to be required under the Vienna Convention if it is strictly interpreted.

II. POLICY OPTIONS "DE LEGE FERENDA"

A. Reduction or Elimination of Future Accidents and Hazards

The preceding survey of the questions of liability arising out of the accident involving Cosmos 954 reveals a number of uncertainties and inadequacies, if not gaps, in the legal framework. In order to reduce or eliminate similar future accidents, hazards or threats arising out of the actual or intended use of atomic power sources in space, a number of policy options may be considered individually or in combination. Among them are:

1. Conclusion of an international agreement banning the use of spacecraft carrying radioactive materials either at all or in Earth orbit, possibly in low or high orbit. If one were to outlaw simply Earth orbit situations, atomic accidents could still happen at launch or in course of the ascendency of a spacecraft. For this reason, such solution would not fully eliminate the risk of harmful radiation. Thus an all-out ban would appear preferable. However, the consequences of such ban for deep space probes will have to be weighed.

Both the United States and the Soviet Union regard nuclear devices the best power source for certain missions. The American program does not require nuclear devices for its existing orbital missions and the United States would be willing to forego the deployment of Earth orbiting satellites with such devices altogether.[33] However, they are considered essential for deep space missions where solar energy is too weak to be practical and atomic reactors have been proposed as the best power source for large satellites of the future.[34] The Soviet program, in turn, reportedly depends on atomic

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[32] Art. I(a).

[33] N.Y. Times, January 31, 1978, p. A-11; *id.*, February 14, 1978, p. A-11.

[34] *Id.*, January 27, 1978, p. A-24.

reactors in orbit to power radar systems for naval reconnaissance missions.[35] For that reason, Russia may be reluctant to accept a ban on them.

2. The second option would be to develop rigid safety precautions and standards in Earth orbiting satellites and/or the use of fail-safe devices if they can be developed and if the risks involved would be reduced to an absolute minimum. Such safety requirements may prevent any radioactive material contaminating the Earth or the lower parts of the atmosphere at launch and after launch.

3. The third alternative would not necessarily eliminate potential accidents but would serve to give advance notice of the impending danger at various stages of space operations. It would include conclusion of an international agreement on notification requirements to the effect that it would be incumbent upon the launching state to give notice of atomic power sources it intends to launch into space: prior to launching, at launching, upon descent and at impact on Earth.[36]

4. Still another option, if feasible, would be to use the shuttle to reduce or eliminate already existing or future hazards. The shuttle could retrieve active materials when their plunge into the atmosphere threatens or could assist in placing them in higher, safer orbit. The conclusion of an international agreement on such and other types of assistance should be seriously considered.

B. Options Regarding the Question of Liability

There are also several policy options which may be considered in connection with the troublesome question of liability. Among them are:

1. Conclusion of an international agreement, perhaps in the form of an additional protocal to the Liability Convention, making it clear that preventive and search measures incidental to an actual or potential threat of nuclear radiation occasioned by a space object will fall under the concept of damage as envisaged in the Liability Convention and the Outer Space Treaty. Such instrument could also include a provision to cover the costs of the indicated measures if undertaken, at the request of the threatened state, by a third party.

2. The second option would be not to conclude an additional agreement on liability incidental to preventive and search measures, but to take the position that it is covered under the Liability Convention and the Outer Space Treaty either by an expanded interpretation of the concept of damage or by a general reference to the principles of justice and equity in the sense of fairness. In this connection, it should be

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[35] *Id.*, January 31, 1978, p. A-11.

[36] A working paper containing, *inter alia*, such notification requirements was introduced at the meeting of the UN Outer Space Scientific Subcommittee earlier this year. See Doc. A/AC.105/C.2/L.115 (April 4, 1978).

observed that while a Soviet offer to pay damages may be prompted by a general desire to be fair and just so as to restore Canada to the condition that existed before the crash of Cosmos 954, any actual reimbursement of Canada by the Soviet Union for the cost of search and preventive measures may create an important precedent for any future interpretation of the concept of damage in the field of space law.

Concluding Observations

The preceding analysis of the case of Cosmos 954 has vividly brought to the fore what may be regarded as the uncertainties and inadequacies in the legal framework to cover similar situations should they arise in the future. The applicable international conventions, including the Outer Space Treaty and the Liability Convention, have not been specific about costs incurred in tracking debris and assessing public health risks. In addition, the analysis has indicated some of the policy choices that may be considered.

Admittedly, much more could be said in support of one or the other policy alternative, much the same as it could be with respect to the question of liability. For instance, even more problematical than the indicated questions of liability would be the question of payment for costs to be incurred in connection with monitoring the region of impact for a year or two to see whether any unusual amounts of radioactive material would show up in the environment. Also, the question of the cost of third party assistance—as intimated in the discussion of policy choices—remains to be considered. Whatever Canada and the Soviet Union may ultimately agree to do or not agree to do, will be an interesting final chapter in the bizarre episode of Cosmos 954.

SOME OBSERVATIONS ON THE CRASH OF COSMOS 954+

*Dr. Peter P. C. Haanappel**

On 24 January 1978, Cosmos 954, a Soviet nuclear powered satellite, reentered the atmosphere of the earth, disintegrated and parts of it crashed on Canadian soil in the remote and very sparsely populated Northwest Territories. On the same day the author of this paper was contacted by the *Canadian Broadcasting Corporation* (C.B.C.) with the request to comment upon the legal implications of Cosmos' disintegration and crash. At that time very little information on Cosmos 954 and its demise were in the public domain. It was then the author's impression that the crash of Cosmos 954 might lead to the application of three international space law conventions: the *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies of 1967*[1]; *the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space of 1968*[2]; *and the Convention on International Liability for Damage Caused by Space Objects of 1972*[3]. Under the Outer Space Treaty, launching States are internationally liable for damage caused on earth to another State or its natural or juridical persons by their space objects or the component parts thereof.[4] Elaborating on this vaguely worded principle, the Liability Convention provides that launching States shall be *absolutely* liable for damage caused by their space objects on the surface of the earth.[5] Furthermore, the Rescue and Return Agreement provides for the return of space objects found on foreign territory to the launching State upon the latter's request and the latter's expense.[6] In other words, it was felt by the author that the Soviet Union

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+ This paper is an elaboration of the author's statement made at the University of Akron School of Law, May 2, 1978.

[1]The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (hereinafter referred to as the Outer Space Treaty) was signed on January 27, 1967 and entered into force October 10, 1967. [1967] 18 U.S.T. 2410, T.I.A.S. 6347, 610 U.N.T.S. 205.

[2]Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space, April 22, 1968, [1968] 19 U.S.T. 7570, T.I.A.S. 6599, 672 U.N.T.S. 119 (hereinafter cited as Rescue and Return Agreement or Rescue Agreement).

[3]Convention on International Liability for Damage Caused by Space Objects, March 29, 1972 [1973] 24 U.S.T. 2389, T.I.A.S. 7762 (hereinafter cited as Liability Convention).

[4]Art. VII.

[5]Art. II.

[6]Art. 5, paras. 3 and 5.

would be liable for damage caused to Canadian citizens or property without regard to fault (principle of absolute liability), that Canada upon Soviet request would be obliged to return the component parts of Cosmos 954, found on Canadian soil, to the Russians and that the latter would then reimburse Canada for the costs incurred in the return of the satellite parts.

A few weeks after the crash, when all the facts had become known, the legal situation under the above-mentioned international conventions turned out to be quite different. The Soviets did *not* request the return of what was left of Cosmos 954 under the Rescue and Return Agreement.[7] *No* physical or property damage had been suffered by Canadian citizens. It also appeared that no *measurable* damage had been caused to the Canadian environment by the nuclear debris of the Cosmos. Nevertheless, in order to *prevent* damage the Canadian Government (with the assistance of the United States) incurred considerable costs in the locating, removing and storing of the Cosmos' debris. Can Canada recover these search and rescue costs, estimated at 3 million dollars, from the Soviets? Such a claim was made, through diplomatic channels, by the Canadians in April, 1978.

It seems that, as far as the three international space law conventions are concerned, only Article VII of the Outer Space Treaty might find application to the claim. The phraseology of that article is very general and *might* be wide enough to cover the costs incurred by Canada in *preventing* possible damage from the Cosmos satellite. It could be argued that Canada's search and rescue costs were caused by fulfilling its common law duty to *mitigate* probable damages and that these costs would therefor qualify as indirect or consequential damage in the sense of Article VII of the Outer Space Treaty. On the other hand, neither the Rescue and Return Agreement nor the Liability Convention seem to cover Canada's claim. The Rescue and Return Agreement, providing for the reimbursement of expenses by the launching State,[8] can find no application, since the Soviet Union made no request for the return of Cosmos 954 under the agreement.[9]

The Liability Convention in its turn is inapplicable because of the narrow definition of "damage" as contained in the Convention. It defines damage as "loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organization."[10] This definition can by no stretch of the imagination cover the costs incurred by Canada in preventing potential damage, where *actual* damage never

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[7] Art. 5.

[8] *Id.*, Par. 5.

[9] *Id.*, Par. 3.

[10] Art. I (a)

occurred or remains unmeasurable (such as general damage to the environment)[11]. Therefore, might the Soviet Union honor Canada's claim, such action could possibly be based on Article VII of the Outer Space Treaty, on uncodified principles of international law, on political accommodation, but *not* on the Rescue and Return Agreement or on the Liability Convention.

In retrospect the crash of Cosmos 954 in the Northwest Territories might induce the international legal community at large and the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space in particular, to consider the following questions:

1) Perhaps the definition of "damage" as contained in Article I (a) of the Liability Convention ought to be broadened so as to include costs incurred by States in *preventing* surface damage to occur from satellite crashes, especially when one is dealing with potential damage from an ultrahazardous object like a nuclear powered satellite;

2) Perhaps the international legal community ought to ban nuclear powered satellites from earth orbit altogether or at least agree on internationally applicable safeguards against the potential dangers of such satellites;

3) The Rescue and Return Agreement favors cooperation between the launching State and the State where a spacecraft or its component parts are found. In the case of Cosmos 954 this would have meant cooperation between the Soviets and the Canadians. In fact, no Soviet-Canadian cooperation occurred. In accordance with the world's political realities it was rather the United States and Canada which cooperated in the search and rescue of Cosmos' debris;

4) The United States, through the North American Air Defense Command (NORAD) and the Soviet Union were aware of the possible reentry, disintegration and crash of Cosmos 954 long before the crash in the Northwest Territories actually occurred. It seems that the Canadian Government was only notified of the potential danger represented by the Cosmos shortly before its crash on January 24, 1978. Through the good services of the United Nations' Secretary General, the international legal community ought to set up a multilateral warning system, whereby launching States or States equipped with satellite tracking stations are required to notify other States of potential surface dangers represented by satellites in earth orbit.

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[11]The narrow definition of "damage" as contained in Article I (a) of the Liability Convention was already recognized as "one of the major problem areas" of the Convention in a Staff Report of 1972 prepared for the Committee on Aeronautical and Space Sciences of the United States Senate. See U.S. Sen. Comm. on Aeronautical Space Sciences, 92nd Cong., 2d Sess. Report on Convention on International Liability for Damage Caused by Space Objects: Analysis and Background Data, 23 (Comm. Print., May 1972).

MEASURING DAMAGES UNDER THE CONVENTION ON INTERNATIONAL LIABILITY FOR DAMAGE CAUSED BY SPACE OBJECTS +

*Ronald E. Alexander**

"Contrary to some early scientific expectation that fragments and parts of objects placed in orbit or otherwise sent to outer space would burn up in the atmosphere prior to reaching earth unless designed and made for reentry, some have fallen back to earth as solid pieces. Even though the incidence of damage has been low. . . as the number of objects put into outer space increases, the probability of damage from falling debris might increase."[1]

Although the semantics belie the potential tragedy which can result from such falling debris, the validity of the above quoted observation was irrevocably established on January 21, 1978 when the nuclear powered Soviet satellite fell from orbit into the Canadian forests.[2] Although Cosmos 954 grounded in a relatively unpopulated area, it could just as readily have impacted in a major urban area with the attendant injury and destruction to lives and property.

It has long been recognized that such space flights and exploration pose a risk not only for direct participants, but also for all those who remain earthbound.[3] This risk of injury has in turn produced a multitude of unresolved questions concerning liability. For example, who should bear liability for injury? Should that liability be dependent upon fault notions or be based upon strict liability? What interests should be protected? What remedies ought to be available to protect those interests? If the available remedies

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+ This article is an elaboration of the author's presentation at the University of Akron School of Law, May 2, 1978.

[1]U.S. Sen., Report, on The Convention on International Liability for Damage Caused by Space Objects Launched into Outer Space - Analysis and Background Data, 92d Cong., 2d Sess. 6 (1972). [hereinafter cited as Senate Rept.]

[2]Satchell, *Can Our Space Scientists Keep Skylab Aloft,* Akron Beacon Journal, May 7, 1978, at 4 (Parade Magazine).

[3]"Since injury or damage might result from a launching, flight and return to earth of various kinds of space vehicles or parts thereof, a number of problems exist with respect to defining and delimiting liability of the launching State and other States associated with it in the space activity *causing injury or damage.*" Report of the *Ad Hoc* committee on the Peaceful Uses of Outer Space of its 14th Sess., UN Doc. A/4141, July 14, 1959. (Emphasis added).

include damages, then how should such awards be measured? And finally, should damage liability be limited in amount?[4]

Some of these questions were initially addressed in the Outer Space Treaty.[5] That treaty established the general principle that the launching state has a liability for the injury caused to persons by its launched objects.[6] One progeny of the Outer Space Treaty, the Convention on International Liability for Damage Caused by Space Objects[7] was conceived to flesh out this principle: "to establish international rules and procedures concerning liability for damage caused by the launching of objects into outer space and to insure, in particular, the prompt and equitable compensation for damage."[8] Its legislative history evidences further an intent that the Liability Convention "contain provisions which would insure the payment of a full measure of compensation to victims and effective procedures which would lead to the prompt and *equitable settlement of claims.*"[9]

Although it is not the purpose of this paper to detail the Liability Convention's procedure for processing claims, it is important to note that the process contemplates settlement through diplomatic negotiations or via a Claims Commission. If diplomatic negotiations fail to produce a settlement, then the party States appoint a Claims Commission to process that claim.[10] Whether settlement is reached through diplomatic negotiations or as a result of the Claims Commission's determinations, the final award must achieve two goals specifically fixed by the Liability Convention: (1) compensation must be determined "in accordance with international law and the principles of justice and equity";[11] and (2) the damage award must "restore the person. . . to the condition which would have existed if the damage had not occurred."[12] The issue of applicable

[4] *See*, Senate Rept., *supra* n. 1 at 7.

[5] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies, Jan. 27, 1967 18 UST 2410, TIAS No. 6347.

[6] *Id.* at Art. VII. It has stated that "this principle . . . acknowledges the following varieties of the connection between the cause of damage and the State responsible for *compensation:* (1)launching (2)procuring the launching; and (3)putting the territory or facilities at the disposal for launching." Senate Rept. *supra* n. 1 at 8. (Emphasis added).

[7] Convention on International Liability for Damage Caused By Space Objects March 29, 1972 (1973) 24 U.S.T. 2389, T.I.A.S. 7762 (hereinafter cited as Liability Convention).

[8] G.A. Res. 2601B (XXIV) of Dec. 16, 1969.

[9] G.A. Res. 2733B (XXV) of Dec. 16, 1970. (Emphasis added). This principle was reaffirmed in G.A. Res. 2777 (XXVI) of Nov. 29, 1971.

[10] Art. XIV, Liability Convention.

[11] *Id.*, Art. XII

[12] *Ibid.*

law (that of the claimant State or the State with potential liability) was apparently a major hurdle to reaching a final draft of the Liability Convention. "Since no agreement was reached on the applicability of the national law of a single State, accord was finally reached on the general principles. . . that the compensation for damage 'shall be determined in accordance with international law and the principles of justice and equity, . . .'"[13] Even though the Liability Convention omits a rigid rule for resolving the question of applicable law, the statement of the two remedial goals may have mitigated the possible adverse consequences of this omission. By noting that compensation is to be determined by applying the principles of justice and equity, the drafters of the Convention have dictated that regardless of the applicable law ultimately selected during the award-fixing procedure, application of that law must achieve equity and justice.

The phrase "justice and equity" makes clear that the term "equity" is used in its popular sense to signify moral justice and not in an Anglo-American legal sense.[14] As one scholar has noted, in this "general juristic sense, equity means the power to meet the moral standards of justice in a particular case by a tribunal having discretion to mitigate the rigidity of the application of strict rules of law so as to adapt relief to the circumstances of the particular case."[15] Indeed, "the need of principles of discretion in applying legal precepts and remedies, of dispensing from strict application of rules under special circumstances or in unusual relations. . . is even more imperative under the complicated and involved relations and circumstances of an increasingly crowded world."[16]

What standard of compensation will do justice to an injured party in the event of injury from falling space objects? At least that measure which will fulfill the Convention's second remedial goal: a measure of relief which will restore the injured persons "to the condition which would have existed if the damage had not occurred."[17] Perhaps in recognition that the most likely injury resulting from a falling space object cannot be remedied by specific restoration of the *status quo ante,* the drafters of the Liability Convention elected instead substitutionary relief. That is, compensating the

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[13] *Senate Rept., supra* n. 1 at 19.

[14] *See,* de Funiak, Handbook on Modern Equity § 1 (2 ed. 1956).

[15] McClintock, McClintock on Equity 1 (2 ed. 1948).

[16] Neuman, Equity in Law: A Comparative Study 10 (1961).

[17] Art. XII, Liability Convention.

injured person for the injury to his person or property.[18] A third remedy not addressed in the Convention is the award of nominal damages in declaration of an injured person's rights.[19] The Liability Convention's silence as to nominal damages need not preclude their availability. The goals of equity and justice could permit an award-making tribunal to determine that the rights of an injured party had been wrongfully infringed by the space object's launching State.[20] The allocation of fault through such a declaration of rights would serve little purpose, however, in light of another provision of the Liability Convention.

That provision states that "[a] launching State shall be absolutely liable to pay compensation for damages caused by its space object on the surface of the earth. . ."[21] Neither negligence nor other standards of fault need be proven to produce a remedial recovery. All that need be established is the presence of the requisite damages. The Convention defines "damage" to mean "loss of life, personal injury or impairment of health, or loss of or damage to property of States or persons, natural or juridical, or property of international intergovernmental organizations."[22] In order to explore each of these several categories of "damage" to determine what measure of recovery would be sufficient to do justice and to also restore the injured person to the condition which would have existed but for the injury, assume that the space object landed on real property owned by Mr. Harry Smith. Both Mr. Smith and Mr. Bob Jones were standing on that property at the moment of impact by the space object. Both Mr. Smith and Mr. Jones sustained personal injuries as a result of the impact. Both were hospitalized and received medical treatment over the next several weeks. Mr. Smith eventually died from his injuries, survived by his wife and three minor children. Further assume that the launching state has absolute liability in this situation. But who is the proper claimant(s)? Had Mr. Smith lived, he could have asserted a compensable claim for his personal

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[18] "[T]he law of torts attempts primarily to put an injured person in a position as nearly as possible equivalent to his position prior to the tort. The law was able to do this only in varying degrees dependent upon the nature of the harm. Thus, where the plaintiff has been harmed in body or mind, money damages are no equivalent but are given to compensate the plaintiff for the pain or for the deterioration of the bodily structure. . .in other situations, as where there has been harm to earning capacity, the law can indemnify the plaintiff for pecuniary loss, such indemnity not being the exact equivalent but one which approximates the pecuniary harm which the injured person has suffered or is likely to suffer in the future." Restatement of Torts, § 901, comment *a.*

[19] *Id.* at §907. *See also,* York & Bauman, Remedies, Cases and Materials 2-3 (2d ed. 1973).

[20] The United States Supreme Court has very recently reaffirmed the importance of nominal damages as a vehicle for the declaration of rights of aggrieved persons. *Carey v. Piphus,* 98 S. Ct. 1042, (1978). The court also noted that an award not to exceed one dollar would accomplish this remedial goal. *Id.* at p. 1054. *See also,* Dobbs, Law of Remedies, § 3.8, (1973); McCormick, Law of Damages, §§ 20-22 (1935).

[21] Art. II, Liability Convention.

[22] Art. I(a), Liability Convention.

injury. Does that claim die with Mr. Smith? Or does the Liability Convention revive it? What of Mr. Smith's surviving family? May they bring an action for their injury resulting from the loss of his life?

Most states of the United States today resolve these questions by means of statutes ordinarily labeled wrongful death statutes and survival statutes.[23] Wrongful death statutes permit the surviving dependents to recover for their losses arising from the death, while a survival statute revives and vests in the decedent's estate the claim which the decedent could have asserted had he lived. A few states have so-called "hybrid statutes" which permit a measure of recovery equaling the combined recoveries permitted under both wrongful death and survival acts.

The Liability Convention does not tie the award for loss of life to the scheme of the particular state of the United States where a space object might impact. Thus a representative of the decedent's estate may recover as under a survival statute. Such an award could include compensation for the decedent's medical expenses between the time of injury and his death, for wages lost while unable to work as a result of the injury. for his funeral expenses, and perhaps for his pain and suffering. While the Liability Convention does not explicitly permit the recovery for the decedent's pain and suffering in the event those injuries subsequently cause his death, it does permit a recovery for "impairment of health" where a claimant suffers *personal injury*. Since impairment of *physical* health constitutes "personal injury," the Convention's reference to impairment of health must relate instead to impairment of emotional or mental health. This provision thus seems to permit recovery for the injured person's pain and suffering if he lives, and probably would allow a like recovery even when he subsequently dies of the injuries.

The injured person who subsequently dies from those injuries is not the only party who may suffer mental anguish as a result of his injury. A decedent's survivors also suffer grievous emotional anguish from their loss of a loved one. Once again the Liability Convention is silent concerning possible recovery for this type of "damage" or loss. Indeed, the Liability Convention does not address the broader question of whether a decedent's surviving family are proper claimants. Yet their loss is more immediate and real than that of the decedent's estate. If the deceased member was the wage earner for the family, then his demise may result in loss of family income, and the attendant financial support of his surviving spouse and children. Loss of inheritance is another element of injury suffered by the survivors. But for his death, the decedent may have left an estate to be inherited at his death by his family. Yet his untimely death will preclude this possible contribution.[24] The survivors may also have paid part or all of the decedent's medical expenses and even the funeral costs. Only if the survivors are

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[23] *See generally*, Dobbs, Remedies §8.2 (1973).

[24] *Id.* at§ 8.3.

permitted to recover these several measures of loss will the Liability Convention serve its goal of moral right.

In the above hypothetical both Mr. Smith and Mr. Jones suffered personal injury, a compensable damage under the Liability Convention. As already noted, the losses produced by personal injury may include medical and hospital expenses, and lost wages or lost earning capacity. Where the injured person fully recovers from his injuries, his lost income will be incurred for an identifiable fixed period. In some situations, however, the injury may be so debilitating as to permanently limit or altogether preclude further ability to work. The Liability Convention does not speak to such future damages explicitly, but it does contain a statute of limitations which contemplates situations where the "full extent of the damage may not be known."[25] It is unclear whether such situations will result in an extension of the time for an initial claim or merely an extension *after* filing for discovering the full extent of prayed-for recovery. What is made clear, however, is that the Convention does permit recovery of damages not fully measurable at the time a claim is asserted. This is precisely the circumstance of future damages. Thus, if an injured person can establish that his injury permanently impairs his ability to work, the Liability Convention may permit recovery of such future damages.

As already stated, the Liability Convention includes impairment of emotional or mental health as a compensable injury. Still remaining is the practical problem of measuring such a recovery. As has been noted by a prominent scholar "it seems clear that the damages for pain and suffering are not compensation in any ordinary sense that they make the plaintiff whole or replace what has been lost, since damages are not pecuniary and since there is no market in pain and suffering by which the damages could be estimated."[26] How this recovery will be measured is no more definitely defined by the Liability Convention than that it be just and equitable. The Convention's second goal of restoring the injured person to the condition which would have existed without the injury is clearly inapplicable since a money award can never restore an earlier emotional state of mind nor eradicate the memory of suffering.

Many times a person who has suffered personal injury will be partially compensated for his loss by some independent source. Whether that source is private insurance, a state compensation scheme, or from a private benefactor, such compensation also serves to partially restore the injured person to the position occupied prior to the injury. The Liability Convention does not address that situation where some collateral source may partially accomplish this same remedial goal of the Convention. Should all such collateral benefits be subtracted from the claimant's recovery under the Convention? Would justice be served by subtracting insurance benefits which had been derived from a policy which had been paid for by the injured person? Or should only those collateral

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[25] Art. X, Liability Convention.

[26] *See,* Dobbs, Remedies 545 (1973).

benefits be subtracted which were rendered by some source to which the injured person had neither paid nor contributed?

There is a fourth remedial measure not mentioned in the Liability Convention. This measure, punitive damages, has been defined as "damages, other than compensatory or nominal damages, awarded against a person to punish him for his outrageous conduct"[27] or to deter similar acts by others. While it is difficult to conceive that a diplomatically negotiated compensatory award would ever contain an agreed element of punitive damages, it is possible that a claims commission might consider the appropriateness of such a remedy.

It is generally agreed that punitive damages are awarded due to the wrongdoing party's culpable state of mind. The requisite degree of cuplability is often described as "malice." Malice is in turn generally defined as evil intent or reckless disregard of the rights of the injured person. The Liability Convention does contemplate a situation where one State may act with the "intent to cause damage."[28] The Convention provides that a launching state will be exonerated from absolute liability in the event that it can establish that the damage caused by its space object was really the result of the claimant State's act or omission done with intent to cause damage. The Convention further provides, however, that no exoneration can be granted "in cases where the damage has resulted from activities conducted by a launching State which are not in conformity with the international law including, in particular, the Charter of the United Nations and the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies."[29] If a claims commission were to refuse to exonerate a launching state for its failure to comply with such international law, that finding of failure would approach the standard of malice which is often sufficient to justify an award of punitive damages. If the claims commission further found that the purposes of punitive damages to punish or deter would be served, then that commission might well designate an award that included a measure of punitive damages. While such a measure might constitute a "damage" arising from the launching State's activity, it would certainly go beyond the remedial goal of restoration.[30]

The above stated hypothetical found Messrs. Smith and Jones standing on Mr. Smith's realty at the time of impact. Assume now that situated upon that land was a

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[27] *See,* Restatement of Torts §908 (1939).

[28] Art. VI ¶ 1, Liability Convention.

[29] Art. VI, ¶ 2, Liability Convention.

[30] *See generally,* Ghiardi, The Case Against Punitive Damages, 8 Forum 411 (1972); Hodgin and Veitch, Punitive Damages Reassessed, 21 Internat. & Comp. Law Quart. 119 (1972); Exemplary Damages in the Law of Torts, 70 Harv. L. Rev. 517 (1957); Prosser, Handbook of the Law of Torts 13 (4th ed. 1971); McCormick, Damages Chp. 10 (1935); 22 Am. Jur. 2d, Damages §261 (1965).

manufacturing business owned by Mr. Smith. Within that structure were various items of personalty which were integral to that business. If the falling space object injured or destroyed the structure containing the manufacturing business and contaminated the land so as to limit or preclude any future use, Mr. Smith will have suffered substantial additional injuries. The Liability Convention allows recovery for "loss of or damage to property" without limiting the property concept to either realty or personalty. Thus, destruction or injury to even intangible personalty would produce a compensable loss under the Convention. Again not stated is the measure of any such compensation.

If the total property is only injured, can the property owner recover an amount equal to the diminution of that property's market value, the cost of restoring the property to its prior condition, or may he recover the larger of the two amounts regardless of whether he in fact repairs the injury?[31] Can he also recover for the loss of use of this property?[32] That loss would occur during the period necessary to repair.

How will such loss be measured? Will that measurement be limited to the market rental value of the property, to the owner's particular use value, to the lesser of the two, or the greater?[33] May the owner also recover interest on the loss?[34] If so, will the interest accrue from the date of injury or some later date?[35]

If the property is totally destroyed, similar measuring questions are presented.[36] Does the owner recover the property's value as measured by his purchase price, by its market value on the date of destruction, or on the date of award? Can be also recover for loss of use? Even if lost use or profits? is compensable, for what period are they recovered? That is, must the owner attempt to minimize this loss by promptly starting

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[31] "In addition to damages for the diminution of the value of the subject matter or other similar element of damages, the plaintiff is entitled to recover for any loss of which the defendant's act is the legal cause, either because the plaintiff is unable to use the subject matter until it is repaired or replaced or otherwise." Restatement of Torts §928, comments *(b)* (1939).

[32] Dobbs, Remedies §§5.3 (loss of use of realty) and 5.11 (loss of use of personal property) (1973).

[33] *Id.* at 333.

[34] *Id.* at §3.5.

[35] *Id.*

[36] "When a chattel is damaged beyond repair and is treated as destroyed, the usual measure of damage is the market value of the chattel at the time and place of destruction with adjustments for salvage value." *Id.* at 375. (footnotes ommited). *See also, Id.* at 379 (measure of damages where personal property is damaged rather than destroyed). *See generally,* McCormick, Damages, Chp. 19 (1935) (injury to interests in personal property).

anew his destroyed business?[37] What if he lacks sufficient capital to initiate such an endeavor until compensated by the launching State?[38] Is his award then limited to that period when a sufficiently capitalized hypothetical owner could have begun this business afresh?

The purpose of this paper has been to identify some of the questions which may arise when first applying the Liability Convention's remedial scheme to an actual injury. While few answers are proffered to the several questions raised, it must be remembered that any answers to the Convention's remedy questions should be arrived at through application of its stated remedial goals. To do less would defeat the obvious intention of the drafters to do justice for the *injured persons* when fashioning individual awards.

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[37]"(1) Except as stated in Subdivision (2), a person injured by the tort of another is not entitled to recover damages for such harm as he could have avoided by the use of due care after the commission of the tort.

(2) A person is not prevented from recovering damages for a particular harm resulting from a tort if the tortfeasor intended such harm or adverted to it and was recklessly disregardful of it, unless the injured person with knowledge of the danger of such harm intentionally or heedlessly failed to protect his own interests." Restatement of Torts § 918 (1939). At least one court has held that the injured party may not recover for preventable loss that the injured party could have prevented but for his financial inability to do so. Brandon v. Capital Transit Co., 71 A. 2d 621 (Mun. Ct. App. D.C. 1950).

[38]For one court's holding that the injured party's financial inability to mitigate does not preclude recovery for otherwise preventable loss, *see,* Valencia v. Shell Oil Co., 23 Cal. 2d 840, 140 P. 2d 558 (1944).

SUBSTANTIVE BASES FOR RECOVERY FOR INJURIES SUSTAINED BY PRIVATE INDIVIDUALS AS A RESULT OF FALLEN SPACE OBJECTS +

Lawrence P. Wilkins *

Space vehicles and their fragments have been falling back to earth since we began putting them up. So far no serious injury has been reported. The recent Cosmos incident sparked interest in the problem of whether, in the event a space object does cause harm in its return to the surface, there are adequate regimes for recovery for that harm.

My treatment of the problem will focus upon three different space objects: one owned by the hypothetical nation of Norka; one owned by the United States Government; and one owned by a private U.S. corporation. The person harmed will be presumed to be a U.S. national. It will be further presumed that Norka, like the U.S., is party to the Outer Space Treaty and the Convention on International Liability for Damage Caused by Space Objects (hereinafter Liability Convention).[1]

Liability of Norka:

Our U.S. national (for convenience, we'll call him Nat) injured by the space object of Norka can benefit from the provisions of the Liability Convention if he can establish that:

(1) he was damaged;

(2) the instrumentality was a space object;

(3) the damage was caused by the space object;

(4) Norka launched, procured the launch, or was the state from whose territory or facility the space object was launched.

Once Nat has established these prerequisites, Norka is absolutely liable without limitation on amount for his injuries.

To clear the first of these hurdles, Nat (or his representative) must show that he has sustained''. . . loss of life, personal injury or other impairment of health; or loss of or

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+ This article is an elaboration of the author's address at the University of Akron School of Law, May 2, 1978.

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[1] Convention on International Liability for Damage Caused by Space Objects, March 29, 1972 (1973) 24 U.S.T. 2389, T.I.A.S. 7762 (hereinafter cited as Liability Convention).

damage to property. . ."[2] Professor Alexander has focused his attention upon the ramifications of "damage" and what it may mean in varying contexts, so I will resist the temptation to launch my own foray of injury. Suffice it to say here, that Nat will recover for the injuries he suffers, so long as those injuries are incurred to the interests in his bodily integrity and property identified in the definition of "damage."

But how does he *establish* his damage? The Preamble to the Liability Convention enunciates and purports to satisfy ". . . the need to elaborate effective international rules and procedures concerning liability for damage caused by space objects. . .," and yet, inspection of the body of the document reveals a gap in those rules and procedures. Article IX instructs Nat that his government will submit a "claim for compensation" to Norka through diplomatic channels, and Article XIV tells him that if the diplomatic negotiations fail, a Claims Commission will be established so that the merits of the claim can be decided. But nowhere does the Liability Convention elaborate upon what constitutes a claim, what items of proof are to be required, and how the allegations are to be evaluated in order to determine if "damage" has indeed occurred. *Compensation,* it is said in Article XII, is to ". . . be determined in accordance with international law and principles of justice and equity. . .". But there is only silence as to how the merits of the assertion by Nat that he has suffered *damage* are to be determined.

Similar problems exist with respect to the items that pertain to the merits of Nat's claim that an instrumentality of Norka was a space object and that the space object caused Nat's damage. The Liability Convention provides only that ". . .'space object' includes component parts of a space object as well as its launch vehicle and parts thereof." Perhaps "space object" has a sufficiently understood meaning common to international states which can be further clarified upon demonstration of need by reference to the draft definitions considered by the Legal Subcommittee, but it is curious that the opportunity to elaborate upon that definition to avoid some obvious problems was passed up by that body. For example, whether articles carried by space vehicles but not specifically designed to move in outer space are to be subsumed in the term was not made clear in the final document.[3]

How strict will the requirements of proof be that the instrumentality was a space object? In the event of complete destruction of the instrumentality upon impact, will it be presumed in favor of Nat that it was indeed a space object, or will the presumption run in favor of Norka? It would seem essential that these kinds of rules be elaborated in such an important document that was so long in coming.

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[2] Art. I, Liability Convention.

[3] *See,* Foster, *The Convention on International Liability for Damage Caused by Space Objects,* The Can. Y. B. of Int'l. L. 137, 145, (1972). [Hereinafter Foster] Convention on International Liability for Damage Caused by Space Objects - Analysis and Background Data, Staff Report prepared for use of the Committee on Aeronautical and Space Sciences, U. S. Senate 92nd Congr. 2d Sess. (1972) at 25 [hereinafter Staff Report].

There may also be a problem of establishing ownership. Article II requires that Norka be a launching state, and Article I defines a launching state to be one ". . .which launches or procures the launching of a space object" or one ". . . from whose territory or facility a space object is launched." Nat should encounter no substantial difficulty in establishing that Norka is a launching state under most circumstances.[4] The intention of the drafters in the definition of "launching state" may well have been to impose liability upon a broad class of states responsible for putting space objects into orbit that later fall and injure people, but the inclusion of ". . . *its* space object" in the Article[5] which actually imposes that liability puts a cloud upon the effectiveness of the language to carry out that intention. The inclusion of that unfortunate three-letter word of inconsistency may provide fertile ground for contention in a contested case.

My background as a teacher of the common law regarding injuries to persons, property, and relations makes the temptation to deal with the issue of causation for the remainder of my alloted space nearly irresistible. But there are other issues to be raised, so I must be content here to suggest that the Liability Convention is seriously deficient in its failure to elaborate upon such problems as:

(1) does "cause" mean *direct* cause, or does it refer to one of a series of elements in a sequential claim of factual events?

(2) does "cause" mean that the instrumentality contributed to the injury of Nat, or does it mean that the instrumentality caused the event which ultimately resulted in Nat's injury?

(3) can Nat establish "cause" simply by showing he was in proximity to the space object when his injuries were incurred, or must he show that he sustained some physical impact with the object?

(4) will Norka escape if some "greater cause" was involved; does Nat have to negate such a possibility in his claim, or can he require Norka to establish the "greater cause" as a matter of affirmative defense?[6]

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[4] *But see,* Foster, *supra,* at 163-168.

[5] Art. II, Liability Convention.

[6] This question is at least partially answered by Article VI which would allow Norka to be exonerated from absolute liability if it ". . . establishes that the damage has resulted either wholly or partially from gross negligence or from an act or omission done with intent to cause damage on the part of a claimant state or of natural or juridical persons it represents." Query: does it exonerate from liability altogether, or simply from *absolute* liability; does it exonerate from liability to Nat in the event some other person represented by the U. S. besides Nat has engaged in the gross negligence or intentional conduct?

Hoping to have established that the liability of Norka, while *potentially* absolute and unlimited, is far from clear-cut, our attention may turn now to Nat's problems when he is injured by a U.S. space object.

Liability of the U.S. Government:

Since the Liability Convention excludes its coverage from situations where the damage is caused by a launching state to one of its nationals,[7] if Nat is injured by a fallen U.S. space object he must seek redress through other mediums. And, since the tradition of governmental immunity under our system of justice maintains that the government may not be sued without its consent, those mediums for recovery are carefully delineated. If Nat is equally as careful in his attempt to establish that his claim conforms to those delineations, he may obtain recovery.

The Federal government has given its consent to be sued for ". . . money damages. . .for injury or loss of property, or personal injury or death caused by the negligent or wrongful act or omission of any employee. . .".[8] A serious difference between Nat's position vis-a-vis his own government and that with respect to Norka is immediately made apparent; Nat has to prove fault to recover here. The words of the statute "negligent or wrongful act" have been interpreted to mean that liability will be imposed only upon the theory that the employees of the government have failed to exercise ordinary care or have engaged in some other conduct constituting misfeasance or malfeasance.[9] The magnitude of this hurdle in a space object accident is superlative. Nat will have to focus upon specific conduct, in the myriad of human activity that is involved with space operations, and establish that it was sufficiently faulty to make the U.S. government answerable. That task is by no means made easier by the fact that much of the human activity involved and the documentation of it are controlled by tight security measures, limiting Nat's access for discovery purposes. Internal procedures are so well developed that the government is well on the way from the outset toward rebutting Nat's claim that the employees failed to exercise ordinary care. Whatever strength Nat's case may have in sympathies for "the injured citizen against the cold, insensitive government" is lost because the trial of such cases is without a jury.

Even supposing that Nat has successfully overcome the obstacles in establishing negligence, his claim may still fail under the statute if the negligence is deemed to have been the exercise of a *discretionary* function of the employee that committed that act of

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[7]Art. VII, Liability Convention.

[8]28 U.S.C.A. § 1346(b), the Federal Tort Claims Act.

[9]See, *Dalehite v. United States,* 346 U.S. 15 (1953); *Laird v. Nelms,* 406 U.S. 797 (1972). This fault requirement is applicable to the administrative remedy that Nat must pursue prior to actual litigation. Section 2675, requires that he submit his claim to the appropriate agency for determination, and that such a claim be denied by that agency before suit can be brought. Section 2672 places a $25,000 ceiling upon awards to be made under this procedure, without prior approval of the attorney general.

negligence.[10] The closer the act that Nat claims to have been the operative negligent act causing his injury comes to being a policy decision, as opposed to a decision involving the operation of the activity pursuant to that policy, the greater the possibility that it will be considered by the court to be a discretionary function, barring Nat's recovery.[11]

Analysis of the decisions dealing with this exclusion from liability teaches that, while generalizations such as that just stated may assist in predicting the outcome of Nat's claim on the basis of what conduct he asserts to be negligent conduct, precision is far from at hand when it comes down to the actual determination of whether the act is nonactionable under the discretionary exclusion. For example, if Nat were to claim that the failure to warn him prior to the accident was the *sine qua non* of his injury, the application of the exclusion may well turn upon the persuasiveness of the argument concerning the existence of an obligation to warn. The facts of the particular case under review may be sufficiently persuasive to impose a "duty to communicate. . . adequate warning of existing foreseeable hazard," the failure of which to exercise might constitute actionable "operational mismanagement."[12] On the other hand, the failure to warn may be determined to be a "discretionary decision. . . that such notice was impractical or would interfere with the carrying out of the project or would involve wasted time without justification."[13]

Nat's claim will be fraught with the same difficulties if he tries to establish faulty conduct involving the very decision to engage in the project. The sonic boom cases provide illustrations of court decisions that have gone both ways on the question of whether such projects involved discretionary decisions.[14]

Nat has other options under federal law, however, in seeking redress for his injuries in order to avoid the difficulties presented by the Federal Tort Claims Act and its limiting provisions. Where the injuries have arisen from the ". . . conduct of the [National Aeronautics and Space] Administration's functions. . .",[15] Nat may submit

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[10] 28 U.S.C.A. § 2680 (a).

[11] This is a gross oversimplification of an extremely complex and troublesome aspect of the Federal Torts Claims Act, but it must suffice for the purposes of this paper. For more detailed discussion of the problems created for persons in Nat's position, *see,* 2 L. Jayson, Handling Federal Tort Claims: Administrative and Judicial Remedies (Chp. 12 1978) [hereinafter Jayson].

[12] *United States v. State of Washington,* 351 F. 2d 914, 91 (9th Cir., 1965) where decedents were killed when their plane flew into power lines across a valley not marked by warning devices. *Cited* in Jayson, *supra,* note 10, at 12-83 n. 12-1.

[13] *Bulloch v. United States,* 133 F. Supp. 885, 888, 889 (Utah, 1955), where claimants' sheep were allegedly killed by radiation from nuclear testing. *Cited* in Jayson, *supra,* note 10, at 12-84 n. 13.

[14] *See,* Jayson, *supra* note 10, at 12-120-12-124.

[15] 42 U.S.C.A. § 2473 (b) (13) (A).

his claim for personal or property injury, or death, to NASA for special administrative determination and settlement by that agency.[16]

Under this administrative claims procedure, Nat can avoid the requirement of proving that the injury was caused by the fault of federal employees. So long as he establishes that the injury arose out of the conduct of the agency's space programs, he can avail himself of the theory of strict liability. Claims procedure, evidentiary standards, scope of review, and investigatory procedures are spelled out in some detail by the agency's regulations.[17]

The administrative scheme of recovery is not without its drawbacks, however. The power of the agency to pay claims is limited to $5,000.00.[18] In the event of serious injury exceeding this amount, Nat would be forced to undergo the rigors of the requirements of the Federal Tort Claims Act. The agency may mitigate this effect if it decides Nat's claim is meritorious by submitting the claim to Congress for its consideration.[19]

The consideration of Congress just mentioned is the remaining scheme of recovery for Nat under the circumstances of injury by a U.S. space object. It becomes operable, however, only after Nat has exhausted his other available judicial and administrative remedies. By private bill, the Congress has unlimited power to provide redress for Nat's injuries. For example, it may simply provide for payment of a definite sum, it may remove monetary limits from the agency's power to determine and settle Nat's claim, or shape relief in some other form.[20]

Liability of the Private U.S. Corporation:

The situation involving injury by a space object owned by a private U.S. corporation presents further complexities to Nat's attempt to obtain redress. The Liability Convention does not address itself to the accountability of such entities to persons injured by fallen space objects. This is a serious omission in light of the fact that the Outer Space Treaty places responsibility upon parties to that treaty for space activities whether the acting entity is governmental or nongovernmental,[21] and in light

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[16]This administrative procedure is independent of the claims procedure required by the Tort Claims Act, § 28 U.S.C.A. 2675. The claimant may select from the two statutes as alternatives. Failure to designate the statute under which the claimant is submitting a claim allows the agency to treat the matter under either. *See,* Jayson, *supra,* note 10, at 1-90.

[17]14 C.F.R. §§ 1204.900-.915, covering claims accruing on or after Jan. 18, 1967.

[18]42 U.S.C.A. § 2473 (b) (13) (A).

[19]42 U.S.C.A. § 2473 (b) (13) (B).

[20] *See,* Jayson, *supra,* note 10, at 1-164.

[21]Art. VI, Outer Space Treaty.

of the avowed purpose of the Liability Convention to "elaborate effective international rules" on the matter. Arguably, Nat could impose the responsibility of the Outer Space Treaty through the medium of the Liability Convention upon a launching state if the launching state was a party to both documents (and if the launching state was some state other than the U.S.). But what if the launching state was not party to one or both of the agreements?[22] Furthermore, even where the launching state is party to both, the problem of the language ". . . *its* space object" in Article II of the Liability Conventions crops up again.

If Nat decided to proceed against the corporation instead of the launching states on a theory of negligence, he faces the very difficult task of establishing a *prima facie* case. As mentioned in previous discussion, penetrating the extremely complex technical features of the defendant's space activities to identify the culpable conduct with specificity would be difficult, time-consuming, and require the services of people qualified to make the investigation, all of which would make the preparatory work quite expensive. A much better theory to proceed upon would be strict liability.

There seems to be considerable agreement that space activities are of the type of high-risk activities upon which a foundation for the imposition of strict liability can be grounded,[23] but the matter cannot be treated as a foregone conclusion at litigation where the matter would be one of first impression. Again, constraints require brevity and over-simplification, but in addition to having to prove damage and causation as in all the other schemes for recovery, Nat would carry the burden of persuading the court and jury that the activity is one in which the imposition of strict liability is justified. The American synthesis of this principle, enunciated in the leading case of *Rylands v. Fletcher* [24] over one hundred years ago, is contained in the Restatement of Torts 2nd, Sections 519 and 520. Those sections, representing a distillation of the American case law impose strict liability where the activity is determined to be "abnormally dangerous." A court considering Nat's claim, and following the Restatement formulation, would make the determination of whether the defendant's space activities were "abnormally dangerous" by reference to several criteria:

(a) Whether the activity involves a high degree of risk of some harm to the person, land or chattels of others;

(b) Whether the gravity of the harm which may result from it is likely to be great;

(c) Whether the risk cannot be eliminated by the exercise of reasonable care;

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[22] *See,* Foster, *supra,* note 2, at 164.

[23] See Foster, *supra,* note 2, at 150-154; Staff Report, *supra,* note 2, at 26.

[24] *Fletcher v. Rylands,* L.R. 1 Exch. 265 (1866); *Rylands v. Fletcher,* L.R. 3 H.L. 330 (1868).

(d) Whether the activity is not a matter of common usage;

(e) Whether the activity is inappropriate to the place where it is carried on; and

(f) The value of the activity to the community.

In evaluating those criteria, it is apparent that each involves the application of value judgments regarding the defendant's activities. In reaching the ultimate conclusion the weight to be given each of the criteria will vary according to the strength of the value judgment accorded to each. From Nat's point of view, criteria (d) through (f) are troublesome. It is not at all apparent that a finder of fact would not attach overriding weight to the importance of space activities and require that Nat bear the risk of injury.

Even assuming that Nat would be successful in imposing a strict liability standard against the corporation, he still faces some extreme difficulty in establishing cause. The imposition of strict liability is nowhere considered to be simply a matter of making the defendant the insurers for plaintiffs' injuries. Because of the involvement of the launching state in actually putting the space object into orbit, the causative factors are multiplied and complicated. The more causative factors present, the greater the number of opportunities for the corporation to escape accountability.

As a final illustrative hypothetical, consider the problems that might be presented if all three of our different types of space objects were involved in the same accident. Suppose that through some negligent act, the private corporation caused the orbit of its space object to rapidly decay. Suppose further that the U.S., after obtaining operational status with the Space Shuttle program, attempted to "rescue" the private space object by bringing it back to earth. As the Space Shuttle began its descent, it encountered the space object of Norka. Recognizing that his reentry attitude would be jeopardized if he made adjustments to avoid the Norka space object, the commander of the Space Shuttle decided to take his chances of missing the Norka craft, since Space Shuttle is many times the size of the former. A collision occurred, the force of which was not anticipated by the commander. The impact causes: (a) the Norka space object to fall from orbit; (b) the corporation's space object to be jarred loose from the space Shuttle and fall from orbit, and; (c) the Space Shuttle to fall uncontrollably to the surface of the earth. All three objects' crashes produce "damage" to Nat the sense contemplated by the Liability Convention.

With all of the substantive bases for recovery available, and three separate respondents available, it would seem that Nat stands a very good chance for full recovery. A closer look reveals otherwise.

First of all, Nat's claim against Norka will be vigorously defended on the basis that its space object did not "cause" Nat's damage. Norka's representatives will argue that "caused by its space object" calls for application of the *sine qua non test:* but for the

acts of the Space Shuttle commander and the corporation's employees, Norka's space object would have remained in orbit. They may also argue that Article VI operates to exonerate them on the grounds that the Space Shuttle commander's decision amounted to gross negligence, since it constituted a reckless disregard for the property and passage rights of Norka.

As to the claim against NASA, Nat will have to prove fault as to any damages in excess of $5,000.00. Even if he is successful in that regard, it is still open to question whether the decision of the Space Shuttle commander was sufficiently discretionary to exonerate NASA from liability under the Federal Tort Claims Act.

IF Nat proceeds against the U.S. corporation, he faces the difficulties of proving negligence, or convincing the court to apply a strict liability standard. Even if successful in either respect, the corporation will, of course, argue vigorously, and with merit, that the acts of the Space Shuttle commander constituted an intervening causative factor which should absolve the corporation from liability.

So, it appears that considerable doubt remains as to the efficacy of each of the regimes discussed in protecting persons injured as a result of fallen space objects. In light of the very real possibility of future accidents brought to light in the wake of the recent Cosmos incident, attention must be given internationally and domestically to insure that it will not be the innocent injured person that bears the risk of such injuries.

THE LEGAL STATUS OF GEOSTATIONARY ORBIT: SOME REMARKS

*Andrzej Gorbiel**

A. Introductory Remarks

Incessant progress of the space science and technology produces new possibilities for the use of outer space and as a result the need for new legal regulations has arisen. A significiant example of this is the problem of the use of the so-called geostationary orbit.

The geostationary orbit is a circular orbit located at a distance of about 35,800 kilometers over the earth's equator. A satellite placed in this orbit turns about the polar axis of the earth in the same direction and with the same period as that of the earth's rotation. The positioning of artificial satellites in the geiostationary orbit is now of great practical importance for telecommunications. But, it is expected that this orbit will be used in the near future for several other applications.[1]

The question of utilization of the geostationary orbit is complicated by the fact that due to technical considerations, the number of artificial satellites, which may be placed in it without causing mutual interferences, is limited.

The first artificial satellite, Syncom 2, was placed in geostationary orbit by NASA on the 26th of July 1963. By July 1977 the total number of geosynchronous satellites reached about one hundred. In the opinion of several experts in space technology, no more than 180 space objects can be placed in geostationary orbit.[2]

The important task of developing an adequate system for the utilization by different States of the geostationary orbit was undertaken by the International Telecommunication Union. The matter was also discussed in detail at the World Administrative Radio Conferences at Geneva in 1971 and 1977. The Final Act of the latter, signed on 13 February 1977 by the representatives of 106 countries, contains a plan assigning positions in the geostationary orbit for broadcasting satellites and

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[1]See L. Perek, Physics, Uses and Regulation of the Geostationary Orbit, or, *Ex Facto Sequitur Lex.* Doc. IAF-SL-77-44, p. 20-22.

[2]Some other experts consider this maximum number to be greater.

frequency channels in the 11.7-12.2. GHz band to States in the ITU Region 1 (Europe and Africa) and 3 (Asia).[3]

The juridical aspects of the utilization of the geostationary orbit has been previously treated in space law literature.[4] But with the advent of claims to exclusive sovereignty by equatorial countries over segments of this orbit, it has become the focus of heated discussion.

B. Claims of the Equatorial Countries

It was Colombia which during the thirtieth session of the United Nations General Assembly in October 1975 first laid claim to a segment of the geostationary orbit lying over its national territory. The representative of Colombia argued that this segment is a part of the territory of his country and that "it is not included in the conception of outer space alluded to in the Treaty on Principles Governing The Activities of States in The Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, signed in January 1967".[5]

This stand of Colombia was again expressed during the next session of UN General Assembly in 1976. At the same thirty-first session an analogous position was taken by Ecuador[6] and Panama.[7]

On November 29, 1976 a special conference of eight equatorial countries convened in Bogota, Columbia. This conference ended on December 3, 1976 with the signing of a common Declaration setting forth in a systematic and detailed manner these nations' position on the legal status of the geostationary orbit.[8]

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[3]This Act will enter into force on January 1, 1979. For the ITU Region 2 (Americas) an interim plan was adopted for the period pending the adoption of a more detailed plan by a Regional Administrative Radio Conference to be held no later than 1982.

[4]See J. Busak, Geostationary Satellites and the Law, Telecommunication Journal (No. VIII, 1972); M. G. Marcoff, Traite de droit international public de l'espace, 64, 232, 618, n. (Fribourg, 1973); B.G. Dudakov, Pravovye problemy ispolzovanya orbit dla iskustvennych sputnikow Zemli, "Sovietskoje Gosudarstvo i Pravo" 78 (No. 4, 1973), n.; G. C. Merckel, The Direct Broadcast Satellite: The Need For Effective International Regulation, 2 Syracuse J. Int'l L. and Commerce 111 (1974).

[5]UN Doc. A/C.1/PV.2052, pp. 45-46.

[6]UN Doc. A/C.1/31/PV.10, pp. 37-38.

[7]UN Doc. A/C.1/31/PV.10, pp. 81-82.

[8]The representative of Brazil signed the Declaration as an observer. For a text of the Declaration, see EL ESPECTADOR (Columbia), December 7, 1976, p. 13A. For the English translation see ITU, Broadcasting Satellite Conference, Doc. No. 81-E (January 17, 1977). 6 J. Space L. 193.

As a starting point the signatories state that "the geostationary synchronous orbit is a physical fact linked to the reality of our planet because its existence depends exclusively on its relation to gravitational phenomena generated by the earth and that is why it must not be considered part of the outer space". This basic statement leads them to the principal point of the Declaration - a proclamation of their national sovereignty over the respective segments of the geostationary orbit as being their "natural resource". Positioning of devices in these segments shall require - according to the Declaration - "previous and expressed authorization on the part of the concerned State".[9]

The next paragraphs of the vast document try to explain the motivation for this advanced claim.

C. Arguments of the Equatorial Countries

The first argument deals with the assertion that the rights of equatorial countries to treat segments of the geostationary orbit as being under their national sovereignty is founded on the fact that these segments, linked with their terrestrial territories by earth's gravitation, constitute one of the natural resources which the Resolutions of the United Nations General Assembly has recognized as belonging to States and especially to the developing countries as part of their "full and permanent sovereignty".[10]

The second argument is formulated by way of deduction from the Space Treaty of 1967. The geostationary orbit may be considered as being not a part of outer space in the meaning of this Treaty because this Treaty had not established a definition of outer space. From this lack of such a definition, the signatories of the Bogota Declaration draw a conclusion that Article II of the Treaty, forbidding any national appropriation of outer space, does not apply to the geostationary orbit.

It is characteristic and somewhat confusing that the Bogota Declaration of December 3, 1976 uses the Space Treaty of 1967 for drawing the above mentioned argumentation and contests its value by saying that it "cannot be considered as a final answer to the problem of the exploration and use of outer space". This is particularly so since its text was "elaborated when the developing countries could not count on adequate scientific advice and were thus not able to observe and evaluate the omissions,

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[9]As to the segments of the geostationary orbit over the open sea the equatorial countries declared that they consider these segments as the "common heritage of mankind" since they are beyond the national jurisdiction of states. *Ibid.*

[10]On this point, the signatories of the Declaration quote the UN General Assembly Resolution 2692/XXV on. "Permanent sovereignty over the natural resources of developing countries and expansion of domestic sources of accumulation for economic development" and the UN General Assembly Resolution 3281/XXIX on "The Charter on Economic Rights and Duties of States". *Ibid.*

contradictions and consequences of the proposals which were prepared with great ability by the industrialized powers for their own benefit''.

D. Discussion in the UN Outer Space Legal Subcommittee

The equatorial countries reitereated their claims to parts of the geostationary orbit at the ITU World Radio Conference held at Geneva in January-February 1977. Several States participating in this Conference made formal declarations that ''the assignment of positions in the geostationary orbit for broadcasting satellites are fully in conformity with the generally recognized principles and rules of international law''.[11]

In the United Nations Outer Space Legal Subcommittee the question was debated for the first time during its Sixteenth Session held in New York from March 14, to April 8, 1977. It was debated in connection with two agenda items: ''Elaboration of principles governing the use by States of artificial earth satellites for direct television broadcasting'' and ''Matters relating to the definition and/or delimitation of outer space and outer space activities''.

Three equatorial countries; Colombia, Ecuador and Guyana which at the time were not members of the UN Committee on the Peaceful Uses of Outer Space and of its Scientific and Technical, and Legal Subcommittees obtained at their request the right to attend the formal meetings of the latter.[12]

The most extensive statement on behalf of the equatorial countries was that of the Colombian representative Mr. E. Gaviria who presented in detail the position of the signatory States of the 1976 Bogota Declaration. He proposed to convene a special international conference for considering ''with the proper care and seriousness the definition of outer space and the special regime called for by phenomenon of the geostationary synchronous orbit''. Maintaining that the proclamation of the national sovereignty over segments of the geostationary orbit is not contrary to the provisions of the 1967 Space Treaty, the Colombian delegate contended simultaneously that this Treaty ''did not take account of the interests of the developing countries'' and sought rather to ban the use of space for military purposes than to deal appropriately with the phenomenon of telecommunications.[13]

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[11]See ITU, Broadcasting Satellite conference Doc. 266/Rev. 1/-E.

[12]UN Doc. A/AC.105/C.2/SR. 266, p. 2.

[13]UN Doc. A/AC.105/C.2/SR.77, p. 2-4. The representative of Colombia also reproached the UN Outer Space Legal Subcommittee that it served ''the interests of the highly industrialized states, harmed those of the developing countries''. This reproach produced a firm opposition on the part of Mr. B. G. Maiorski, representative of Soviet Union, who rightly stated that the Subcommittee acted in accordance with the principle of consensus and ensured that the views of all countries, both developed and developing, received an equal hearing and equal respect. *Id.* at 5.

Ambassador M. A. Albornoz from Ecuador stated that a rejection of the claims of equatorial countries would lead to "a neocolonialism of outer space". He compared these claims to national sovereignty over segments of the geostationary orbit with those concerning the admitted jurisdiction of the coastal States over the maritime economic zone.[14]

The juridical analogy with the legal status of the maritime economic zone was also invoked by the Indonesian delegate Mrs. I. M. Damanik who proposed to conclude a treaty stipulating "the granting of priority to equatorial states in the use of the geostationary orbit".[15]

The representative of Kenya Mr. J. Simani emphasized the urgent need of the formulation of a definition of outer space taking "into account the special position of equatorial countries with respect to the geostationary orbit forming part of their natural resources".[16]

The position of equatorial countries produced criticism by a number of delegations of member States of the United Nations Outer Space Legal Subcommittee. But their statements in this matter had a general and preliminary character without detailed analysis of the various juridical aspects and implications of the problem. The delegate of the Soviet Union, Mr. B. G. Maiorski, said the geostationary orbit is inseperable from outer space and the location of States did not creat any right of ownership to it or to any segment of it.[17]

The author of this paper, acting as the representative of Poland, stated that the geostationary orbit forms an integral part of outer space and "unquestionably comes under the provisions of Article II of the Treaty of January 27, 1967" and that it "could not be subject to the exclusive sovereignty of States".[18]

More extensive pronouncements were made by the delegates of the United Kingdom and United States.

Mr. A. M. Greenwood, head of the British delegation, rightly pointed out that the claims of equatorial countries were vague as to the question of whether or not these countries claim part of the geostationary orbit as a slice taken out of the rest of outer

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[14]UN Doc. A/AC.105/C.2/SR.272, p. 3.

[15] *Id.* SR.272 at 6.

[16] *Id.* SR.280 at 2.

[17] *Id.* SR.282, at 3. A more detailed presentation of the Soviet position in this matter is contained in UN Doc. A/AC.105,L.94.

[18]UN Doc. A/AC.105/C.2/SR.277, p. 2.

space or whether their claims included the whole of the space segment between the underlying country and the geostationary orbit.[19]

Mr. D. P. Stewart, United States delegate, criticized with insight the assertion that the legal admissibility of the national appropriation of the geostationary orbit is based on its dependence on earth's gravitation.[20]

It is expected that the seventeenth session of the UN Outer Space Legal Subcommittee to be held at Geneva in 1978 will have a more detailed and complete discussion of the matter.

E. Claims of National Sovereignty over the Geostationary Orbit and International Law

An adequate juridical evaluation of the international legal status of the geostationary orbit begins with an adequate statement of its real essence.

The signatories of the 1976 Bogota Declaration classify the geostationary orbit as "a physical fact" depending exclusively on the earth's gravity. This approach is an improper one. In reality the geostationary orbit is nothing more than one of the possible trajectories of the artificial earth satellites.

The space technology experts agree that the position of an artificial satellite in geostationary orbit is dependent on several factors such as: the launch and station-keeping propulsion, the attraction of the earth, the moon and the sun, and the solar radiation pressure.[21] Therefore the force of the earth's attraction is merely one of the elements determining the maintenance of an artificial satellite in the geostationary orbit, but it is not the only one.

It is quite nonsensical to maintain that the alleged rights of a sovereign over segments of the geostationary orbit derive from the action of the gravitational force of the terrestrial territories belonging to equatorial countries. The force of the earth's gravity derives from the mass of the whole of our planet and the sub- division demanded by the equatorial countries is unfeasible and preposterous.

The rejection of this argument of the signatory States of the 1976 Bogota Declaration also overturns the thesis that parts of the geostationary orbit constitute their "natural resources".

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[19] *Id.* SR.269, at 8.

[20] Press Release USUN-18/77 (April 7, 1977).

[21] A highly precise description of these factors determining the position of the geostationary satellites in orbit was given recently Professor Lubos Perek, Chief of the United Nations Outer Space Affairs Division, in his above cited paper.

The remaining principal plea in the position of the equatorial countries is seeking a juridical base for the admissibility of national appropriation of segments of the geostationary orbit in the absence of an outer space definition or delimitation in the text of the 1967 Outer Space Treaty. This plea is juridically pointless, too.

The fact that the 1967 Treaty failed to define the scope of the term 'outer space' is not tantamount to the impossibility of determining this scope in a general manner by way of deducing it from the Treaty's provisions, as a whole.

The main intent of the Treaty was to institute a set of international legal principles governing the activities of States in the exploration and use of outer space. This use encompasses objects launched into outer space and in particular artificial earth satellites placed in orbit around the earth. Therefore, implementation of the 1967 Treaty is possible on the assumption that its provisions concern those regions of space in which the artificial earth satellites are placed. The acceptance of an opposite assumption deprives the 1967 Treaty, and other international conventions based on it, of a reason for their existence.

An admission that Sates have a right to decide at choice which parts of space above the earth they will treat as outer space under the rule of the 1967 Treaty will be tantamount to a recognition of total arbitrariness inconsistent with the essence of international legal order.

One should conclude that the legal status of the geostationary orbit cannot be different from that of the whole outer space and in consequence any national appropriation of it is inadmissible.

AN INTEGRATED LEGAL SYSTEM FOR SPACE +

by
Hamilton DeSaussure *

Currently there are 560 space shuttle operations planned through 1992.[1] If each of these operations were to carry a six-man crew, 3,300 astronauts would be launched into space before the end of this century. While the space shuttle is the only means of space transportation now being geared up for operational use, plans are being considered for other methods of low cost access to the vast regions beyond the earth's atmosphere. As cheaper transportation provides greater access to space, entry into space by commercial firms is certain to expand.[2] Some experts predict space industry revenues will reach $20 billion annually by the year 2000.[3] Products and processes already being considered are: satellites (for communication, remote sensing and solar power), crystal growth, pharmaceuticals, alloying of metals and ball bearings, electronic components, and ultrapure exotic materials that can be produced in zero gravity.[4] A recent survey shows that a sizeable selection of U.S. companies are already contemplating spaceborne activity. Boeing has conducted a study for NASA that involves converting the sun's rays to electrical power and beaming them to earth. The plan would require scores of shuttle flights to build a construction base in space and would require a five hundred man construction crew for about a year to build a solar power satellite.[5] In a more conjectural vein, Professor O'Neill of Princeton proposes a beachhead manufacturing plant in space with a large factory of workers living within a one-mile circumference of the plant.[6] It is

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+ This paper is based on a presentation by the author at the 1977 Annual Meeting of the American Astronautical Society in San Francisco.

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[1]Hearings on H.R. 2221 Before the House Subcommittee on Space Science and Applications of the Committee on Science and Technology, 94th Cong., 2d Sess., (1976) [1 1978 NASA Authorization, 394 (1976)] (hereinafter cited as 1978 NASA Authorization).

[2]1966 proposal for a "skyhook"; a cable from a satellite in geostationary orbit to earth. Payloads would be sent up the cable mechanically: Hearings Before the House Subcommittee on Space Science and Applications of the Committee on Science and Technology, 94th Cong., 1st Sess. (1975) (*Future Space Program 1975*, 198 (1975).

[3] *"The Shuttle Opens the Space Frontier to U.S. Industry," Bus. Week,* August 22, 1977, at 49.

[4]The most important system being considered by NASA is the Space Construction Base, *see* 1978 Authorization at 399. This space station would serve for a ten year study of space industrialization and satellite power generation. *Id.* Also being studied are: large structures in orbit via the shuttle and development of Heavy Lift Launch Vehicles. *Id.* at 400, 415.

[5] *Akron Beacon J.*, February 1, 1978, at 2.

[6]. *New Scientist,* June 23, 1977, at 720.

entirely possible that the number of persons, including scientists, engineers, and other members of the labor force, who cross the threshold into space before the end of this century may exceed present estimates by the tens of thousands.[7]

As we penetrate the space frontier in large numbers, the legal problems which confront us on earth will also ascend into the space environment. Human activity cannot long endure in a legal vacuum. Affairs in space will have to be subject to the same complex legal regime which exists on earth. An established order brings stability to human conduct and provides the predictability so needed to promote human progress and maintain harmonious relationships.

The foundation for such a legal regime has already been set forth in such documents as, the Outer Space Treaty of 1967,[8] the Treaty on the Rescue and Return of Astronauts and Return of Space Objects of 1968,[9] the Convention on Liability for Damage Caused by Space Objects of 1972[10] and the Convention on Registration of Space Objects of 1975[11]. Some of the fundamental principles provided therein are that in outer space: international law applies;[12] there can be no national appropriation by claim of sovereignty or by use or by occupation;[13] and states bear international responsibility for their national activities.[14] Also provided is that the activities of nongovernmental entities require the authorization and continuing supervision of the appropriate state, and that jurisdiction and control over space launched objects and the

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[7]Prof. Gerard K. O'Neill believes a beachhead manufacturing plant in space could be built well before the turn of the century which could build one new colony every two years. He estimates that this could lead to as many as 200,000 people living in space by the year 2000. Lutz-Nagey, *"Gerry O'Neill and His Solar-Powered Space Factory", Automation,* July, 1976, at 22.

[8]The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (hereinafter referred to as the Outer Space Treaty) was signed on January 27, 1967 and entered into force October 10, 1967 [1967] 18 U.S.T. 2411, T.I.A.S. 6347, 610 U.N.T.S. 205.

[9]Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space, April 22, 1968, [1968] 19 U.S.T. 7570, T.I.A.S. 6599, 67 U.N.T.S. 119 (hereinafter cited as Rescue and Return Agreement or Rescue Agreement).

[10]Convention on International Liability for Damage Caused by Space Objects, March 29, 1972 [1973] 24 U.S.T. 2389, T.I.A.S. 7762 (hereinafter cited as Liability Convention).

[11]Convention on Registration of Objects Launched into Outer Space, January 14, 1975_____U.S.T._____, T.I.A.S. 8480. See also Hearing before the Subcommittee on Space Science and Applications of the House Committee on Science and Technology, 94th Cong., 2d Sess. (1976).

[12]Outer Space Treaty, Art. III.

[13]*Id.* Art. II.

[14]*Id.* Art. VI.

personnel therof, while in outer space, remains with the launching state.[15] These principles are a foundation, but only a foundation, for the web of intricate rules which must accompany any sustained and concentrated use and exploration of the realms beyond this earth.

Broadly speaking, there are two views as to how law may emerge for outer space. One view is that this new arena for human endeavor is so vast, so potentially hostile, and so unique that a completely new, perhaps even revolutionary, legal system is necessary. As early as 1961, this view was raised. At that time Ambassador Jha of India was asked whether merely overlaying international law on outer space would suffice. He wrote:

> When the day comes that men of various nations, through international cooperative efforts, journey into outer space, the concepts of nationality, territorial affiliations, (and other concepts) should perhaps be forgotten and will be out of place in outer space. International law may need radical adaptation, conceptual or otherwise, for application to outer space.[16]

The other view is that existing terrestrial laws should be adapted to the space environment without any radical break. A soviet author, Academician E.G. Vassilevskaya, has stated that the expansion of space activities from pure science to the applied use of outer space makes it necessary to develop further "the law-making activity in the exploration and use of outer space."[17] Whichever view one takes, however, it is not likely that a suddenly new and detailed set of laws for spaceborne activity can be compiled without a greater depth of experience. Existing executive, legislative and judicial processes are earthbound. For the foreseeable future, at least, the judges, administrators and legislators who must settle, regulate, or pass laws to cover spacebound controversies sit on this earth and are trained under the great legal systems, principally the common and civil law systems, which exist here. Terrestrial law as applied and administered to earthly activities will have to be adapted for outer space. The question then is which terrestrial law. There are fifty-two legal systems in the U.S. alone and well over 200 throughout the world, each having potential application to outer space. The various legal systems of the world are not uniform in their legislative and judicial approach to international activity. Completely diverse decisions can turn on the system of justice brought to bear on the dispute or controversy which arises in space. Ideally there should be substantial integration of all the civilized legal systems in their applications to outer space. There is precedent. The treaties creating the European

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[15] *Id.*

[16] S. Lay and H. Taubenfield, *The Law Relating to Activities of Man in Space* 66, note 15 (1970) (statement of Ambassador Jha). *See also,* R. Chernow, *Colonies in Space May Turn Out to Be Nice Places to Live,* 6 Smithsonian Magazine 62 (Feb. 1976).

[17] D. Vassilevskaya, *Drawing up a Draft Treaty on the Moon,* Proceedings of the Nineteenth Colloquium on the Law of Outer Space 99 (1977). Finch and A. Moore, *Ecospace: The Economics of Outer Space and the Future,* 62 A.B.A. J. 338 (March, 1976).

Communites provided for substantial harmonization of the national laws of the signatory countries.[18] Scandanavian countries have also succeeded in unifying large segments of their laws.[19] It is also possible that the practice of spacefaring nations will produce a common law analagous to the maritime law developed by seafaring states, although such a development is not likely in this rapidly unfolding space age.

Undergirding the extension of any national or international laws into outer space are the paramount issues of state, federal and international jurisdiction. Jurisdiction has a dual meaning. It means the capacity to prescribe a rule of law and it also means the capacity to enforce that rule.[20]

The Outer Space Treaty deals primarily with prescriptive rather than enforcement jurisdiction. By providing that the registry State retains jurisdiction and control over its objects and personnel *while in outer space or on a celestial body,* amenability to legal process on return to earth is not within the bounds of the treaty. The treaty also provides that nongovernmental entities in outer space shall be authorized and supervised by the appropriate State. The operative words are "while in outer space" and "in outer space."[21] Once personnel and objects return to earth, they come within the territorial and national jurisdiction of local law enforcement agencies. While torts may occur, crimes may be committed, and contracts breached in outer space, the pursuit of legal remedies, civil or criminal, is earthbound. Two of the great legal systems of the world, the common and civil law systems, approach the exercise of terrestrial jurisdiction from different viewpoints. In the case of tort or crime, the common lawyer will be first interested in where the incident giving rise to the complaint occurred, and also whether the tortfeasor or perpetrator is within the court's reach. The civilian lawyer will have more interest in the nationality of the parties and objects involved, the victim, and actor, and the craft. The principle and often the exclusive basis for the exercise of prescriptive or enforcement jurisdiction in a common law country is territorial. The United States is a good example of a sovereign which closely adheres to the common law. In the matter of prescriptive jurisdiction, the Supreme Court has written that "the legislation of Congress, unless a contrary intent appears, is meant to apply only within the territorial jurisdiction of the United States."[22] When it comes to enforcement (or adjudicatory) jurisdiction, common law systems generally require that physical presence,

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[18]E. Stein, *Assimilation of National Laws as a Function of European Integration,* 58 A.J. Int'l. L. 1 (1964).

[19]N. Pontoppidan, *A Mature Experiment: The Scandinavian Experience,* 9. Am.J. Comp. L. 344 (1960).

[20]Restatement (second) of Foreign Relations §§ 17, 20 (1965). For a proposal to promote a functional jurisdiction in outer space, *see* I. Csabafi, *The Concept of State Jurisdiction in International Space* Law 126-151 (1971).

[21]Outer Space Treaty, Arts. VI, VIII.

[22] *Foley Bros. v. Filardo,* 336 U.S. 281, 285 (1948).

voluntary consent, or certain minimum contacts with the forum are essential for the court to take *in personam* jurisdiction. In civil law systems, nationality is the prime basis for the exercise of either prescriptive or enforcement jurisdiction. In France, for example, a civil court may exercise its powers over any alien, wherever he may be, who breaches his duty to a French national.[23] Neither the tortious conduct nor the alien defendant himself need be located in that country.

With the placing of the European Space Agency's (ESA) Spacelab in orbit by the launch of a U.S. space shuttle in 1980, a shirtsleeve environment for the conduct of scientific and technical experiments will be provided for astronauts of different nationalities. Assume six space scientists, three American and three French are actively engaged in research on board and that they remain in orbit for thirty days. An American scientist is negligent. He mishandles an experiment and a French colleague is seriously injured. Upon their return to earth the Frenchman may sue the American in a French court although the American has never been in France and has no relationship with the country other than that the tort is committed upon the Frenchman. Neither the Outer Space Treaty nor the Liability Convention deny the right of spaceborne personnel to seek a remedy within their own legal system. Suppose, however, it is the Frenchman who is negligent and the American scientist who is injured. The American wishes to sue in a U.S. court. Our courts may refuse to exercise their adjudicatory jurisdiction over the French scientist unless he is personally summoned within the political boundaries of the court, or consents to the suit, or otherwise can be found to have some minimum relationship with the forum state. The American may be compelled to sue in a French court and under an unfamiliar law. It is true the same disparity of jurisdiction exists on earth. The factors that intensify this situation in outer space, however, are the close living quarters and sustained and frequent contacts which human activity in space will engender. West German law provides an even more exorbitant basis for the exercise of adjudicatory jurisdiction than does France. The German code of civil procedure provides that a claim for money damages may be asserted in the court of any district wherein the defendant has property.[24] This is not like a common law in rem proceeding where the property itself may be the subject of the dispute. Once the defendant's property is found within its political boundary, the German court has personam jurisdiction up to the amount of provable damages which may far exceed the value of the property. To take an extreme case, a book or a scientific paper forwarded to a German colleague may vest the appropriate German court with power to decide a spaceborne tort committed by the alien property owner.

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[23]Art. XIV Civil Code cited from H. deVries, N. Galston and R. Loening, Materials for the French Legal System 2 (1977).

[24]deVries and Lowenfeld, *Jurisdiction in Personal Actions-A Comparison of Civil Law Views,* 44 Iowa L. Rev. 306, 334 (1959).

Assume now the conduct of our luckless American scientist in the ESA spacecraft is so reckless that it amounts to criminal conduct. Will a U.S. criminal court have competence to prosecute? In common law systems, criminal offenses must be defined by statute and they are not applied extraterritorially, absent clear legislative intent.[25] The application of this rule was clearly expressed in a case involving an assault by a Puerto Rican passenger upon the pilot of a U.S. commercial aircraft in flight over the high seas. At the time, the admiralty and maritime jurisdiction of the United States extended to crimes committed "upon the high seas or on any other waters within the admiralty and maritime jurisdiction of the United States and out of the jurisdiction of any particular state."[26] In arresting judgment against the Puerto Rican passenger, the federal district court held that a statute regulating crime *upon* the high seas did not provide a federal court jurisdiction to consider an offense committed *over* the high seas. Shortly after this decision Congress extended the special maritime and territorial jurisdiction of the United States to include aircraft in flight over the high seas.[27] More recent cases have determined that the "special maritime and territorial jurisdiction" of the United States extends to homicides committed on an iceflow in the Arctic Ocean,[28] and on the grounds of the U.S. Embassy in equatorial Guinea.[29]. U.S. legislation now provides for a special aircraft jurisdiction of the United States.[30] This jurisdiction extends to civil and military aircraft of the United States while in flight and any other aircraft within the United States or outside the United States when its next scheduled destination or last point of departure is in the United States. Anyone who commits assault upon a flight crew member on board an aircraft within this special aircraft jurisdiction is subject to punishment by a U.S. federal court. This special aircraft jurisdiction extends to most federal crimes when committed in the airspace on board civil and military aircraft of the United States while in flight, and any other aircraft within the United States or outside the United States when its next scheduled destination or last point of departure is the United States.[31] The Chief Counsel of the Federal Aviation Administration advised the General Counsel of NASA in March 1977 that the Space Shuttle was not an aircraft.[32] It is doubtful that a court would construe the special aircraft jurisdiction of the U.S. as extending to an act onboard the shuttle even within the airspace.

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[25] *U.S. v. Bowman*, 260 U.S. 94 (1922).

[26] 18 U.S.C. §451 (1950).

[27] *U.S. v. Cordova*, 89 F. Supp. 298 (E.D.N.Y. 1950).

[28] *U.S. v. Escamilla*, 467 F2d 341 (4th Cir. 1972).

[29] *U.S. v. Erdos*, 474 F.2d 157 (4th cir. 1973).

[30] 49 U.S.C. § 1301(32) (1970).

[31] *Id.*

[32] Letter from the Chief Counsel of Federal Aviation Administration to the General Counsel of NASA (March 11, 1977).

There is no express statute conferring U.S. jurisdiction in federal courts for offenses committed in outer space. However, there is a Senate proposal to revise the criminal laws of the United States which would extend federal criminal jurisdiction to outer space. The special jurisdiction of the U.S. is rewritten in the Senate bill to cover "aerospace jurisdiction" which applies to "any aircraft or spacecraft of the United States during flight or while in outer space."[33] Also covered would be any other spacecraft or persons in space "if and to the extent provided by treaty or other international agreement having the force of a treaty."[34] Certain crimes against the United States do have extraterritorial reach. A federal statute making interstate or foreign thefts a federal offense could apply to a theft from a spacecraft or satellite, even with the strict construction required in applying a criminal law. The statute provides "whoever embezzles, steals, or unlawfully takes. . . from any. . .other vehicle, or from any station, platform or depot, or from any air terminal, aircraft terminal or air navigation facility. . .shall be fined not more than $5,000 or imprisoned not more than ten years, or both. . . ."[35] Certain other crimes against the United States have extraterritorial reach such as treason, perjury committed before a U.S. officer abroad, and conspiracy against the United States.[36] However, the bulk of U.S. criminal law is based on territorial application. Absent some legislative provision creating a special spacecraft jurisdiction, many spaceborne crimes may not be punishable in the United States. Civil law systems retain a strong nationality and protective basis for the exercise of criminal jurisdiction. The French code of criminal procedure provides that a French citizen abroad who commits an act "qualified as a crime punishable by French law may be prosecuted and judged by the French courts."[37] An alien outside France who commits a crime against a French citizen may also be prosecuted in a French court under French law.[38] Turkey and Mexico are examples of other civil law countries which provide for national competence offenses abroad committed against their nationals.[39] Such penal laws, having no territorial limitation, can easily be assumed to apply in an outer space environment as well.

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[33]Proposed Amendments to the Federal Criminal Laws: Hearings Before the Senate Subcommittee on Criminal Laws and Procedures of the Committee on the Judiciary, 93rd Cong., 1st Sess. (1973) (Reform of the Federal Criminal Laws 4229 (1973)).

[34] *Id.* at 4228.

[35]18 U.S.C.*2* 659 (1970).

[36] *U.S. v. Bowman,* 260 U.S. 94 (1922) (conspiracy); *U.S. v. Pizzarusso,* 388 F.2d 8 (2d Cir. 1968) (perjury); *Gillars v. U.S.,* 182 F.2d 962 (D.C. Cir. 1950) (treason).

[37]Article 689 French Code of Criminal Procedure, cited from H. deVries, N. Galston and R. Loening, *supra* n. 23.

[38] *Id.* at 90. (Article 689-1).

[39] *France V. Turkey,* P.C.I.J. Ser. a, No. 10, (1927), 2 Hudson World Court Reporters 20 (1935); *The Cutting Case,* 1887 U.S. Foreign Rel. 757 (1887).

In the case of the commission of a crime on board a U.S. spacecraft by a foreign national, Professor Gorove believes Article VIII of the Space Treaty, which provides that the registry State retains jurisdiction over its spaceborne objects and personnel while in outer space, applies. He calls it an example of primary jurisdiction and writes:

> It is hard to visualize how the state of registry without some additional understanding or agreement. . . would be willing to surrender foreign personnel and other visitors to the foreign state for what would appear to be trial and punishment, by waiving its primary jurisdiction.[40]

Nevertheless this treaty jurisdiction applies in outer space only. The disparate viewpoints as to the exercise of terrestrial jurisdiction that now prevail among the various legal systems on earth still require harmonization if some uniformity is to be obtained for the punishment of criminal offenses committed in outer space.

Another problem which our disparate legal systems generate is the thorny issue of choice of law. Once a court assumes jurisdiction, it may be even more difficult for it to decide which law to apply to the spaceborne event. Each legal system builds its own substantive law (*e.g.*, torts, property, contracts and crimes). Legal determinations may depend on whose law applies. Contributory negligence may defeat the claim of the U.S. space scientist in one jurisdiction and only mitigate the damages in another. In one State the amount of damages recoverable for wrongful death may be limited by statute, and in another any limitation may be constitutionally prohibited. Where title to property is transferred in outer space, one terrestrial jurisdiction may place risk of loss on the seller until delivery, while another may place it on the buyer. The same negligent conduct of a spacefarer may make his earthbound employer liable in one jurisdiction and not in another. The doctrine of respondeat superior is only one example. What rules will develop as to the standard of care for space activity, as to justified risk, and as to unforeseeable or intervening causes are also important but as yet undefined legal criteria. Dr. Robinson of the Smithsonian Institution even suggests that the quality of life in space may be so unique that new approaches are required by lawyers to settle these questions.[41] As the legal systems which may handle the dispute on earth multiply, the greater the probability of variation of the ultimate outcome.[42]

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[40]Gorove, *Criminal Jurisdiction in Outer Space*, 6 Int'l. Law. 313, 320 (1972).

[41]Robinson, *Space Law*, 80 Tech. Rev. 62, No.1 (October/November 1977).

[42]It may be that contractual choice of law and even choice of forum clauses should be concluded between the launching authority and the spaceborne personnel to make certain the applicable court and law. *See* as to choice of law *Scherk v. Alberto-Culver Co.*, 417 U.S. 506 (1974). *See* as to choice of forum *M/S Bremen v. Zapata Off-Shore Drilling*, 407 U.S. 1 (1972).

In many common law jurisdictions, courts will apply the law of the place where the tort occurred, where the contract was executed or to be performed, or where the property was located when title passed, to determine the rights of the parties. Where the relevant events have transpired outside the forum State, the court searches for the applicable foreign substantive law. Assume a civil action by an injured scientist is commenced in Ohio for a spaceborne tort. Under the rule of lex loci delicti (the law of the place of the tort), the Ohio court would be at a loss to determine the substantive rights of the parties for a spaceborne tort. Should the court apply Ohio tort law for want of an alternative? Or should it apply the law of the place where the victim resides or has his nationality, or the law of the State registering the craft, or the law of the nationality or residence of the tortfeasor? Applying forum law may lead to forum shopping whereby the victim seeks the most hospitable jurisdiction in which to make his claim. On the other hand, applying any of the other possible laws may be no more equitable when balancing the interests of all the States and parties. Suppose the negligence of the U.S. scientist results in the death of a colleague on board a spacecraft. At common law there was no remedy for wrongful death. Every state in the Union has now enacted a wrongful death statute. The Ohio wrongful death statute is typical. It provides that when death is caused by the wrongful act, neglect, or default in another jurisdiction, for which a right to maintain an action and recover damages is given by statute, such right of action may be enforced in Ohio.[43] However, where there is no statutory right to recover from wrongful death as in the case of outer space, will a court in Ohio judicially extend the Ohio wrongful death statute into outer space, or seek to apply the Federal Death on the High Seas Act? Or will the Court decide no cause of action is stated for want of an applicable statue?

Until 1970 the Supreme Court held there was no common law right of recovery for wrongful death on the high seas.[44] In 1920, Congress passed the death on the High Seas Act to provide a civil remedy for death on the high seas.[45] It authorized a personal representative of the decedent to sue in a federal district court in admiralty for the benefit of the decedent's next of kin. Since 1941 the Death on the High Seas Act has applied to aircraft as well as to vessels. In one celebrated air law case the court said:

> The means of transportation into the area is of no importance. The law would indeed be static if a passenger on a ship were protected by the act and another passenger in the identical location 3,000 feet above in a plane were not. Nor should the plane have to crash in the seas to bring the death within the Act any more than a ship would have to sink as a prerequisite.[46]

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[43] O.R.C. § 2125.01 (Baldwin 1976).

[44] *The Harrisburg*, 119 U.S. 199 (1886) overruled by *Moragne v. States Marine Lines*, 398 U.S. 375 (1970).

[45] Death on the High Seas Act, 46 U.S.C.§§ 761-767 (1970).

[46] *D'Aleman v. Pan American World Airways*, 259 F.2d 493, 495 (2d Cir. 1958).

Will the courts apply the Act to deaths 300 miles above the surface of the seas if they apply it 3,000 feet above? It is extremely doubtful that it will be judicially extended so high. Absent a new enactment specifically reaching into space, the forum court must either apply its own wrongful death statute or reject the lawsuit of the decedent's plaintiff.

Limitation of liability for extraterrestrial conduct also poses a serious question. The doctrine of limitation upon an owner or operator's liability has been a part of maritime law for most of the shipowning countries of the world for centuries, and a part of aviation law for international air carriers for over forty years.[47] The rationale behind this limitation is that ship owners and air carriers need protection from overwhelming losses. The loss limitation for ship owners may be based on the value and weight of the vessel, while the limitation of liability for international air carriers is set forth by international treaty. The consequences of a mishap in outer space, bringing loss of life, personal injury, property damage, or damage to the earth's environment, may be far more catastrophic than such loss occurring from mishaps at sea or in the airspace. Public policy dictates that this risk should not be borne by private spacefaring companies alone. The liability imposed by the convention on a launching State for damage caused by its space object does not exhaust all the problems which may occur. It does not cover injury or damage to nationals of the launching State or to foreign nationals participating in an operation of the launching State's space object. It does not cover damage caused by spaceborne personnel, unless the damage is precipitated by a space object. Most significantly, it does not preempt any remedy an injured party may have under his own law. Adequate, prompt, and full relief for harms caused by activity in space will frequently lie outside the Liability Convention.

Since the Liability Convention provides no remedy for a U.S. national who suffers injury either caused by a U.S. space object or while he is on board a U.S. spacecraft, he must look to U.S. legislation for any claim against the government. Tort claims against the federal government are a major source of tort litigation, and the principal legislation waiving governmental immunity is the Federal Tort Claims Act.[48] At one time, suits pending before the federal courts involving claims under this Act amounted to considerably more than $300 million.[49] However, the Federal Tort Claims Act is inapplicable by its terms "to any claim arising in a foreign country."[50] This foreign

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[47]Limitation of Liability Act, 49 Stat. 960 (1935) (Current version, at 46 U.S.C.§§ 183, 185 (1970)). For aviation law, see The Convention for the Unification of Certain Rules Relating to International Transportation by Air, October 13, 1929, 49 Stat. 3000 T.S. 867.

[48]Federal Tort Claims Act, 28 U.S.C.§ 1346 et seq. (1970).

[49]L. Jayson, Handling Federal Tort Claims 1, 7-8 (1974).

[50]28 U.S.C.§ 2680 (K) (1970).

country exception has been held to bar a suit against the government for a wrongful death occurring at a Newfoundland U.S. airbase under a long-term lease to the United States.[51] It has also been held to bar suits against the government for claims arising in occupied areas which are not under the sovereign jurisdiction of the United States.[52] Since the Outer Space Treaty provides that the outer space is not subject to national appropriation by claim of sovereignty, the rationale of the Supreme Court in limiting the scope of the Federal Tort Claims Act would seem to preclude its application to wrongful conduct by governmental employees in outer space. There are other obstacles to recovery under the Federal Tort Claims Act. First, the Act does not apply where the negligent conduct involves a discretionary function of a U.S. employee.[53] Liability of the U.S. under the Act is based on fault; strict liability principles do not apply.[54] Second, the Act does not cover intentional torts.[55] Prior to instituting suit, the plaintiff must present his claim to the "appropriate federal agency" for administrative consideration.[56] Finally, the Act looks to the law of the place where the act of omission occurred to determine substantive rights. For spaceborne torts, a federal district court has no substantive "law of the place" to follow.

Claims against the U.S. for harm caused by NASA or its personnel are covered by the National Aeronautics and Space Act of 1958.[57] The Act provides NASA with authority to settle any claim for $5,000 or less against the U.S. "for bodily injury, death, or damage to or loss of personal property resulting from the conduct of the Administration's function where such claim is presented to the Administration in writing within two years after the accident or incident out of which the claim arises."[58] Where the claim exceeds $5,000 and it is considered meritorious by NASA, it is "to report the facts and circumstance to Congress for its consideration." The NASA Act has no territorial restrictions and applies to conduct of NASA personnel in space as well as within the earth's environment. In addition, there is no requirement that fault be established. If the damage was caused by the conduct of NASA employees, presumably it will be treated as a meritorious claim. Where the claim results from serious injury or

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[51] U.S. v. *Spelar*, 338 U.S. 217 (1949).

[52] *Burna v.* U.S., 240 F.2d 720 (4th Cir. 1957).

[53] *Eastern Air Lines v. Union Trust Co.*, 221 F.2d 62 (D.C. Cir. 1955).

[54] *Laird v. Nelms*, 406 U.S. 797 (1972).

[55] 28 U.S.C. § 2680 (h) (1970).

[56] 28 U.S.C. § 2675 (1970).

[57] National Aeronautics and Space Act (1958) (amended 42 U.S.C. § 2451 et seq. (1970)).

[58] 42 U.S.C. § 2473 (13) (A) (1970).

death, or serious property loss, the $5,000 limitation will be inadequate and it will have to be approved by Congress.[59] Our injured space scientist may still prefer judicial, rather than administrative and legislative settlement. The NASA Act does not preclude any other available remedy, and our injured space scientist may seek his remedy in a competent national court. However, the sovereign immunity of the United States will bar his suit unless he can convince the court the Federal Tort Claims Act applies in space, and the negligient conduct of NASA personnel does not involve a discretionary function.

NASA is presently evaluating a proposal to turn the management of nearly all space shuttle operations over to private contractors by 1982.[60] This would have significant legal implication as to tort liability and contractual obligation for space performed transportation. Such managers would not benefit from the sovereign immunity of the U.S. nor would the Federal Tort Claim or NASA acts be applicable to their conduct. It would expose them to the same liability and responsibility which private enterprises retain in space or on earth.

Apart from the need to unify an approach on jurisdiction and choice of law issues and the need to synchronize the national application of torts, contracts and property law, there is also an urgent need to transfer principles of maritime salvage to outer space. The Agreement on the Rescue and Return of Astronauts and the Return of Space Objects is not sufficiently comprehensive.[61] It imposes a duty upon contracting states to assist the personnel of spacecraft in distress and to recover and return disabled or lost space objects upon request. However, the treaty obligations are imposed upon *Contracting Parties* and *Intergovernmental Organizations* and not upon private enterprise. A private person who saves property at sea voluntarily may receive a generous reward. The reward is not based on compensation for work done, a quantum meruit, but is based on the risks involved and the skill displayed by the salvor.[62] As more objects are launched into space, and as privately owned satellites begin to proliferate, towing and rescue operations may become widespread. Privately operated salvage operations seem likely to occur. Where a contracting state has made no request for the return of a space object, and therefore no duty devolves upon other contracting parties to locate and return the disabled or missing spacecraft, the space objects may still be found and towed to safety by another privately owned craft. Anything salvageable in space that is found and returned by private enterprise should result in compensation to the rescuing party. The maritime law of salvage is complex and detailed. It has accumulated throughout the

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[59] 42 U.S.C.§ 2473 (13) (B) (1970).

[60] *Av. Week & Space Tech.*, March 16, 1978, at 12.

[61] For a detailed analysis of the Rescue Treaty, *see* Dembling and Arons, *The Treaty on Rescue and Return of Astronauts and Space Objects*, 9 Wm. & Mary L. Rev. 630 (1968).

[62] G. Gilmore and C. Black, The Law of Admiralty 532 (2d ed. 1975).

centuries of maritime practice; it is a part of the jus gentium and is nearly uniform among the seafaring countries. U.S. courts exercise a discretionary jurisdiction over salvage claims at sea which have no U.S. contact except the happenstance that the rescuers libel the salved ship in a U.S. court. [63] Since maritime salvage law has been carefully elaborated over many centuries of commerce, and since the high seas is under no State's sovereignty, matitime principles may be readily adaptable to operations for private salvage in space.[64]

The time has come for a select number of distinguished lawyers, representing the principal legal systems of the world, to assess the many diverse laws which *could* apply to space activity and determine how to establish a uniform order of law for space. Such a distinguished group of jurists could materially aid in the progressive development of a uniform system of law by proposing how the rules of the various common, civil and other legal systems of the world could be blended for compatible application in outer space. The group could also evaluate how much of international air and maritime law could be transferred to the fourth dimension. Their objective would not be to develop a new code of space law, but to establish a common consensus as to how to allocate jurisdiction for extraterrestrial activity, how to choose the applicable substantive law, and how to provide for some judicial uniformity. Mrs. Galloway,[65] the well known consultant on international space activities, has written that partial approaches to the establishment of a legal regime in outer space could result in inconsistencies which could not be later codified into an harmonious legal system. The objective, she writes, is to secure the maximum of States becoming parties to the total structure of space law rather than the maximum number of treaties.

One way to achieve a community-wide consensus on the elevation of national law and judicial competence to outer space is through the International Law Commission. This Commission was established by the General Assembly to make recommendations on the progressive development and codification of International Law. As an adjunct to the International Law Commission, the General Assembly could now create a special committee to work on Space Law implementation. This committee could function under the Committee on Peaceful Uses of Outer Space and work closely with the Outer Space Affairs Division of the UN Secretariat. By means of this new committee, all

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[63] *See Usatorre v. Compania Argentina Navegacion Mihanovich Ltda.*, 49 F. Supp. 275 (S.D.N.Y. 1942) rev'd on other grounds. 172 F.2d 434 (2nd. Cir. 1949). *See also Lauritzen v. Larsen*, 345 U.S. 571 (1953).

[64] In 1963 M. Menter, then a Colonel in the U.S. Air Force wrote that "[a]nalagous related laws such as the law of the sea and air law" must be examined for their applicability to outer space. M. Menter, Formulation of Space Law, Proceedings of the Sixth Colloquium on the Law of Outer Space 2 (1964).

[65] Galloway, The Future of Space Law, Proceedings of the Nineteenth Colloquium on the Law of Outer Space, Edited by Schwartz, p. 15 (October 12-15, 1976, Anaheim, California).

nations would share in the adaptation of earthly laws to outer space, and hopefully a jus gentium would emerge for outer space as it has for the high seas.

Perhaps a more productive way of bringing about a unification of law for space would be through the institution of the Hague Conference on Private International Law. This conference of government experts has been meeting every four years since 1893 to prepare international agreement on the codification of private international law. There are now 28 members to the Conference including the United States and Japan. An extraordinary session could be summoned and nonmember States, particularly those represented on the Committee on the Peaceful Uses of Outer Space, as well as member States could be invited. Since World War II, The Hague Conference has been especially successful in harmonizing community law, and a number of potential conflicts of national laws have been reconciled through treaty. Particularly significant agreements have been concluded on choice of court, relation of national law to law of domicile, selection of jurisdiction, the taking of evidence, and the enforcement of judgments.[66] It would be a great stride toward the vaster exploration of space if a special session of the Conference could set forth a series of agreements on the integration of national laws for space application.

Finally, there are several private organizations or academic institutes which might take up this task. The International Law Association, or the American Society of International Law have the talent and resources to lead the way. Among the academic institutions, the Institutes of Air and Space Law at McGill University and at the University of Cologne also have the depth of experience and the background in several legal systems to begin to etch out the needs and priorities for agreements among space States on the harmonization of space law.

Certainly we have reached a critical state in outer space development. With the space shuttle age approaching, lawyers must not fall back in the task of developing a scheme for a legal system beyond the earth which will produce international cooperation rather than generate transnational conflict.

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[66]For a listing of the conventions drafted by The Hague Conferences *see* 13 Int'l. Legal Materials 474 (1974).

THE BOGOTA DECLARATION*

1. The geostationary orbit as a natural resource

The geostationary orbit is a circular orbit in the equatorial plane in which the period of sidereal revolution of the satellite is equal to the period of sidereal rotation of the Earth and the satellite moves in the same direction as the Earth's rotation. When a satellite describes this particular orbit, it is said to be geostationary; such a satellite appears to be stationary in the sky when viewed from the earth, and is fixed at the zenith of a given point on the Equator, whose longitude is by definition that of the satellite.

This orbit is located at an approximate distance of 35,871 km above the Earth's Equator.

The equatorial countries declare that the synchronous geostationary orbit is a physical fact arising from the nature of our planet, because its existence depends exclusively on its relation to gravitational phenomena caused by the Earth, and that for that reason it must not be considered part of outer space. Therefore, the segments of the synchronous geostationary orbit are an integral part of the territory over which the equatorial States exercise their national sovereignty. The geostationary orbit is a scarce, natural resource whose importance and value is increasing rapidly with the development of space technology and with the growing need for communication; therefore, the equatorial countries meeting in Bogota have decided to proclaim and defend on behalf of their peoples the existence of their sovereignty over this natural resource. The geostationary orbit represents a unique facility which it alone can offer for telecommunication services and other uses requiring geostationary satellites.

The frequencies and orbit of geostationary satellites are natural resources fully accepted as such under the current rules of the International Telecommunication Union. Technological progress has caused a continuous increase in the number of satellites using this orbit, which could lead to saturation in the near future.

The solutions proposed by the International Telecommunication Union in the relevant documents with a view to achieving a better use of the geostationary orbit and preventing its imminent saturation are at present impracticable, and are also unfair, because they would considerably increase the cost of utilizing this resource, especially for developing countries. Such countries do not have the same technological and financial resources as industrialized countries, which enjoy an evident monopoly in the

*For a text of the Declaration see EL ESPECTADOR (Columbia), December 7, 1976, p. 13A. For the English translation, see ITU, Broadcasting Satellite Conference, Doc. No. 81-E (Jan. 17, 1977), Annex 4.

exploitation and use of the synchronous geostationary orbit. In spite of the principle established by Article 33, paragraph 2, of the 1973 International Telecommunication Convention, that in using frequency bands for space radio services, members shall bear in mind that radio frequencies and the geostationary satellite orbit are limited natural resources and that they must be used efficiently and economically so as to allow equitable access to this orbit and to its frequencies, we can see that both the geostationary orbit and the frequencies have been used in a way that does not allow equitable access to the developing countries, which do not have the technical and financial means that the great Powers have. Therefore, it is essential for the equatorial countries to state their determination to exercise their sovereignty over the corresponding segments of the geostationary orbit.

2. Sovereignty of equatorial States over the corresponding segments of the geostationary orbit.

In describing this orbit as a natural resource, the equatorial States reaffirm "the right of peoples and nations to permanent sovereignty over their natural wealth and resources, which must be exercised in the interest of their national development and of the well-being of the people of the State concerned", as stated in Resolution 2692 (XXV) of the United Nations General Assembly, entitled "Permanent Sovereignty Over Natural Resources of Developing Countries and Expansion of Domestic Sources of Accumulation for Economic Development".

Furthermore, the Charter of Economic Rights and Duties of States solemnly adopted by the United Nations General Assembly in Resolution 3281 (XXIX) natural resources, in Article 2 paragraph 1, reads: "Every State has and shall freely exercise full permanent sovereignty, including possession, use and disposal, over all its wealth, natural resources and economic activities".

The above-mentioned provisions lead the equatorial States to affirm that the synchronous geostationary orbit, being a natural resource, is under the sovereignty of the equatorial States.

3. Legal status of the geostationary orbit

Bearing in mind the existence of sovereign rights over the segments of the geostationary orbit, the equatorial countries consider that the legal system applicable in this area must take into account the following:

a) The sovereign rights put forward by the equatorial countries are directed towards rendering real benefits to their respective peoples and to the world community, in complete contrast to the present state of affairs, in which the orbit is used primarily for the benefit of the most developed countries.

b) The segments of the orbit corresponding to the areas of the high seas beyond the national jurisdiction of States shall be considered as the common heritage of mankind. Consequently, the competent international agencies may regulate their use and exploitation whenever that is for the benefit of mankind.

c) The equatorial States do not object to free orbital transit or the transit of communications requiring satellites covered and authorized by the International Telecommunication Convention, when these satellites pass through their space territory in gravitational flight outside their geostationary orbit.

d) Devices to be placed in a fixed position on an equatorial State's segment of the geostationary orbit shall require previous and express authorization on the part of the State concerned, and the operation of the device shall be governed by the national law of that State. It is to be understood that this authorization is different from the coordination requested in cases of interference among satellite systsms, as specified in the Radio Regulations. The authorization in question clearly relates to countries' right to allow the operation of fixed radio stations within their territory.

e) The equatorial States do not acquiesce in the presence of satellites on their segments of the geostationary orbit and declare that the existence of such satellites does not confer any right to place satellites there or to use the segment unless expressly authorized by the State exercising sovereignty over the segment in question.

4. Treaty of 1967

The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, signed on 27 January 1967, cannot be considered as a final answer to the problem of the exploration and use of outer space, particularly since the international community is now calling in question all the terms of international law which were drawn up at a time when the developing countries could not count on adequate scientific advice and were thus not able to detect and assess the omissions, contradictions and inconsistencies in the texts, which were prepared with great ability by the industrialized Powers for their own benefit.

There is no definition of outer space that is valid and satisfactory for the international community such as might be cited to support the argument that the geostationary orbit is included in outer space. The Legal Sub-committeeof the United Nations Committee on the Peaceful Uses of Outer Space has been working for a long time on a definition of outer space but has not yet been able to reach agreement on the matter.

Therefore, it is imperative to arrive at a legal definition of outer space, since to apply the 1967 Treaty without one would merely be to ratify the presence of the states that are already using the geostationary orbit. In the name of the principle of non-appropriation by states, what was actually developed was a technological sharing-out of the orbit, which in the end simply comes down to national appropriation, and this must be denounced by the equatorial countries. Experience so far and the developments foreseeable in the years ahead show up the obvious gaps in the 1967 Treaty which force the equatorial states to take the position that the geostationary orbit is not covered by its provisions.

The lack of a definition of outer space in the 1967 Treaty, which has already been referred to, means that Article II can not apply to the geostationary orbit and therefore does not affect the rights of the equatorial states that have already ratified the Treaty.

5. Diplomatic and political action

While Article II of the aforementioned Treaty does not make an express exception for the synchronous geostationary orbit, as an integral part of the territory of equatorial states, the countries that have not ratified the Treaty should refrain from undertaking any steps to put into effect provisions whose legal invalidity has already been exposed.

The representatives of the equatorial countries attending the meeting in Bogota wish to make clear their position regarding the declarations by Colombia and Ecuador in the United Nations, affirming that they consider the geostationary orbit to be an integral part of their sovereign territory; this declaration is the historical background for the defense of the equatorial countries' sovereign rights. These countries will do their utmost to see that similar declarations are made in international agencies and to bring their international policies into line with the principles set forth in this document."

Signed in Bogota 3rd December 1976 by the Heads of Delegations.

Geraldo Nabcimento Silva
Observateur du BRESIL

Soehardjono
Indonesia

Sara Ordonez de Londono
Colombia

Peterson John Kinya
Kenya

Tchitche Linguissi
Congo

Khalid Younis Kinene
Uganda

Jose Ayala Lasso
Ecuador

Wabali Bakitambisa
Zaire

EVENTS OF INTEREST

A. Past Events

1. Space Law Workshop—"Space Stations and Habitats," Annual Meeting of the American Society of International Law, Washington, D. C., April 28, 1978

There was a space law workshop on "Space Stations and Habitats" held during the annual meeting of the American Society of International Law in Washington, D. C., April 28, 1978. The meeting was co-sponsored by the International Institute of Space Law and the International Law Section of the American Bar Association.

The keynote speaker of the space law workshop was T. Stephen Cheston, Associate Dean of the Graduate School of Georgetown, University, whose address was entitled, "The Future of Outer Space Law: Some Observations." In his presentation, Dean Cheston presented legal problems envisaged as a result of his participation in the NASA-Ames summer studies on man's living and working in space. A "Reaction Panel" and other discussants responding to the legal issues raised were Carl Q. Christol, Edward R. Finch, Jr., S. Neil Hosenbal, Ronald F. Stowe, Stephen Gorove, Eilene Galloway, David Leive, Stephen Doyle and Hamilton DeSaussure. Martin Menter served as moderator and Amanda Moore as reporter of the workshop program. A summary of the program is expected to appear in the Proceedings of the American Society of International Law.

Martin Menter
President, Association
of the U. S. Members
of the International
Institute of Space Law

2. Meeting of A.B.A. International Law Section, Committee on Aerospace Law, Aug. 5, 1978, New York City.

The Committee on Aerospace Law of the International Law Section of the American Bar Association held a meeting on Saturday, August 5, 1978 at the Herbert Hoover Suite, at the Waldorf Astoria Hotel. The meeting was chaired by Hon. Edward R. Finch, Jr. and reports were made by three of the Past Chairmen, Messieurs Dembling, Menter, and Cavanaugh. A report in writing on the 1979 WARC was presented by Subcommittee Chairman, Amanda Lee Moore, Esq., on a recent proceeding of the Committee on Peaceful Uses of Outer Space, of the United Nations, including developments in the new Moon Treaty and the ratification status of the existing Outer Space Treaties. Mr. Finch presented a proposed paper that will be delivered by him, on The Geostationary Orbit and Global Interdependence, at the 29th Congress of the International Astronautical Federation in Dubrovnik, Yugoslavia in October and requested comments thereon.

The Committee unanimously approved proposed National Space Transportation System Insurance legislation which in substance, parallels the Price-Anderson Act. All Committee Members have received copies of this proposed legislation and internal coordination within the ABA is currently being effected. It is believed that the proposed legislation can be considerably shortened and simplified. Many of the details in the proposed legislation will be relegated ultimately to the form of NASA regulations.

General Menter made a report on the American Society of International Law Proceedings and Workshop held in Washington, D. C., during the Spring meeting of the American Society of International Law and the Section of International Law.

The Committee discussed U. S. Presidential Decision Memorandum 37 which establishes a new U. S. Space Policy in certain respects.

The Committee reported on a completed 10 Volume Law-Science Dictionary, in 5 languages, which requires funding for publication.

The Committee discussed cooperation with the American Bar Foundation for Volume III of the American Bar Foundations' series on Development of Law of Outer Space. The Committee discussed, at length, a proposed Institute for 1979, with the Section of Science and Technology of the ABA, to be held in Houston, Texas. It is subject to the approval of the Council of both Sections.

The reports of the Subcommittee Chairmen on the Outer Space "Shopping List" progress were received.

A discussion was had on HR-12505 and U. S. Senate-2860 pending before the U. S. Senate Subcommittee on Energy Research and Development. It was noted that HR-12505 had passed the U. S. House of Representatives by a vote of 276 to 96.

The Committee discussed and reviewed the various papers to be presented in their individual capacity by Committee Members, at the 29th International Astronautical Federation in Dubrovnik, Yugoslavia, during the first week of October.

Announcement was made to the Committee by the Chairman of the Spring Princeton Conference on Outer Space Manufacturing; and the Chairman was congratulated by the Past Chairman on his recent election as a member of the International Astronautical Academy.

It was agreed that the date of the next meeting of the full Committee would be in February, 1979, during the ABA Mid-Year Meeting.

Edward F. Finch
Chairman
Aerospace Law Committee
International Law Section
American Bar Association

3. Other Events

On May 2, 1978 a Symposium was held under the auspices of the University of Akron College of Law and chaired by Professor Hamilton DeSaussure. The discussions dealt with the legal questions and related problems arising out of the crash of a Russian satellite, Cosmos 954, over Canadian territory. Written versions of the presentations by the participating distinguished panelists are included in this issue of the Journal.

4. Brief News

Pioneer Venus I, launched from Cape Canaveral, Florida, started its 400-million mile journey which is expected to put it in orbit around Venus. The purpose of the project carrying a $250-million price tag is to shed light on the reasons why Venus evolved so differently from its "twin planet" Earth.

The military services are exploiting the potential of emerging technologies and techniques to produce such developments as a field communications system for the foot soldier via satellite. The recent demonstration of manpack satellite communication by the U. S. Army Satellite Communications Agency culminated three years of intensive design and development work.

A recent study of the number of military satellites in use estimated that the Russians had 661 and the Americans 337 in orbit. The numbers change from month to month as satellites come in and out of use. The picture is further confused by the number of dormant or "dark" satellites in orbit which may be used at some future date.

Communications Satellite Corp. will investigate the feasibility of deploying remote unmanned seismic observations, which could be controlled and report seismic disturbances via satellite.

B. Forthcoming Events

As reported previously a session will be devoted to problems of space law during the Manila World Conference of the International Law Association, Aug. 27-Sept. 2, 1978. Also, as already reported the 21st Colloquium on the Law of Outer Space will be held during the XXIXth Congress of the International Astronautical Federation, Oct. 1-8, 1978 in Dubrovnik, Yugoslavia.

On Sept. 14, 1978 there will be a Symposium on "Satellites, Space and International Law" in Washington, D. C. under the auspices of the Federal Bar Association. In addition, there will be a Space Debris Symposium at the University of Virginia Law School, Oct. 20, 1978 and a "Frontiers of Space Law" session, Oct. 31, 1978 during the 25th Conference of the American Astronautical Society in Houston, Texas.

Space Law Perspectives, edited by Mortimer D. Schwartz (Fred B. Rothman Co., South Hackensack, N.J. 1976)

The book consists of commentaries based on volumes I-IV (1957-1972) of the Colloquia on the Law of Outer Space, which were sponsored by the International Institute of Space Law of the International Astronautical Federation. Many of the early volumes of the Colloquia are out of print, and the compiler has numbered each chapter of the book to correspond to the Colloquium it covers. Hence, Colloquia I-XIV are included.

Each chapter contains one or more of the original articles reproduced as originally published or excerpted especially for the book. In addition each chapter contains commentary on other items in the original Colloquium volume and reflections on the material contained in the chapter. The volume is not a mere reprinting of earlier items but rather a review of the published accomplishments of the International Institute of Space Law as perceived through current perspectives.

Scholars contributing to the book include Fr. W. Von Rauchhaupt, H. Dorandeu, A. Moll, Stephen Gorove, I.H. Ph. Diederiks-Verschoor, W.A. Kral, G. Adolf Durr, G. Verdacchi, and Werner Frhr von Braun.

The Industrialization of Space, Part 2, Vol. 36, edited by Richard A. Van Patten, Paul Siegler, and E.V.B. Stearns, (Univelt, Inc., San Diego, Calif. 1977).

This book consists of a compilation of essays on the short-term and long-term effects of industrialization in outer space by private industries sponsored by national governments.

Industrialization is discussed to alleviate the current unemployment and inflation problems on earth by suggestions in the book that include transforming NASA's Charter into an organization similar to that of the Tennessee Valley Authority. The organization, the Space Utilization Authority, would cope with domestic problems in space, such as rising birth rates and the depletion of non-renewable natural resources, plus explore newly developed options including the conversion of solar energy into electricity through the use of microwaves beamed to earth. Various experiments already under way by Apollo and Skylab are described, such as production of serums made from the unique, more rapid separation of body cells in space to dissolve blood clotting, which will be ready for marketing in the mid-1980s.

The final essays deal with an analysis of the Outer Space Treaty of 1967 and its legal impact on commercialization and private development in space by transnational corporations. In addition to jurisdictional and choice of law problems, private industry and new political structures will be subject to the treaty's provisions that the "exploration and use of outer space shall be carried out for the benefit and in the interest of all countries."

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Robinson, Militarization and the Outer Space Treaty; Time for a Restatement of Space Law, 16 Astronaut. & Aeronaut. 26 (Feb., 1978).

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C. Official Publications

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D. Miscellaneous

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Introduction

Should There Be A World International Space Agency?—Part I

Matters Relating to the Definitions and/or Delimitation of Outer Space and Outer Space Activities—Part II

Ways of Coordinating Space Science and Technology With Space Law—Part III

Addendum

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