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PROTECTION AGAINST SPACE DEBRIS – THE WORST CASE SCENARIO

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Introduction

In broad terms a major conflict exists between two critical interests. These are the peaceful exploitative aspects of the space environment and the perceived security needs of States. On the one hand all of humanity benefits from the fullest use of space-based communications, remote sensing, and scientific inquiry. Satellites can also be employed defensively. They can serve as operational elements of a State's right to preserve its sovereignty and territorial integrity.

The June 2000 conversations between President Clinton and President Putin, because of their focus on national defense, implicitly were related to the means whereby the threat of large space debris might be dealt with. At present the world's strategic environment may be moving from the policy of mutual assured destruction, i.e., of an unlimited response to a preceeding attack, as a means of deterrence, to the establishment of a nationwide defense shield referred to as National Missile Defense (NMD), designed to protect against incoming foreign warheads. The rationale for such a defensive shield is that so-called "rogue" States might acquire and use nuclear weaponry against the United States.

The Republican candidate for the U.S. President, Mr. George W. Bush, has taken the position that the United States should reduce substantially the number of American nuclear weapons, while building, both in the United States and abroad, an extensive defense system to guard against missile attack. His plans call for a comprehensive missile defense that could be launched from land, air, and outer space. Mr. Bush has suggested that the United States should reduce the number of its nuclear warheads to lower levels than suggested by Mr. Clinton.

In June 2000 a Russian spokesman viewed as unacceptable existing "American plans for an antimissile system [since it constituted] an attempt to break out to full superiority in the military sphere."[1] Behind this observation was the concern that the proposed U.S. approach would violate the 1972 Antiballistic Missile Treaty, which bans the construction of large missile shields.[2] Perceptions of strategic security between the two countries continues to be influenced by the American Strategic Defense Initiative (Star Wars proposal) of March 23, 1983.

In his speech to the Russian Duma on June 5, 2000 Mr. Clinton stated "I believe we ought to be able to proceed in a way that preserves mutual deterrence, preserves strategic stability, and preserves the ABM Treaty."[3] It has been thought that Mr. Clinton's remarks about the ABM Treaty were the reason for Mr. Putin to acknowledge a concern for the potential of so-called "rogue states."[4] It called for the creation of a joint center for monitoring nuclear missile launches.

Lurking behind all proposals for the practical elimination of dangerous space debris, which can cause damage to objects in space and to persons and property on Earth, is the important concern that any rule of law applicable to and inhibiting the threat of debris might also be applicable to active satellites engaged in national security activities. This is based on the assumption that among the possible means for protection against space debris are satellites and missiles, even though the employment of such services could itself produce unwanted debris. It is extremely doubtful that the two major space countries would risk the use of nuclear weaponry to deal with the threat of debris. Such a use would be wholly beyond and outside of international legal standards of reasonableness and proportionality applicable to the exercise of force in a State's defense.[5]

From both the political and the legal perspective clearly there is a need to allow States likely to be harmed by foreign space debris to take unilateral action with respect to such debris without derogating from the right of States in general to take unilateral protective measures against aggressive foreign anti-satellite satellites or aggressive foreign ballistic missiles.

Operational procedures for neutralizing large foreign non-functional space objects and component parts, which constitute debris, are limited. One means, conducted in space, might be direct contact with the offending debris by a space object of the shuttle type, in order to reposition it in a safer orbit or to facilitate its entry into the atmosphere with the expectation that it would then self-destruct without causing harm to persons and property on Earth. This would not be an immediate response to the threat.

Another procedures might be the use of lasers by anti-satellite satellites or ground based missiles. Successful use of such devices would produce smaller debris, which, under optimal circumstances would vaporize before it reached the Earth's surface, although it would create for a while new dangers to satellites operating in the vicinity of the new fragments. The response time might be shorter than that of a close approach by a shuttle.

For smaller debris, both foreign and that produced by the threatened State, reliance might be had on a permanently installed collecting device.[6] Presumably this device could be operated by non-military authorities. But, anti-satellite and missile operations would be military in nature.

It is also important to mention at the outset that different legal approaches govern the use of protective measures by a State against debris generated by it and that produced by a foreign State. There is an important distinction between a State's exercise of territorial jurisdiction and of extra-territorial jurisdiction.

Role of International Law

The standard approach to international law is that it is not an unlimited horizon of moral imperatives. It deals with only those subjects of such law including customary international law. The problem, of course, is to determine what subjects fall within the scope of international law.

It is evident that international law has a great deal to say about the range and scope of national sovereignty as well as the extent and meaning of national jurisdiction, since the exercise of national jurisdiction is the means whereby national sovereignty is implemented, either effectively or ineffectively. There are two geographical areas in which States exercise jurisdiction. First, it is exercised within a State's territory. Second, and with increasing regularity it is being exercised by a State beyond its territory, e.g., extra-territorial jurisdiction. This phase may, if the exercise occurs within the territory of another State, raise serious questions relating to accommodation with or disrespect for the latter's sovereignty.

There circumstances naturally produce a general inquiry. If the world's scientific and technical community understands the factual situation (debris and dangers) and has proposed important, if limited remedial measures, why it is that the world's legal community has not embarked on programs or projects which might provide the needed protections? This would allow for an orderly approach to the subject and could provide procedures designed to reduce the prospect for international tensions and discord.

In the era of a sure and steady enhancement of the values and interests of globalization additional questions must be asked: Who is most harmed by space debris? Stated otherwise: Who benefits the most from the presence of protective legal rules and standards? Who can prescribe the rules for national responses to threatening debris? What are the lawful and effective responses?

With society's overwhelming acceptance of and reliance on electronic communications, the private users of such facilities can be the greatest losers from the presence of space debris. In an economic sense the institutions providing such services are equally great losers. By the same token, governments which have the duty to protect the interests of users and suppliers are losers when commercial uses are disrupted. Governments with their concern for national security are losers in this separate area. To the extent that governments default in the protection of commercial uses it may be possible that private consortiums will fill the void.

For a while governments may deem it inexpedient to formulate rules and standards specifically directed at the regulation and control of foreign space debris. However, it should not be assumed that governments, acting collectively, will continually default from taking corrective action respecting dangerous debris. In the meantime Article 3 of the 1967 Principles Treaty mandates that general international law is applicable.[7]

Role of the United Nations

Much time and thought has been given to space debris by individuals, legal and scientific societies, governments, and, within specific limitations, public international organizations. Despite the increasingly serious threat posed by space debris to space activities, and despite the tremendous outpouring of effort and inquiry, as of this date only the Scientific and Technical Subcommittee of the UN's Committee on the Peaceful Uses of Outer Space (COPUOS) has come to grips with the subject. If the Legal Subcommittee had been engaged to the same extent, perhaps an analysis of the kind being undertaken in this article would be unnecessary. Regrettably, that is not the case.

The focus of the Scientific and Technical Subcommittee has been on the means and methods to prevent, mitigate, and otherwise reduce the harms, actual and potential, produced or yet to be produced by

space debris. Beginning in 1994 and continuing to the present the subcommittee progressively has given attention to the subject. In 1994 it focused on measurement techniques, mathematical modeling, the character of the debris environment, and spacecraft design.[8] In 1995 it gave particular attention to measures to mitigate the risks of debris.[9] In 1996 attention was again given to each of the foregoing subjects. For example, with regard to mitigation, inquiry was directed to shielding and collision avoidance.[10] In 1997 special attention was given to modeling of the space debris environment and risk assessment.[11] In 1998 the focus was again on mitigation.[12] In 1999 COPUOS gave its approval to the Subcommittee's ongoing assessment of the "effectiveness of existing mitigation practices and to the extent to which they were being implemented and stated that efforts to model and characterize the debris environment should continue."[13] The 1999 Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, while supporting the work of the Scientific and Technical Subcommittee, identified as a potential agenda item for the Legal Subcommittee the "legal aspects of space debris and review of existing norms of international law applicable to it. . . ."[14] The Conference also gave support to a practical approach that would facilitate the location of space debris, namely, "A disaster mitigation system, using scientific, Earth observation, data collection and mapping satellites coupled with a near-real-time data fusion (sic) and distribution system. . . ."[15] Such efforts, while laudatory, obviously are of a limited nature.

It is true that many worthy scientific and technical assessments of means and methods to prevent, mitigate, or otherwise reduce the harms produced by space debris have been made. Their focus has been on the avoidance of harm to operational space objects by small pieces of fragmented launched objects and their component parts. They have been directed toward reducing the prospect of harms; they have not resulted in formal legal prescriptions which would allow States, while acting either collectively or individually, to engage in measures that would prevent to the optimum degree the harms to persons and property following the impacting of large, non-functioning, space objects on functioning space objects or upon the surface of the Earth.

Perhaps the prospect of large space debris impacting on the surface of the Earth and causing harm there to persons and property is quite remote. In this case there would be no need for an assessment of a threatened State's legal grounds for taking protective measures. Perhaps there is the fear that if such protective measures were accorded legitimacy that such authority might be wrongfully extended so as to be supportive of imagined national-security needs. In such a case the rule would have to be designed in such a way as to carefully circumscribe its use. Yet, there have been instances of Earth-based destruction resulting from errant and non-functional space objects. Further, existing international agreements and general customary international law contain prescriptions dealing with the boundaries of the inherent right of self-defense.

Missing from existing studies has been an assessment of the practical means available to prevent large debris from causing harm on the Earth to persons and property. More importantly there has been almost a total absence of analysis of the legal premises upon which a State could take measures designed to prevent, through destruction or other effective procedures, a foreign non-operational satellite from causing earth-based harms to the threatened State.

While the international legal community has expressed itself on the dangers of space debris, it has yet to be placed on the agenda of the Legal Sub-Committee of COPUOS, undoubtedly because of the perceived relationship between the elimination of threatening space debris and the prospect of eliminating threatening ASATs.

The Legality of Unilateral Protective Measures

The failure to write new treaties dealing with the extra-territorial exercise of jurisdiction over foreign space debris may require a threatened State to engage in unilateral protective action. It is this prospect that I had in mind when I offered as a subtitle to this article "The Worst Case Scenario." This was based on the proposition that collective action taken on the basis of existing principles and rules is less offensive to the perceptions of its national sovereignty on the part of the State against which the unilateral protective action is taken. Nonetheless, in the face of inadequate collective measures, it can hardly be expected that a threatened State can fail to engage in such reasonable protective action as is legally available to it.

In seeking to arrive at a practical answer that could command legal respect it is necessary to start with the provisions of Article 8 of the 1967 Principles Treaty which states that "A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and any personnel thereof, while in outer space or on a celestial body."[16] Thus, the question has arisen whether the State of registry has rights and duties relating to such an object, and in particular whether that State has exclusive jurisdiction and control when the object threatens operating satellites in orbit or when the object, in close proximity to the Earth, e.g., in national airspace and no longer in outer space, poses dangers of harm to persons and to property located on the Earth's surface. Article 8 does not confer exclusive jurisdiction on the State of registry.

If Article 8 does not preclude a State other than the State of registry from exercising authority over a foreign functional space object, it might be supposed that there is also no exclusive jurisdiction and control over the object when it has taken the form of space-based debris. Without endeavoring to dispose of the view that a State other than that of registry may also exercise jurisdiction and control in a definitive manner, owing to space limitations, it may be sufficient to point out that Article 31 of the 1969 Vienna Convention on the Law of Treaties specifies that a treaty shall be interpreted "in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in light of its object and purpose," and also subject to supplementary means of interpretation as set forth in Article 32.[17]

Debris Defined

In 1994 under the leadership of K.-H. Böckstiegel and Maureen Williams, following many years of consultations with members, the International Law Association adopted the Buenos Aires International Instrument on Protection of the Environment from Damage Caused by Space Debris. In Article 1(c) space debris was defined to mean "man-made objects in outer space, other than active or otherwise useful satellites, when no change can reasonably be expected in these conditions in the foreseeable future."[18] "Man-made objects" include the launched object, the object when it has become non-functional, the

component parts of space objects, and fragmented bits and pieces, including such small items as flecks of paint and solid fuel residues, all of which can pose problems for orbiting satellites. Small-size orbital debris ranges in size from 1/100 mm to 20 cm. Included within this list would be the decommissioned Iridium fleet and the Compton Gamma Ray Observatory.[19]

While commentators over time were divided as to the identity and composition of space debris, there is general support now on the part of scholars for the Buenos Aires Instrument's definition. Such debris includes tiny particles of space junk all the way up to very large non-operational space objects. Since none of the formal international space agreements mentions the word "debris," the evolutionary development of the present understanding of the term is all the more meaningful.

Sovereignty and Jurisdiction

As previously noted the exercise of jurisdiction by a State is a manifestation of State sovereignty. "Control," being used conjointly with "jurisdiction" in Article 8 of the 1967 Treaty, may be perceived also as a manifestation of State sovereignty. In commenting on these terms Judge Lachs has indicated that they produce certain rights and obligations. In particular the expression "control" implies that a State of registry "has a right to require other States to refrain from interfering with the direction and supervision of the object or with any of the technical arrangements necessary for the fulfillment of its mission of exploration and use of outer space. It should also be interpreted as implying certain obligations for the State concerned, in particular those of ensuring (a) that the object or the personnel thereof do not infringe the legitimate rights of other States and (b) that the mission they are intended to perform does not conflict with the rules of law of outer space."[20]

It is generally accepted that jurisdiction accords to a State the capacity under international law "to prescribe" and "to enforce" a rule of law.[21] Through prescriptive jurisdiction States identify certain courses of conduct as delictual. Professor D.W. Bowett has provided examples of the use of prescriptive jurisdiction, namely, "criminal, civil, commercial codes, or regulations governing tax or currency transactions."[22] Professor Bowett also identifies some of the means whereby the enforcement element of jurisdiction can be implemented. He distinguishes between judicial and administrative procedures, with the latter including "arrest or seizure."[23]

Writing in 1958 C.W. Jenks identified as immediate space problems the issue of jurisdiction over activities in space[24] and self-protection against interference from space or with activities in space.[25] He observed that jurisdiction in space could be exercised by both international institutions and by States. In either case "questions will arise as to the extent to which and the manner in which national authorities may protect themselves against interference from space with matters within their territorial jurisdiction or interfere, by electronic or other means, with activities in space for the purpose of making such protection effective, or for other reasons."[26]

Jenks offered specific examples of where extra-territorial jurisdiction might be appropriate, namely, "interference from space with ground-based telecommunications or aviation, or damage on earth or to aviation resulting from the disintegration of space installations."[27] He cautioned, however, that "No abstract principle is likely to be of much service for the purpose of resolving such questions."[28] Moreover, he noted that satellites seeking to

re-enter the atmosphere would vaporize at certain heights so that there might not be a real problem. He also observed that when the re-entry problem was solved that this would create a new set of dangers.[29]

During the formative period of international space law there were numerous proposals based on security considerations which favored the diversion or destruction of space objects under certain circumstance. For example, The Davis Draft Code of Rules on the Exploration and Uses of Outer Space, prepared by British experts in the late 1950s, held that a State which had not given its consent to the presence of a foreign operating space object, was accorded the right "to divert or destroy" the offending spacecraft, except in the event of an emergency landing.[30] This proposal, borrowing from then-existing international air law, emphasizes the distinction between the prescriptive and the enforcement elements of jurisdiction

Debris and National Jurisdiction

Following the first space launches an increasingly refined science and technology have produced a very large number of launches, with a majority being successful, and a substantial minority being unsuccessful.

Between 1957 and 1999 there were 3,973 successful launches.[31] Between 1993 and early 1998 there were 39 major space losses.[32] Between May 8 and November 9, 1998 there were an additional six unsuccessful launches.[33] In 1999 and in 2000, unfortunately, there were more. In varying degrees both successful and unsuccessful launches have produced an abundance of potentially and actually harmful space debris.[34]

The threat to successful space activities by debris has brought with it a vast literature.[35]

International inquiries into the subject of jurisdiction have a longer history. The 1965 version of the Foreign Relations Law of the United States, Restatement of the Law, Second, was sponsored by the American Law Institute. The European Advisory Committee participated in the section dealing with jurisdiction. The Restatement (Third) made modifications.[36] Taking into account these and additional studies[37] it has become possible to distinguish a set of principles which in appropriate circumstances would allow for the extra-territorial exercise of jurisdiction.

In applying one or more of the principles, particularly in light of national sensitivity to the prerogatives of sovereignty, which, today, is being diminished by the forces of globalization, account must be taken of limitations on jurisdiction to prescribe.[38] Thus, Subsection (3) of Section 403 of the 1987 Restatement contains the admonition: "When it would not be unreasonable for each of two states to exercise jurisdiction over a person or activity, but the prescriptions by the two states are in conflict, each state has an obligation to evaluate its own as well as the other state's interest in exercising jurisdiction, in light of all the relevant factors, including those set out in Subsection (2); a state should defer to the other state if that state's interest is clearly greater."[39] Article 9 of the Principles Treaty requires that in such situations every State must take into account "the corresponding interests of other States."[40]

At the heart of approaches to the national exercise of extra-territorial jurisdiction is the concern for national security. In recent years this condition has been augmented by world outrage over the violation of basic human rights.[41] In both situations the conduct of foreign nationals is perceived as causing harm to the national or

international rights and interests of the affected State.

At present six approaches to the exercise of extra-territorial jurisdiction have emerged. They are territoriality, nationality, protective, passive personality, universality, and effects. Reference to the principles in the context of international space activity goes back to the cold war era with its concern for self-defense.[42]

The applicability of one or more of the above principles depends on the State of registry of the space object. Thus, it would not be questioned if a State of registry, pursuant to either the territoriality or the nationality theory, were to take unilateral action to prevent harms to its persons and property. Such action is a frequent occurrence when the launch fails or there is a reason to destroy the space object or its large component parts shortly after take-off. A State may employ the territoriality principle to deal with external events having a harmful impact on its territory. A State uses the nationality theory to impose constraints on a national, who, while abroad, embarks on conduct regarded as injurious to the parent State. The passive personality theory supports national legislation which deals with an act "committed outside its territory by a person not its national where the victim of the act was its national."[43] It has been applied to terrorist activities directed against nationals "by reason of their nationality."[44]

Three of the theories take into account the fact that the indicated conduct is criminal in nature. Thus, the passive personality, protective, and universality theories respond to conduct that is usually so serious as to qualify as a criminal act. The protective principle applies to offenses occurring outside the affected State by individuals who are non-nationals. Examples include espionage, counterfeiting, falsification of official documents, perjury before governmental officials, and violation of immigration and customs laws.[45] The universal principle, which has seen an increasingly wide acceptance and application in recent years, began with punishments of piracy and the slave trade. At present it is invoked in order to deal with attacks on or hijacking of aircraft, genocide, war crimes, and "perhaps certain acts of terrorism."[46]

Although the protective principle may be invoked in order to punish for criminal conduct, according to Bowett doubt has been raised as to such a limited characterization. He has stated that States "may claim such jurisdiction in relating to conduct which is not generally regarded as criminal at all."[47] Similarly, the universality principle has not been limited to criminal proceedings. This principle has been applied to remedies in tort or restitution by affected persons.[48] The effects principle focuses on "activity outside the state, but having or intended to have substantial effect within the state's territory."[49] Examples of this principle, which has its basis in injury to persons and property within a territorial area, include injury caused by firing a weapon into a State's territory from abroad, sending libelous publications across a national boundary, and sending injurious products from abroad. The authors of the Restatement have summarized this principle. Pursuant to it a State may "exercise jurisdiction based on effects in the state, when the effect or intended effect is substantial and the exercise of jurisdiction is reasonable."[50]

In light of the substantial damage which could be inflicted on a State by large foreign debris, such as a non-functional satellite or component parts, it is evident that the territorial, protective, effects, and universality principle have application to a State's decision to engage in the exercise of extra-territorial jurisdiction. Although the

harms against which action may be taken by a threatened State, as reflected in the foregoing examples, appear to be quite modest in comparison to the potential harm of large space debris, that should not exclude the legality of extra-territorial jurisdiction respecting such debris. To the contrary, the greater the danger the larger is the right and the responsibility of a threatened State to rely on such jurisdiction to engage in protective measures.

In weighing whether unilateral measures should be employed the threatened State could rely justifiably on the international liability for damage provision of Article 7 and the "due regard to the corresponding interests of all other States" provision of Article 9 of the 1967 Principles Treaty. Further, support can be found in the 1979 Convention on Long-Range Transboundary Air Pollution with its reference to harms to the human environment.[51] It recites that States are not to "cause damage to the environment of other States or of areas beyond the limits of national jurisdiction."[52] This has led to the observation that "there can never be a general right to cause substantial damage to another State."[53]

Concerns Respecting Unilateral Measures

While, from the perspective of harmonious relations between States, the exercise by a State of extra-territorial jurisdiction may be considered by the affected State as an incursion on its sovereignty, it is a fact that there are numerous instances in which the exercise of extra-territorial jurisdiction has been accepted. In the vast majority of situations there has been no undue burden on national security. The invocation has not resulted in countermeasures involving force. Nevertheless, great caution may be required, particularly if tense relations between affected States already exist.

Such concerns should not raise the issue of the legality of unilateral measures, although in practice, collective protective action would be preferred. The concerns relate to the means whereby protection might be assured.

The State of registry will monitor its space objects and will be aware of possible collisions and out of control descents. It may be able to avoid collisions and steer rogue satellites into ocean areas where those elements which are not vaporized will descend into open and unpopulated areas. A different situation may exist where the rogue satellite is subject to the jurisdiction and control of a foreign State. In such circumstances the State which could be impacted may not have detailed and reliable information concerning the nature, contents, and composition of the non-functioning large object. If such information were not provided by the State of registry, the jeopardized State, particularly in light of the presence on some space objects of nuclear-based fuels, might be compelled to take unilateral protective action. The fact that such a scenario may be quite remote does not obviate the need to assess the legal and practical responses to such a situation.

Conclusion

With globalization there will be a continually enlarging demand for more satellites in orbit. They will provide the communications and other services required to meet the needs for information, and more importantly, instant or real time information. To meet the needs new satellites must increasingly be placed in orbit. With such launches there will be failures. Older satellites are now completing their life expectancies. It is certain that space debris will result. Such debris, small or large, will

continue to be a threat to space objects and to persons and property on Earth.

Legal responses must be provided to the foregoing facts. While scientific and technical responses may be forthcoming, they, at best, can only mitigate the nature and extent of the harm resulting from the presence of both large and small debris.

There is a need for legal rules directly applicable to space debris. Such agreed upon rules would contain prescriptions and enforcement measures designed to reduce or eliminate the threat of space debris. The duty to achieve such results cannot be confined only to the State of registry although it must have the central responsibility.

There are a sufficiently large number of launching States having a common interest in mitigating and eliminating the threat of space debris that it can be hoped they would constitute a nucleus for forming relevant prescriptions and enforcement measures. At the present they have avoided the issue, possibly because of the perceived relationship between eliminating space debris and the need for rules allowing for defense of a State's territorial integrity.

Special, if necessary, legal rules for protecting against harmful space debris should be the product of collective State action, and might result in a formal international agreement.

However, absent such an outcome, there need only be a recognition of the fact that existing international law upholds the rights of States to engage in actions which have extra-territorial effect. While in a highly advanced legal system it would always be the best course to proceed by way of collective judgments, this is not always possible for a less advanced legal system, such as the one consisting of international law.

As a consequence of national sovereignty a State my enact laws applicable within the territory of that State. Additionally, a sovereign State may enact laws having extraterritorial force, that is, it may exercise national jurisdiction and control over events occurring beyond the areas over which it exercises territorial sovereignty. Among the choices open to the invoking State the strongest is the protective principle. The goals sought by several other principles, notably, the territorial and the universal principle, can be perceived as contributing to the enhancement of the substantive authority contained in the protective principle.

In short, the worst case scenario would be one in which a State threatened by foreign space debris failed to invoke and employ the legal opportunities available to it via the exercise of extra-territorial jurisdiction.

NOTES

1. *Christian Science Monitor*, June 6, 2000, p. 6, quoting Mr. Nikolai Zyubov, who was identified as an independent analyst in Moscow.

2. 23 UST 3435; TIAS 7503.

3. *Supra*, note 1 at 7.

4. The view is widely held that the principal danger in the nuclear field at the present time is the risk that "loose nukes" will fall into the hands of terrorists or irresponsibly militant States. Chinese officials have stated that the building of "NMD would abrogate the anti-ballistic missile treaty." *Christian Science Monitor*, June 22, 2000, p. 6.

5. However, it has been stated that "A unilateral right of states to remove foreign space objects is likely to cause

international conflict in view of the sensitivity of technological and military secrecy." F.K. Schwetje, Liability and Space Debris, in K.-H. BÖCKSTIEGEL, ed., ENVIRONMENTAL ASPECTS OF ACTIVITIES IN OUTER SPACE, STATE OF THE LAW AND MEASURES OF PROTECTION 36 (1990).

6. P. Sterns and L. Tennen, The Autonomous Space Processor for Orbital Debris (ASPOD) Project and the Law of Outer Space: Preliminary Jurisprudential Observations, Proceedings of the 38th Colloquium on the Law of Outer Space 107 (1996).

7. Entered into force on October 10, 1967. 18 UST 2410; TIAS 6347; 610 UNTS 205.

8. U.N. Doc. A/AC.105/571, 13, 10 March 1994.

9. U.N. Doc. A/AC.105/605, 16, 24 Feb. 1995.

10. U.N. Doc. A/AC.105/637, 24, 4 March 1996.

11. U.N. Doc. A/AC.105/672, 19-32, 10 March 1997.

12. U.N. Doc. A/AC.105/697, 18-25, 25 Feb. 1998.

13. General Assembly Official Records, Fifty-Fourth Session, Supplement No. 20 (A/54/20) 6 (1999).

14. Id. at 67.

15. Id. at 70.

16. Supra, note 7.

17. 63 AJIL 875 (1969), 8 ILM 679 (1969).

18. International Law Association, Report of the Sixty-Sixth Conference, Buenos Aires, Argentina, 1994, 317.

19. The latter, weighing 17 tons, was deliberately guided into the atmosphere by NASA on June 4, 2000 so that it would incinerate and break up. Tons of metal came to rest in the planned corridor ranging from about 2,500 miles southeast of Hawaii and extending in a southeasterly direction for some 2,000 miles. The controlled reentry was deemed less risky than allowing the satellite to destruct on its own. *Los Angeles Times*, 5 June 2000, p. A14. This reentry can be compared to that of the Skylab, which the United States abandoned in 1979. It fell out of control into the Indian Ocean and onto sparsely inhabited areas of western Australia.

20. MANFRED LACHS, THE LAW OF OUTER SPACE 70-71 (1972). Italic added.

21. American Law Institute, Restatement of the Law, Third (1987); Foreign Relations Law of the United States. See #402 at 237 ff for the analysis of the authority to prescribe jurisdiction and #431 at 321 ff for the authority to enforce jurisdiction.

22. D.W. Bowett, Jurisdiction: Changing Patterns of Authority Over Activities and Resources, in R. St. J. MACDONALD and D.M.

JOHNSTON, Editors, THE STRUCTURE AND PROCESS OF INTERNATIONAL LAW 555 (1983), republished in W. MICHAEL REISMAN, Editor, JURISDICTION IN INTERNATIONAL LAW 237 (2000).

23. Ibid.

24. C.W. JENKS, THE COMMON LAW OF MANKIND 390-394 (1958).

25. Id. at 394-395.

26. Ibid.

27. Id. at 395.

28. Ibid.

29. Ibid.

30. Draft Code of Rules on the Exploration and Uses of Outer Space 14 (n.d.). See also A. WOHLSTETTER and B.G. CHOW, SELF DEFENSE IN SPACE (1986).

31. TRW SPACE LOG 99 (1999).

32. 2 International Space Industry Report, No. 16, 28, Sept. 28, 1998.

33. Id. at 12.

34. On March 31, 1999 NASA reported that there were 8,674 non-functional objects in space which were large enough to be tracked from the ground. The former Soviet Union was responsible for 3,901 and the United States for 3,941, with the European Space Agency, China, Japan, India, and other countries being responsible for the remainder. NASA/JOHNSON SPACE CENTER, Christian Science Monitor, p. 2, June 24, 1999.

35. One convenient source is the Archimedes Institute Bibliography available at http://www.permanent.com/com/archimedes/ArchimedesBiblio.html. Another is the Orbital Debris Quarterly News which contains reports of the U.S. Inter-Agency Space Debris Coordinating Committee, now in its fifth volume. Major publications on the subject are H.A. BAKER, SPACE DEBRIS: LEGAL AND POLICY IMPLICATIONS (1987), INTERNATIONAL ACADEMY OF ASTRONAUTICS, COMMITTEE ON SAFETY, RESCUE, AND QUALITY, POSITION PAPER ON ORBITAL DEBRIS (1933), ORBITAL DEBRIS, A TECHNICAL ASSESSMENT, Committee on Space Debris, Aeronautical and Space Engineering Board, Commission on Engineering and Technical Systems, National Research Council (1995). In 1999 the Scientific and Technical Subcommittee of COPUOS published a 46 page TECHNICAL REPORT ON SPACE DEBRIS. A/AC/105/720. In 1999 the journal Space Debris with a focus on space debris research, technology, and policy began publication.

36. Supra, note 21. The subject was addressed in lectures as The Hague Academy of International Law by M. Bourquin in 1931, M.S. Korowicz in 1961, F.A. Mann in 1964, and R. Higgins in 1993. Focusing directly on space activities was the 1971 book by I.A. Casabafi entitled CONCEPT OF

37. Reisman, supra, note 22.

38. Absent a power to prescribe there would be no occasion to engage in enforcement measures.

39. Restatement Case Citations, #403, p. 208. In such circumstances there may be an evident need for the affected States to attempt to balance their competing national interests. Bowett, supra, note 22 at 568.

40. Supra, note 7.

41. B.S. Brown, Primacy or Complementarity: Reconciling the Jurisdiction of National Courts and International Criminal Tribunals, 23 Yale J. Int'l L. 383 1999; H.M. Osofsky, Domesticating International Criminal Law: Bringing Human Rights Violators to Justice, 107 Yale L. J. 191 (1997).

42. John C. Cooper, Self-Defense in Outer Space and the United Nations, 45 Air Force and Space Digest 51 (1962); N. Kittrie, "Aggressive" Uses of Space Vehicles – the Remedies in International Law, Proceedings of the Fourth Colloquium on the Law of Outer Space 198 (1964); C.Q. CHRISTOL, INTERNATIONAL SPACE LAW, 416-430 (1966); C.Q. Christol, Jurisdiction and Control: Permissible Unilateral Responses to Dangerous Space Debris, *liber amicorum* for Prof. Dr. K.H. Böckstiegel (in print).

43. Restatement Third, supra, note 21, 240.

44. Ibid.

45. Ibid., 240.

46. Id. at 254.

47. Supra, note 22 at 562.

48. Restatement, Third, Supra, note 21 at 255.

49. Id. at 239

50. Id. at 239

51. ILM 1442 (1979).

52. Ibid.

53. J.A. Frowein, Customary International Law and General Principles Concerning Environmental Protection in Outer Space, in K.-H. BÖCKSTIEGEL, ed., supra, note 5 at 165.