

Vienna.tx1
21 March 1995

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**Review of the Regulatory Regime Governing the Space Environment
- The Problem of Space Debris -**

Paper
for the Symposium

**"Technical and Policy Issues Related to the Use of the Space Environment",
Vienna, 27 March 1995,**

under the auspices of the
**UN Committee on the Peaceful Uses of Outer Space
and the International Institute of Space Law**

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1. Introduction

Outer space has been perceived in the 1980s as the new "fourth medium" of environmental protection¹, next to land, water and air. But at the Rio Conference on Environment and Development in 1992 the question of the space environment was almost entirely neglected² and, in fact, the discussion has been so far basically limited to experts and organizations concerned with outer space activities. The use and exploration of outer space from the viewpoint of environmental protection has two different main aspects. The first aspect is the contribution of outer space technology to environmental monitoring by remote sensing³ and by indirect benefits of technological innovations which may be useful for the development of environmentally sound processes and products and the saving of energy.⁴ The second aspect concerns the negative impact of outer space activities on the environment on earth and in outer space. Problems under consideration include topics such as harmful contamination and interference⁵, damage to the ozone layer and damage caused by space stations and solar satellites, as well as the still more remote issue of the impact of future mining operations on celestial bodies.⁶ Recently, however, the discussion of space-related environmental problems has focused on two main issues which are distinct, but related: damage caused by nuclear and radioactive space activities and space debris. This reflects that there are different priorities in the practice of international rule-making also with regard to the space environment.⁷

It is well-known that the Cosmos 954 incident in 1978 and later accidents gave the impetus for regulatory concern with respect to the use of nuclear power sources in outer space on the international level. But it took more than a decade of debate before the General Assembly adopted the Principles on the Use of Nuclear Power Sources in Outer Space in December 1992.⁸ These non-binding principles are not considered as adequate by a number of states and

¹ P.C. Storm, Die Bedeutung der Erforschung und Nutzung des Weltraums für den Umweltschutz, in: K. Kaiser/St. Frhr. von Welck (eds.), *Weltraum und internationale Politik* (1987), pp. 55 et seq.

² See, for example, the Research Paper No. 26...

³ PM, Erdfernerkundung, and YIEL

⁴ Peter-Christoph Storm, Welck, at pp. 570-571.

⁵ On planetary protection see G.H. Schwehm, Planetary Protection, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), pp. 61 et seq.

⁶ See I.H.Ph. Diederiks-Verschoor, *An Introduction to Space Law* (1993), pp. 116 et seq., distinguishing six different types of damage. ON minin: Storm, in Welck

⁷ See N. Jasentuliyana, Priorities for International Protection of the Space Environment, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), pp. 231-240.

⁸ See R.S. Eaton, The Use of Nuclear Power Sources in Outer Space, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection*

are currently under review.⁹

The other problem, on which this paper will concentrate, is related to the man-made pollution of outer space by the phenomenon called "space debris". After nearly 35 years of outer space activities, almost 22,000 objects launched into space have been catalogued with about one-third of them still in orbit. Of the more than 7000 space objects in orbit, only about 150 to 350 are active satellites; the rest consists of non-functional objects.¹⁰ It is estimated that approximately 70,000 objects larger than 1 cm in diameter, including satellites and pieces thereof, spent rocket stages, bolts, etc. are in various orbits. Moreover, in addition, there are probably hundred thousands of smaller particles, like i.e. paint flakes, which, due to the high velocity, are capable of causing serious damage to operational space objects in case of collision.

The problem of space debris was largely neglected until the mid 1970s, although first attention to its potential hazards was already given in 1965.¹¹ Following the first comprehensive public pronouncement of space debris by the American Institute of Aeronautics and Astronautics (AIAA) in 1981, research efforts were initiated and coordinated not only in the United States, but also by ESA and ESA member states, Japan and Russia. The general result of this research has been that the issue of orbital debris, particularly in lower orbits and in the geostationary orbit, must be addressed.¹² Such concern, however, does not necessarily mean the recognition of an immediate need for new international rules and principles, as it does not necessarily imply that the nature and urgency of the problems with regard to different orbits are the same. For example, in lower orbits there is a natural cleaning effect of removing space debris by the decay into the atmosphere after some time where most objects burn up. This effect is not available in the geostationary orbit. Nevertheless, it is important to note that the aforementioned Expert Group position paper, which was approved by the Board of Trustees of the International Academy of Astronautics

(1990), pp. 53 et seq.; PM NYIL and Benkō

⁹ problems: UK paper

¹⁰ L. Perek, Space Debris, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), p. 8 with figures in 1987.

¹¹ 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* (1990), p. 30 refers to R. Cargill Hall, Comments on Traffic Control of Space Vehicles, *Journal of Air Law and Commerce*, Vol. 31 (19865), p. 329. The contention that Japanese scholars first raised the issue in 1971 is thus incorrect: Nagatomo, H. Matsuo and K. Uesugi, Some considerations of the near Earth in future, Proceedings, 9th International Symposium on Space Technology and Science (Tokyo, 1971), p. 257, mentioned by Japan in UN Doc. A/AC.105/593 of 1 December 1994, p. 5.

¹² Professor Rex (1995) statement notes that it is now more or less common opinion that measures must be taken to deal with the accumulation of objects in the geostationary orbit. He also draws attention to the altitude region of 800 to 1000 km, mostly used by earth observation satellites, where currently the highest density of debris can be found.

(IAA) at its session of 19 October 1993 and also fully reflects the views of COSPAR¹³, stresses the need for preventive action with specific recommendations and concludes:

"Now, as the realities of the orbital debris problem start to become clear, it is evident that the most challenging task might well be how to develop regulations, accepted practices, or treaties that serve to control the growth of this hazard. Nearly 800 papers, articles, newsletters, and books have been written on this topic, but not one binding agreement has been reached on how to mitigate and minimize orbital debris. For this reason, we believe that the most important documents to be written concerning space debris do not yet exist."¹⁴

The increasing awareness of the problem in the scientific and technical community has induced the legal experts in space law to also take up the matter at an early stage in various fora, such as the International Institute of Space Law (IISL)¹⁵ and the Space Law Committee of the International Law Association (ILA).¹⁶ One important highlight has been the discussion of the topic from an interdisciplinary perspective at the 1988 "Colloquium on Environmental Aspects of Activities in Outer Space" organized by Professor Böckstiegel in Cologne, the proceedings of which are published.¹⁷ Meanwhile, there are a number of other publications on the matter, also dealing particularly with space debris.¹⁸ After 8 years of study, in 1994 the ILA Space Law Committee, under the chairmanship of Professor Böckstiegel and with Professor Maureen Williams as Rapporteur, adopted a draft Legal Instrument on the Protection of the Environment from Damage Caused by Space Debris at its meeting in Buenos Aires.¹⁹

¹³ See UN Doc. A/AC.105/593 of 1 December 1994, pp. 20-21 (Committee on Space Research).

¹⁴ p. 16. Other papers, reflecting European and American views, summarizing the research results so far are the Report on "Space Debris" by the Space Debris Working Group of the European Space Agency (1988) and the Report on Orbital Debris by the Interagency Group (Space) in the United States (1989).

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¹⁷ K.-H. Böckstiegel, Preface and Introduction, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), pp. 1-4; Böckstiegel already noted in his presentation 1983 at the United Nations on "Space Law at the Turn of the Century" in 1983 that environmental aspects should be a major concern for the future.

¹⁸ See I.H. Ph. Diederiks-Verschoor, Environmental Protection in Outer Space, *German Yearbook of International Law*, Vol. 30 (1987), pp. 249 et seq.; Qizhi He, Environmental Impact of Space Activities and Measures for International Protection, *Journal of Space Law*, Vol. 16 (1988), pp. 117 et seq.; G.C.M. Reijnen/W. de Graaff, *The Pollution of Outer Space, in Particular of the Geostationary Orbit. Scientific, Policy and Legal Aspects* (1989); H.A. Baker, *Space Debris: Legal and Political Implications* (1989).

¹⁹ Published in ZLW, but incorrect text...

The international political and law-making process, on the other hand, has been more reluctant to address such issues. And although there is a consensus that the problem of space debris constitutes a serious threat to future engagements in outer space²⁰ as well as to radio astronomy²¹, and early suggestions have been made by legal experts to deal with the issue in the Legal Subcommittee of UNCOPUOS²², due to lack of consensus, it was only in 1994 that the topic was placed on the agenda of the Scientific and Technical Subcommittee of UNCOPUOS. Proposals to also occupy the Legal Subcommittee with it have met with resistance by other delegations, taking the position that more secure and complete knowledge on space debris must be obtained, before legal regulation can be contemplated.²³

After some general considerations (2.), I intend to discuss the current legal situation and the changes suggested by legal experts and the ILA draft instrument under the following main aspects: the problem of defining space debris (3.), the general obligation to protect the environment (4.), specific obligations to cooperate and exchange technology and information (5.), consultation obligations (6.), responsibility and liability (7.), dispute settlement (8.) and some more specific issues (9.) Finally, I will offer some conclusions (10.)

2. General Considerations

Generally speaking, the function of an environmental regulatory regime is basically twofold: (a) to establish norms preventing damage to the environment and (b) to provide for restitution

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²¹ See S. van den Bergh, *The Effects of Space Debris and Satellite Interference on Astronomy*, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), pp. 71 et seq.; Reijnen, UN doc.

≈ KHB 1985

²² See Statement by Ms. Beth A. Masters, United States Representative to the Thirty-Second Session of the Scientific and Technical Subcommittee of UNCOPUOS, on Agenda Item 8, Space Debris, 13 February 1995:

"I would like to conclude by commenting on the role of the Subcommittee in addressing orbital debris. COPUOS previously agreed that this Subcommittee should develop a continuing, deliberate, specific multi-year plan for the Committee's work on orbital debris and address the acquisition and understanding of data on the characteristics of the space debris environment. The US continues to hold the view that it is not appropriate, at this time, to move the discussion of space debris into the Legal Subcommittee or to develop recommendations in the Subcommittee to underpin new legal norms for orbital debris. An adequate base of knowledge must be established within this Subcommittee before considering whether new legal norms should be developed."

Similarly the delegation of the United Kingdom (Statement by Mr. Richard J. Tremayne-Smith BNSC) noted

"that it is not appropriate to discuss space debris in the Legal sub-committee at this time, when it is clear that the technical issues need further study and consideration by a range of bodies, including academia and industry. It is certainly not the time to rush into drafting any prescriptive or restrictive texts that are not well founded."

or compensation in case damage has occurred. The emphasis has come to lie on precaution rather than on compensation and dispute settlement after damage to the environment has occurred. Certainly, one should not overlook the fact that an effective liability regime enforcing the "polluters pay principle" also has the effect deterring the repetition of harmful activities in the future. The central question in the case of space debris, however, is whether sufficient evidence can be produced to attribute the damage to a particular state and, whether our general knowledge of the phenomenon is sufficient and reliable enough to be able to attach specific legal consequences to certain conduct of states, be it actions or omissions.

Legal aspects of outer space activities in general and of the protection of the space environment in particular can not be properly dealt with without close cooperation with scientific and technical experts and deepened knowledge of lawyers of the continuing process of technological development in the exploration and use of outer space.²⁴ This need for an interdisciplinary approach is stronger in space law than in many other branches of the law²⁵ and must be observed not only with regard to formulating new legal rules in principles but also with respect to interpreting existing norms properly in the light of scientific and technological development. I agree with Sir Robert Jennings who in the fields of space law and environmental law referred to "the quite strict parameters provided by science and technology" and noted: "So often, when a problem has been scientifically investigated, the course of the development of the law is thereby made clear, and it becomes apparent that the possible choices are much more limited than would be imagined, certainly by lawyers speculating without the benefit of scientific knowledge."²⁶

The current regulatory regime governing the space environment has two different levels: the international level and the national one. Some action has meanwhile been taken on the national level, as in the United States.²⁷ Here I will deal only with the relevant international law, which basically consists of treaties, international customary law and general principles in the sense of the list of sources contained in Art. 38 of the Statute of the International Court of Justice.

At the outset, it may be noted that it is generally acknowledged by the legal experts in the field that the existing rudimentary treaty provisions are inadequate to effectively protect the

²⁴ Emphasized also by Böckstiegel, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), p. 1; M. Lachs, Customary International and General Principles of Law, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), pp. 149-152; see also Lachs AJIL.

²⁵ PM NYIL

²⁶ R. Jennings, Customary Law and General Principles of Law as Sources of Space Law, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), p. 151. See the corresponding remarks from a scientist, J.H. Carver, Protecting of the Environment in Outer Space, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), pp. 193 et seq.

²⁷ Public Law

space environment.²⁸ There are only few scholars who take a more optimistic view.²⁹

Customary international law consists of the two elements of state practice and the conviction of states that such practice reflects a legal obligation. It exists next to treaty law, as far it is not specifically derogated among the treaty parties, with the limit of higher norms of *ius cogens* or peremptory norms, as stipulated in Art. 53 of the Vienna Convention on the Law of Treaties. There are rather diverse views in the literature on the relevance of custom and general principles for regulating environmental effects of outer space activities. A negative school of thought concludes that specific rules of customary international law compelling states to prevent the pollution of outer space by space debris are lacking and that customary rules and general principles on the protection of the environment are either inapplicable or do not go beyond what is stated in the Outer Space Treaty (Rauschning)³⁰. A more positive school of thought attributes an important role to both custom and general principles in support of the contention that international law could not conceive the contamination of outer space to be legal (Frowein), or in the sense of complementing the fragmentary existing treaty framework (Williams) or at least constituting a suitable basis to develop it (Konstantinov).

Rules and principles of customary international environmental law are indeed rudimentary at best. Custom is not a very suitable method of developing specific rules and principles in this area.³¹ Principle 21 of the 1972 Stockholm Declaration on the Human Environment obliges states also to protect the environment of areas beyond national jurisdiction, the so-called international commons, including outer space, and to refrain from causing damage. But what this exactly means is far from established, even if one admits that this principle has meanwhile acquired the quality of a binding legal norm of custom. Even in that case it appears to be restricted to serious or significant harmful effects.³²

Finally, general principles of law as a source may safely be neglected here because it is

²⁸ See Frantzen, p. 627.

²⁹ E.G. Zhukova-Vasilevskaia, Protecting of the Outer Space Environment According to the Norms and Principles of International Space Law, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), p. 107.

³⁰ D. Rauschning, Customary International Law and General Principles of International Law concerning the Protection of Outer Space from Pollution, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), p. 186 concludes that there are no specific rules of custom obliging states to avoid producing space debris and that general principles are not applicable or do not go beyond what is stated in the Outer Space Treaty.

³¹ See also G.M. Danilenko, Space Activities and Customary Law of Environmental Protection, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), pp. 178 et seq.; Rauschning, *supra* (note 31), p. 185 refers to "ways and means of a technical character".

³² See also Danilenko, *supra* (note 31), p. 173; Beyerlin...

generally recognized that in space law they are of very limited usefulness.³³

The experience with international law-making concerning the terrestrial environment is that governments are not easily moved to accept new "hard law" obligations the precise consequences of which, especially in cost terms, they feel unable to calculate, even if the necessity of a solution to a problem is obvious in principle. Long-term commitments in their view must be warranted by long-term net benefits. This explains to a large degree the development of "soft law" in global environmental protection where states prefer to test new international rules and standards of conduct in practice without a legally binding commitment and which allows for political compromise in formulating abstract goals and principles which often do not mean very much in practice.

It has been convincingly demonstrated by scientists that the earlier measures are adopted to deal with the space debris problem, the lesser is the danger to have to face a situation later which has become intolerable and extremely difficult and costly to remedy.³⁴ Prevention is certainly better than cure. But prevention costs money and that in the eyes of governments must be justified on the basis of clear and tenable solutions. In international environmental law-making this problem is being discussed under the heading of "scientific uncertainty". It relates to the degree of scientific and technical knowledge required before it makes sense to try to formulate workable rules and principles of law. The arguments of those favourable to quick regulation rest on the assumption that the risk of costs of delay (in the broadest sense) is too high to warrant waiting for more definite results. The opposite position, mostly taken by governments, is that there is no justification for premature regulation in view of the financial costs of steps which may prove unnecessary and in view of restrictions that premature regulation may impose on technological development and the finding of alternative solutions. The respective constituencies of these arguments are, of course, different. [PM discussion of Adde]

Another general aspect is the question under which conditions the creation of effective new norms can be expected. [Lang] The experience of terrestrial environmental law-making is of particular interest in this connection, but it must also be qualified with regard to the specifics of the different interest constellation in international space law-making. Effective treaties will not be concluded if the major space powers abstain and relevant customary international law cannot develop without their practice, in the same way as land-locked states are not likely to make significant contributions to the general development of the law of the sea, apart from sustaining their specific interests of access to the sea and its richness.

3. The Definition of Space Debris

Space debris is not a term to be found in any of the existing international legal instruments governing outer space. There is no binding definition of the concept in international law and scientific and legal proposals do not necessarily fully coincide. {CSSSR uN paper}. The outer

³³ Jennings, *supra* (note 26), p. 151; Frantzen, p. 625: no importance

³⁴ Perek, *supra* (note 10); K.-H. Böckstiegel, *supra* (note 17), p. 3.

space treaties use the term "space objects", but there also is no agreed definition of it in international law. Some would like to include only payloads, while others consider the term to encompass also non-functional objects, including debris.³⁵ In the end this depends on the particular treaty regime, which is particularly relevant with regard to the scope of the 1972 Liability Convention, with which I will deal later. Proposals to adopt a definition of space debris in the Scientific and Technical Subcommittee of UNCOPUOS have not yet found acceptance by some other delegations who consider this step to be premature.³⁶

However, there are workable definitions proposed by both scientists and lawyers which are very similar. The Ad hoc Expert Group of the International Academy of Astronautics Committee on Safety, Rescue, and Quality has defined space debris as:

"any man-made Earth-orbiting object which is non-functional with no reasonable expectation of assuming or resuming its intended function or any other function for which it is or can be expected to be authorized; including fragments and parts thereof. Orbital debris includes non-operational spacecraft, spent rocket bodies, material released during planned space operations, and fragments generated by satellite and upper stage breakup due to explosions and collisions."³⁷

The ILA Instrument qualifies "space debris" as

"man-made objects in outer space, other than active or otherwise useful satellites, when no change can reasonable be expected in these conditions in the foreseeable future."³⁸

Examples given, from what debris may result include:

- "Routine space operations including spent stages of rockets and space vehicles, and hardware released during normal manoeuvres.
- Orbital explosions and satellite breakups, whether intentional or accidental.
- Collision-generated debris.
- Particles and other forms of pollution ejected, for example, by solid rocket exhaust.
- Abandoned satellites."³⁹

While the relevance of the difference of using the terms "spacecraft" in the first definition and the narrower term "satellite" in the ILA draft needs to be explored, it is interesting to

³⁵ Perek, supra (note 10), p. 7.

³⁶ PM YIEL

³⁷ Position Paper on Orbital Debris compiled by an Ad hoc Expert Group of the International Academy of Astronautics Committee on Safety, Rescue, and Quality, dated 8 March 1993, p. 1. The paper is annexed to UN Doc. A/Ac.105/593 of 1 December 1994.

³⁸ Art. 1 (c).

³⁹ Ibid.

note that the size of debris is of no concern to either definition and that both emphasize the loss of any function of objects or parts thereof. The delegation of the Czech Republic⁴⁰ to UNCOPUOS distinguishes the term "space debris" from the above definition of "orbital debris" given by the Ad hoc Expert Group, in the sense that the first also includes objects while they are decaying in the atmosphere down to their possible impact on the ground. This intends to serve to enlarge the scope of regulatory attention. As will be shown below, the same purpose is achieved in the ILA draft Instrument by defining other relevant terms, such as "environment" and "damage", accordingly.

4. General Obligation to Protect the Environment

The term "space environment", whether or not one adopts an anthropocentric approach with regard to the generally controversial term "environment" on earth, and apart from the unresolved problem of the proper delimitation of air space and outer space, is by no means self-explicable. Some authors maintain the concept of a "space environment" does not make any sense because there outer space would lack an ecological system.⁴¹ This view has been rebutted on the grounds that there is also an ecological balance in outer space.⁴² In my view, what really matters is not the character of the environment in outer space, but the fact that the question of adequate regulation of outer space activities in this respect arises from the double purpose in the interest of the international community and future generations, namely (a) to be able to safely continue with the exploration and use of outer space without producing harmful effects in outer space and (b) to prevent detrimental consequences from the pollution of outer space for life on earth.

The outer space treaties largely neglect environmental protection. Art. I of the Outer Space Treaty⁴³ may perhaps be interpreted as establishing a principle that, in the interest of equality of states in the use and exploration of outer space, no state is allowed to change the space environment in a way which would hinder outer space activities of other states.⁴⁴ But such a principle is vague and does not envisage specific legal consequences. The Outer Space Treaty is a framework treaty containing very general principles, requiring further elaboration before they can be effectively applied.

Furthermore, we have the environment related clauses in Art. IX of the Outer Space Treaty

⁴⁰ Statement on Space Debris, Scientific and Technical Subcommittee of UNCOPUOS, Thirty-Second Session, 6-17 February 1994.

⁴¹ Rauschnig, *supra* (note 30), pp. 181-186, at p. 184.

⁴² G. Jaenicke, *Suggestions for Legal Measures and Instruments*, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), pp. 251-256, at p. 253. See also B. Frantzen, *Umweltbelastungen...*, in: Böckstiegel, *Handbuch...*, p. 611 note 88

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⁴⁴ Frantzen, p. 610 with references.

and Art. 7 of the Moon Treaty. Art. 7 and other relevant provisions of the Moon Treaty may be neglected here⁴⁵, simply because of the low legal and practical significance of the Treaty in view of the very limited number of signatures and ratifications and the fact that none of the state parties are currently in a position to conduct activities on the moon⁴⁶. The Treaty is not binding for non-parties and the relevant space powers. In particular, it does not establish any customary law principle of the so-called heritage on mankind with specific legal consequences, although some tend to argue to the contrary.⁴⁷

Art. IX of the Outer Space Treaty, on the other hand, was not designed with the protection of the environment as such in mind, but rather in the interest of the other states parties to the Treaty.⁴⁸ The provision, stipulating that states parties shall avoid "harmful contamination" of outer space, including the moon and other celestial bodies, "and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and where necessary, shall adopt appropriate measures for this purpose", does not bind states which have not accepted the Outer Space Treaty. While the failure to expressly mention commercial activities in Art. IX may be qualified as a drafting mistake without legal consequence, more important is that the Outer Space Treaty refrains from clarifying what is "contamination" and under which circumstances such contamination is "harmful".⁴⁹ There are no objective standards and the question at which point space debris, for example, becomes a specific danger to the space environment, depending on the degree of risk of collision with functioning space objects is a matter of dispute and rests on the specific context⁵⁰.

It is important to note in this connection that the methods of tracking space debris are still rather imperfect. Writing in 1987, Perek notes that the tracking network of NORAD permits with radar to detect objects of 4 cm diameter at 200-300 km altitude, or 10 cm at 1000 km, or 1 m at 5000 km. Optical methods enable the detection of 15 cm objects at 5000 km and

⁴⁵ See E. Galloway, *The Present Status of the Agreement Governing the Activities of States on the Moon and other Celestial Bodies*, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), pp. 81 et seq.

⁴⁶ See also Danilenko, *supra* (note 31), pp. 171 et seq.

⁴⁷ PM, NYIL

⁴⁸ Frantzen, p. 611.

⁴⁹ Zhukova-Vasilevskaia, *supra* (note 29), p. 105; M. Williams, *Customary International Law and General Principles of Law*, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), pp. 158 et seq.; see also the analysis by Danilenko, *Space Activities and Customary Law of Environmental Protection*, *supra* (note 31), p. 171.

⁵⁰ Within the limited scope of this paper, I need not deal with the issue of "back-contamination" addressed in Art. IX, apart from noting that this notion also lacks any clear criteria for the unfavourable alteration of the earth environment. See Frantzen, pp. 612-613 with references.

1 m objects in the geostationary orbit.⁵¹ Objects included in the database of the United States Space Command's Space Surveillance Network (SSN) are objects larger than 10-50 cm in diameter for LEO and 1 m in diameter in higher orbits.⁵² These methods have been and are being improved.⁵³ But existing inventories are still unable to register huge amounts of debris and estimations of the population in certain orbits depend on methods of mathematical computer-based modelling with all their inexactness and uncertainties which require support by measurement data.⁵⁴ The reliability and precision of such models is one of the central problems for assessing the future evolution of the space debris population and the effectiveness of available countermeasures accurately enough, also in terms of costs and feasibility.⁵⁵

If it is true that the rate of annual increase of this space debris in orbit amounts to 10%, it is not surprising that experts conceive the likelihood of collision in orbit as increasing considerably⁵⁶. One altitude identified in 1985 as having the highest probabilities of collision

⁵¹ Perek, *supra* (note 10), p. 8, writing in 1987; Schwetje, *supra* (note 11), p. 31 states that NORAD "can track an object of the size of a soccer ball in geosynchronous orbit".

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⁵³ In 1995 the United States delegation informed UNCOPUOS on new progress made in 1994 in this respect. According to this information the Haystack Orbital Debris Radar is able to detect debris objects that are as small as a pea orbiting 650 km in space. It was found that at low altitudes of 400-650 km the actually measured debris population was below predicted levels. On the other hand, in higher altitudes of 750-900 km, important for scientific, earth observation, weather and communications satellites, the amount of debris was higher than predicted in modelling. The detection of small debris objects is expected to be improved by space based missions commenced by the United States in 1994 (Orbital Debris Radar Calibration Spheres). Furthermore, as regards the geostationary orbit, studies have shown that one-third of the objects identified in this orbit are not registered in any catalog. The deployment of a portable Liquid Metal Mirror Telescope in 1994 is expected to assist in detecting objects as small as 1 cm at altitudes ranging from that of the Space Station to sunsynchronous orbits and as small as 5-10 cm in the geostationary orbit.

⁵⁴ A report on national research from Germany notes: "A reliable database describing the debris population is only available for a minor part of the population, about 7,300 objects, whereas the characterization of the larger risk posed by the untrackable population is subject to debris modelling. These models are based on the simulation of all in-orbit fragmentations and are supported by a number of actual measurements. The ESA MASTER is currently under development at the Institute of Space Flight Technology and Nuclear Reactor Technology (IfRR) at the Technical University of Braunschweig under contract to ESOC (10453/93/D/CS). The development is in the final stages, the finalization and distribution of the model are scheduled for early 1995. The model will provide a huge background of information to users with an engineering, scientific or political background." UN Doc. A/AC.105/593/Add.1 of 24 January 1995, p. 3.

⁵⁵ See Statement by D. Rex, Thirty-Second Session of the Scientific and Technical Subcommittee of Copuos, 6-17 February 1995, Agenda Item 8: Space Debris.

⁵⁶ See, with references, K.-H. Böckstiegel, Procedures to Clarify the Law Regarding Environmental Aspects of Activities in Outer Space, manuscript by courtesy of the author, to be published in: Proceedings of the International Institute of Space Law 1989. Perek., *supra* (note 10),

is at 800-1000 km.⁵⁷ As regards LEO, for example, a recent British study concludes that under current levels of debris deposition into orbit, catastrophic growth of collision fragments should not occur for at least 10 years. But if this deposition rate would grow, the cascading phenomenon may occur as soon as 2040.⁵⁸ The other main concern is related to the physical crowding of the geostationary orbit by satellites.⁵⁹

What matters is also that there is also no international procedure to establish legally binding standards in this respect. This is the main problem for assuming, as Frowein does, that "[as] soon as the scientists were able to prove that additional debris would create not only a theoretical but very practical risk for new space activities or even for the Earth a new rule might well be come into existence".⁶⁰ Scientific advice is essential, but it is also often conflicting, and needs to be translated into binding international standards through established procedures.

Finally, we have the principle of cooperation⁶¹. Cooperation plays a prominent role in space law, but I agree with Maureen Williams that international cooperation is not a rule of customary international law or a general principle of law.⁶² On the other hand there may very well be a duty to cooperate as a general principle, existing irrespective of possible disputes on lawfulness of a specific action or on liability, if damage beyond control of one state with substantial risks for other states, such as in the case of transfrontier nuclear accidents. In this case the state responsible is obliged to inform, cooperate and limit the damage.⁶³ [areas beyond national jurisdiction Principle 21 and Rio Declaration] But the existing space treaties do not establish a general obligation to protect and preserve the earth

pp. 13-15 for details as of 1987.

⁵⁷ Perek, *ibid.*, p. 14 with reference to D.J. Kessler.

⁵⁸ C.R. McInnes, An analytical model for the catastrophic production of orbital debris, *ESA Journal*, Vol. 17, No. 4 (1993), pp. 293-305, cited by the United Kingdom in UN Doc. A/AC.105/593 of 1 December 1994, p. 16.

⁵⁹ W. Flury, The Situation in the Geostationary Orbit, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), pp. 17 et seq.

⁶⁰ J.A. Frowein, Customary International Law and General Principles Concerning Environmental Protection in Outer Space, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), p. 165.

⁶¹ see V. Kopal, Some Remarks on Legal Aspects of Space Debris, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), p. 46, emphasized also by Zhukova-Vasilevskaia, *supra* (note 29), p. 105, suggesting that the principle should become "legally obligatory"

⁶² Williams, *supra* (note 49), p. 161. But check UN Charter and EPIL.

⁶³ Frowein, *supra* (note 60), pp. 166 et seq.

and space environment.⁶⁴

In Art. 3, the ILA draft Instrument establishes a general obligation of states and international organizations parties to it to cooperate "directly, and/or through the pertinent international organizations, to protect the environment and implement this instrument effectively"⁶⁵ and to "take all appropriate measures to prevent, reduce and control any damage or significant risk arising from activities under their jurisdiction or control which are likely to produce debris."⁶⁶ It is important to note that in the preceding Article the scope of application of the instrument is limited to "space debris which causes or is likely to cause direct or indirect, instant or delayed damage to the environment, or to persons or to objects."⁶⁷ The draft instrument clarifies that the term "environment" in the instrument is not restricted to the space environment but includes "earth environments within or beyond national jurisdiction", such as the high seas and Antarctica.⁶⁸

The obligation to prevent, reduce, and control any damage must also take the broad definition of "damage" into account which covers not only "loss of life, personal injury or other impairment of health, or loss of or damage to property", but also "any adverse modification of the environment of areas within or beyond national jurisdiction."⁶⁹

Somewhat surprisingly, there is also a definition of "contamination/pollution", terms used as synonyms and considered as "inclusive of all harmful elements other than space debris", in the sense of "a human modification of the environment by the introduction of undesirable elements or by the undesirable use of those elements".⁷⁰ If one reads the following final text of the draft Instrument, however, the reason for including this definition, as it says "[f]or the purposes of this instrument"⁷¹, is unclear, for it only refers to "space debris" and not once to "contamination/pollution" in the operational articles.

5. Cooperation and Exchange of Technology and Information

In a preventive approach, the need for specific forms of international cooperation and exchange of knowledge and information is generally recognized. The 1975 Registration

⁶⁴ Danilenko, *supra* (note 31), p. 171.

⁶⁵ Art. 3 (1).

⁶⁶ Art. 3 (2).

⁶⁷ Art. 2

⁶⁸ Art. 1 (d).

⁶⁹ Art. 1 (e).

⁷⁰ Art. 1 (a) and (b).

⁷¹ Art. 1.

Convention, generally a weak instrument in practice⁷², is an inadequate tool in this respect.⁷³ An obligation to provide - limited - data "to the greatest extent feasible and as soon as possible" only exists with regard to the launch of a space object and when it is no longer in orbit. It does not really encourage a practice of registering data which may assist in determining the degree of pollution of the space environment⁷⁴. Scientists have emphasized the necessity of improving of mechanisms to collect, process and disseminate in time data on space debris (Perek).⁷⁵ Lawyers have proposed the extension of the information required under Art. IV of the Registration Convention⁷⁶.

Art. 4 of the ILA draft Instrument contains some more specific obligations of states and international organizations, including the following:

- "(a) To cooperate in the prevention of damage to the environment and make every effort to avoid situations that may lead to disputes.
- (b) To cooperate, in accordance with their national laws and practices, in promoting the development and exchange of technology to prevent, reduce, and control space debris.
- (c) To encourage and facilitate the flow of information of a scientific, technical, economical, legal, and commercial nature relevant to this instrument."⁷⁷

When promoting these activities, special attention is to be given to the needs of developing countries.⁷⁸

In fact, we already have forms of international cooperation with regard to space debris, which, however cannot be in any way be classified as "custom" in the legal sense as a source

⁷² See L. Perek, Suggestions for the Future, in: K.-H. Böckstiegel (ed.), supra (note 10), p. 215.

⁷³ Frantzen, p. 619.

⁷⁴ V. Kopal, Some Remarks on Legal Aspects of Space Debris, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), p. 47 takes a different view stating that the latter provision Art. IV (3) "offers a good basis for developing a practice of providing more detailed information about space debris remaining in outer space in connection with the decay of space objects". See also E.G. Zhukova-Vasilevskaia, supra (note 29), p. 106. But see to the contrary HE Qizhi, On Strengthening International Measures for Protection of Space Environment, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), p. 247.

⁷⁵ Perek, supra (note 72), pp. 211 et seq. makes a list of specific suggestions.

⁷⁶ Frantzen, p. 631 with references

⁷⁷ Art. 4 (a)-(c).

⁷⁸ Art. 4 (f).

of international law.⁷⁹ In 1993 NASA, ESA, NASDA (Japan) and the Russian Space Agency (RSA) formed the multilateral Interagency Orbital Debris Coordination Committee (IADC). Within this framework scientists can exchange information on space debris activities, cooperate in space debris research, review the progress of ongoing activities and discuss debris mitigation options. There are also four working groups dealing with measurements, environment and data bases, protection and mitigation of orbital debris.

6. Consultation

One major problem area in international law is the extent to which states are obliged to notify and consult other states if certain activities cause, or are likely to cause, damage to the environment. Under customary international law, with some confidence it is possible to identify a general obligation of states, at least in serious cases involving significant harm, to inform other states on new or additional environmental hazards which may affect them⁸⁰. Less secure is the existence of a general obligation in customary international law to consult other states in such cases⁸¹. [check Beyerlin, etc. PM] At least, as far as the form of procedure of consultation is concerned, we have no agreed custom. And, certainly, there is no general obligation in state practice of having to obtain the consent of an affected state before commencing with a potentially harmful activity. The problem is basically left to the rules and principles of state responsibility and liability.

With regard to outer space activities, Art. IX of the Outer Space Treaty provides for a consultation procedure which can be invoked either by a state party responsible for an activity or experiment planned would cause potentially harmful interference with activities of other states or by any state party endangered by the project of another party.⁸² But such a request must be based on sufficient reason which presupposes that the possibly affected state has to be in possession of necessary information concerning the foreign project or activity. Art. IX does not explicitly mention any obligation to provide such information, however, this may be based on principles of customary law.⁸³

Furthermore, the question is whether a state may refuse to enter into consultations.⁸⁴ He Qizhi takes the view that consultation is not mandatory. Refusal to initiate or to enter into consultations would not constitute a violation of the Treaty.⁸⁵ This view is supported by the

⁷⁹ incorrect Reijnen.

⁸⁰ Williams, *supra* (note 49), p. 159; Danilenko, *supra* (note 31), p. 173.

⁸¹ I am thus less sure than M. Williams, *supra* (note 50), p. 159. See Beyerlin... and Danilenko, *supra* (note 31), pp. 173 et seq.

⁸² Text...

⁸³ Frantzen, p. 615.

⁸⁴ See Zhukova-Vasilevskaia, *supra* (note 29), p. 104.

⁸⁵ HE Qizhi, *supra* (note ⁷³85), pp. 246 et seq.

unclear status of such obligations in international environmental law in general.⁸⁶

Lacking an objective international authority, state parties in fact control themselves and are more likely to be guided by the perceived national interest than by general environmental considerations, making consultations an unlikely event in practice. Moreover, consultations are consultations only and need not lead to a certain result or agreement. Even if it is clear that the activity in question will result in a change of the environment, the Outer Space Treaty provides no legal instrument to stop it.⁸⁷ A possibly endangered state has no right of veto. Finally, the provision clearly only refers to planned activities. It does not establish any obligations to consult with respect to activities in progress.

What are the concrete obligations following from Art. IX for states parties to the Outer Space Treaty? Even if one could argue that they are obliged to contribute to the removal of space debris, should entire areas of outer space become polluted, the fact remains that any specific measures to be adopted are left to their discretion. Whether the measures are "appropriate" or not thus depends on the subjective assessment by a particular state itself. There is no international agency or mechanism which could set binding objective criteria.⁸⁸

Lawyers have proposed that this ineffective consultation procedure should be substituted by an efficient and binding dispute settlement mechanism.⁸⁹ The draft ILA instrument goes some way in that direction. If a state, group of states or international organizations "have reasons to believe that activities carried out under their jurisdiction or control, or planned to be carried out under their jurisdiction or control, or planned to be carried out, produce space debris that is likely to cause damage to the environment, or to persons or objects, or significant risk thereto", consultations must be held.⁹⁰ Any party to the instrument may also request consultations "when it has reason to believe" that the activity of another party "produces space debris that is likely to cause damage to the environment".⁹¹ The provision further stipulates that "refusal to hold consultations, or the breaking up of such without justification, shall be interpreted as bad faith."⁹² The draft Instrument sharpens this to an obligation also to "negotiate in good faith" not only to hold consultations or talks, but to "also pursue them with a view of reaching a solution".⁹³

⁸⁶ see below.

⁸⁷ Frantzen, p. 615.

⁸⁸ Frantzen, pp. 613-614 with references.

⁸⁹ Frantzen, 632, K.-H. Böckstiegel, supra (note 17); ILA

⁹⁰ Art. 4 (d).

⁹¹ Art. 4 (d).

⁹² Art. 4 (d).

⁹³ Art. 4 (e).

Although no actual result of such negotiations is required and the text of the ILA Instrument does not contemplate any requirement of agreement of parties potentially affected by space debris of another party to the particular activity at issue, the obligations are stricter than in Art. IX of the Outer Space Treaty in several respects. First, not only states but also international organizations are covered. Second, the consultation requirements are not limited to planned activities. Third, a request for consultation cannot simply be refused and consultations must be held with the aim of reaching solutions. Thus, a breach of these obligations would imply legal consequences of liability.

7. Responsibility and Liability

It is well known that the Outer Space Treaty distinguishes between responsibility and liability in Arts. VI and VII. With regard to liability, one must distinguish between the Outer Space Treaty and the Liability Convention. Neither the parties to these treaties are identical, nor is the liability regime. The Outer Space Treaty only contains a general clause on liability and is based on the traditional fault principle in customary international law, requiring wrongful intent or some form of negligence on the part of the launching state.⁹⁴ The 1972 Liability Convention is rather unique in international law in establishing for the first time a genuine inter-state principle of absolute liability, regardless of fault and the related burden of proof problems for claimant states, if damage occurs on their territory or to an aircraft in flight.⁹⁵

The Convention, however, does not protect the space environment as such⁹⁶, but only space objects of other states or persons or property on board. Here the fault principle applies, for which no clear standards exist, except by recourse to customary international law. The Convention also requires actual damage in the physical sense⁹⁷ and is thus no basis for claims of removing inactive space objects or space debris before a collision with a foreign space object occurs.⁹⁸

Liability of the launching state(s) further requires that a space object has caused the damage. The term "space object", however, is not clearly defined in international space law.⁹⁹ While

⁹⁴ PM Haftung

⁹⁵ Malanczuk

⁹⁶ See also Zhukova-Vasilevskaia, *supra* (note 29), p. 107 with reference to Jasentuliyana and He Qizhi; S. Gorove, *Environmental Risks Arising from space Activities: Focus on the Liability Convention*, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), p. 127 arguing that there is no recourse under Convention if damage to elements of the environment is not related to damage to property. See also Danilenko, *supra* (note 31), p. 176, He Qizhi, *supra* (note 74), p. 247.

⁹⁷ PM, Haftung, see also Gorove, *supra* (note 96), p. 127, who also includes damage from nuclear radiation from a nuclear power source in the concept.

⁹⁸ See vitt

⁹⁹

it is not doubted that launching states are liable for damage caused by inactive satellites, some confusion exists on whether there is also liability for damage caused by space debris of a space object which has disintegrated, for example, colliding with an active satellite of another nation.¹⁰⁰ Even if one argues that the term space object includes component parts and thus space debris of whatever size¹⁰¹ [CSSR 1992 paper UN] of a disintegrated object, the real difficulty lies in the field of evidence and burden of proof. The claimant state has to show that the damage was caused by artificial space debris and not by a natural object. It must further prove that the piece at issue stems from an identified space object of another state. If space debris collides with an foreign active satellite in orbit, the claimant state also would have to establish fault in some form of negligence on the part of the state to which the debris is attributed. Practically, all of this will be impossible in most cases¹⁰². Moreover, in a situation where the object is large enough to be trackable and identifiable, it is likely that measures in advance are taken to avoid collision.¹⁰³

Proposals in the literature to impose absolute liability on the registry state for damage caused by its debris in outer space are only suggestions for changing the law in the future, not current law under the Convention¹⁰⁴. Some try to achieve the same result by reinterpreting the fault principle in a sense that it would be negligent to cause space debris¹⁰⁵. But this view is too simplistic because, unless deliberately caused, space activities completely without production of space debris is not possible at the moment and removal measures are not generally and immediately adoptable.¹⁰⁶ Establishing fault in a claims procedure is also hampered by the fact that approximately half of the satellite breakups cannot be clearly attributed to a certain cause and more knowledge would require considerable mission-specific information which is not easily to be obtained.¹⁰⁷ At any rate, such a proposal is also nothing more than a view on the desirable law in the future, not a valid interpretation of the Liability

¹⁰⁰ Frantzen, pp. 620-621 with references.

¹⁰¹ See also Kopal, supra (note 74), p. 47; Gorove, supra (note 96), p. 129.

¹⁰² See also Kopal, supra (note 74), p. 47; Gorove, supra (note 96), pp. 131 et seq.

¹⁰³ Schwetje, supra (note 11), p. 41.

¹⁰⁴ For example Hall, cited by Schwetje, supra (note 11), p. 40; see also S. Gorove, supra (note 37), p. 132. Danilenko, supra (note 31), p. 176, sees a possible exception under current law: "In cases involving significant environmental damage the principle of absolute liability may, however, become applicable if environmental damage clearly results in damages as defined by the Convention." But he gives no reason for this deviation from the clear wording of Arts. II and III of the Convention in this respect. This is surprising as he later correctly observes that there is no such principle of absolute liability in customary international law outside of specific treaty regimes.

¹⁰⁵ Carl Q. Christol, *The Modern Law of Outer Space* (1982), p. 142.

¹⁰⁶ See also Schwetje, supra (note 11), pp. 40-41.

¹⁰⁷ Schwetje, *ibid.*, 41.

Convention as it stands¹⁰⁸. Moreover, neither the introduction of the absolute liability principle or a corresponding reinterpretation of the fault principle by themselves would overcome the still persisting identification and evidence problems.

The question whether a launching state may be held liable for leaving an inactive satellite in outer space under the fault principle [under general int. law? then later] has been answered in the negative in view of the still small risk of collision. There would be no internationally wrongful act because the launching state is not responsible for a harmful contamination in the sense of Art. IX of the Outer Space Treaty.¹⁰⁹ This reasoning implies that a different rule may apply once the assessment of the degree of collision risk changes. With regard to certain orbits, there are already statements from the scientific community in this direction. But it is not clear how reliable this data is. The central question, however, is who is the ultimate assessor with legally binding effect and in which procedure is this to be determined? And, if there is no collision and actual damage to another space object, the question remains of who is the proper claimant state. The international community as a whole, meaning every state, or all other space nations interested in (and capable of) using the orbit¹¹⁰? Furthermore, what would the purpose of such a claim be? It cannot be for compensation for direct damage because there is no actual damage, only a danger.

Judge Lachs and others have referred to the codification project of the International Law Commission on liability for acts not prohibited by international law and noted that the development of the law so far has been inadequate, requiring closer collaboration between lawyers and scientists.¹¹¹ But the value and future of this codification project and its relationship to the parallel project of the ILC to codify state responsibility for internationally wrongful acts is very much open to doubt. At any rate there is no standard of absolute liability in customary international law outside of specific treaty regimes.¹¹²

The existing liability regime is therefore highly inadequate of providing solutions to the problems caused by space debris. As a general rule, the ILA Instrument stipulates that its responsibility and liability rules "apply to damage caused by space debris in the space environment and, in the absence of other international agreements on the matter, to damage caused to the earth environment."¹¹³

The first important observation is, as noted above, that the instrument defines "damage" in a much broader sense than Liability Convention. Furthermore, in Art. 7 the ILA instrument lays down that parties launching or procuring the launch of a space object bear international

¹⁰⁸ See also Gorove, *supra* (note 96), p. 132.

¹⁰⁹ Frantzen, p. 623.

¹¹⁰ Williams, *supra* (note 49), p. 158 seems to take this view.

¹¹¹ in KHB

¹¹² PM Haftung, see also Danilenko, *supra* (note 31), pp. 177 et seq., contrary to Reijnen.

¹¹³ Art. 6.

responsibility for "assuring that national activities are carried out in conformity with the provisions of this Instrument, the 1967 Space Treaty, and the 1972 Liability Convention". Clearly, the term "international responsibility" is meant to be used here in the sense of Art. VI of the Outer Space Treaty, ensuring state responsibility for all national, including private outer space activities. The question is whether the additional reference to the 1972 Liability Convention is appropriate. If the specific legal implications in this respect under the 1972 Convention are the same as under the Outer Space Treaty, then it would not appear harmful, but perhaps superfluous. If they are not, then a problem arises for those parties which have accepted the Outer Space Treaty, but not the Liability Convention.

Under Art. 8 of the ILA document, parties are "internationally liable" to other parties for damage arising from launching or procuring the launch of a space object "as a consequence of space debris produced by any such object". The Liability Convention with its distinction between fault liability and absolute liability is not specifically mentioned in contrast to the aforementioned article on responsibility. As noted above, the Liability Convention contains an absolute standard of liability only for damage (in the sense of actual, physical damage at least in the first place) occurring on the surface of the territory or to the aircraft in flight of another state party. As the Outer Space Treaty, contrary to some assertions in the literature, did not proceed beyond customary international law standards of liability, excluding absolute liability¹¹⁴, it seems that the current standard implied by the draft ILA instrument is that of fault liability, unless customary law progresses to a different standard and thus may have an impact on the interpretation of the instrument in the sense of subsequent treaty practice.¹¹⁵

The true innovation for parties to the Liability Convention, therefore, in accepting the ILA instrument would be not in extending absolute liability beyond the narrow scope of Art. II of the Liability Convention, but to extend the fault liability principle to "any adverse modification of the environment of areas within or beyond national jurisdiction" as defined in Art. 1. In consequence, the evidentiary and burden of proof problems remain. In addition, this begs the question of the appropriate claimant state entitled to take legal action for damage done to the space environment as such by another state. Is it an *erga omnes* obligation, entitling all states to react, and if so, with which precise legal consequences as regards state responsibility and dispute settlement? These issues are far from settled in general international law and the codification activity of the International Law Commission.¹¹⁶ It is also not clear what exactly damage arising "as a consequence of space debris" means because this leads into the controversial area of identifying the causal link and "approximate cause" in state responsibility. Another source of unclarity concerns the implications within the liability regime as such of the wording of Art. 2, dealing with the scope of application of the instrument, covering space debris "which causes or is likely to cause direct or indirect, instant or delayed damage to the environment, or to persons or objects." This seems to go beyond the secured concept of compensable damage envisaged in the Liability Convention.

¹¹⁴ Malanczuk, Haftung

¹¹⁵ Karl Wolf

¹¹⁶ articles in EJIL

These issues seem to need further clarification.

8. Dispute Settlement

Effective Dispute settlement mechanisms are crucial problem of international law because states are generally reluctant to submit to binding third-party decisions.¹¹⁷ The Liability Convention provides for a dispute settlement mechanism, but not for a binding third-party decision at the end, if both parties do not agree. We have no practice under the Liability Convention, except for the references to it by Canada and the former USSR in the negotiations leading to the settlement of the Cosmos 954 case by an ex-gratia payment and there is some dispute on the legal significance of this event.¹¹⁸ Finally, the Liability Convention only applies to parties who have accepted it before an incident has given rise to a claim, not in general¹¹⁹

Art. 9 of the ILA Instrument addresses the problem of enforcing the obligations it lays down in substantive terms by providing for dispute settlement procedures, including the possibility of binding interim measures. These provisions may be summarized as follows: If consultations fail, and the parties do not agree within 12 months on a means of peaceful settlement, a party may request submission of the dispute to arbitration or adjudication under the terms of the ILA Draft Convention on the Settlement of Space Law Disputes which is appended as an annex to the instrument. However, parties have the right to exclude the application of this Draft Convention, fully or in part, which, in effect means that a binding third party decision can be avoided in principle. This may need reconsideration in the light of the future review of the Draft Dispute Settlement Convention by the ILA, taking into account the elaborate system in the 1982 Law of the Sea Convention, which in this regard was uncontroversial among states in contrast to the deep-sea mining provisions.

It should be finally mentioned that the ILA Instrument refrains from addressing a number of specific issues, such as the question of which concrete measures are considered to be "appropriate" to prevent, reduce and control space debris. Some of these issues will be briefly discussed in the following.

9. Specific Issues

9.1 Military Activities and Ban on Intentional Breakup

It is known that the origin of debris is partly mission-related, in the sense that it is connected with the normal operation of the launching vehicle and spacecraft, for example spent rocket

¹¹⁷ Merrills

¹¹⁸

¹¹⁹ Such question raised by the United Kingdom A/AC.105/593/Add.3 of 7 February 1995, p.8.

stages, covers and explosive bolts.¹²⁰ Most of it, however, derives from explosions of space objects. These can be intentional, as in the case of the testing of military objects such as anti-satellite weapons, or unintentional. However, the causes of explosions in outer space are often difficult to determine.

Treaty provisions with an environmental side effect are those relating to the prevention of certain types of military use of outer space, such as Art. IV of the Outer Space Treaty, prohibiting the stationing in outer space of nuclear weapons and other weapons of mass destruction, or the Nuclear Tests Stop Treaty of 1963, which also applies to outer space.¹²¹ But France and China are not parties to the latter treaty. One can further mention the 1977 Environmental Modification Convention¹²², Art. 55 of Additional Protocol I to the Geneva Convention¹²³, the Non-Proliferation Treaty, the ABM-Treaty, or the Bacteriological Weapons Convention, which have an indirect environmental effect within their limited scope of application¹²⁴. The suggestion, however, that damage caused to the space environment by military preparations "endangering the outer space ecological balance and limiting in this way the sphere of peaceful uses of space is a serious breach of Arts. I and IX of the 1967 Treaty"¹²⁵ is not convincing in view of their vague wording.

Proposals have been made to prohibit intentional explosions of space objects, particularly in military projects, and to limit the occurrence and effects of unintentional explosions or other malfunctioning through establishing international quality standards, as can be found, for example, in the field of international aviation. The ILA draft does not include a specific ban on military testing or other intentional breakups. It makes no distinction between intentional and unintentional breakups and leaves the development of appropriate rules and standards to the cooperation of states and international organizations under the general obligation to protect the environment.

9.2 Obligation to Remove Debris

Current international law does not provide for a clear obligation to remove space debris. Art. I of the Outer Space Treaty is too vague to consider any obligation of removal of derelict space objects from orbit by the launching state, even if this were technically and economically feasible. [German paper 1992 UN]¹²⁶. Therefore, proposals have been made

¹²⁰ Perek, supra (note 10), p. 11.

¹²¹ Art. 1.

¹²² Art. II includes outer space.

¹²³ Frantzen, p. 618 with references.

¹²⁴ On the military aspects see He Qizhi, supra (note 74), pp. 245 et seq.

¹²⁵ Zhukova-Vasilevskaia, supra (note 29), p. 107.

¹²⁶ D. Rex, Space Debris - Its Origin and Suggestions for Future Avoidance, in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures*

to conclude treaty instrument achieve the removal of inactive satellites from their orbit, either by way of a controlled descent or by transfer to so-called grave-yard orbits, especially with regard to the crowded geostationary orbit.¹²⁷ The ILA draft leaves the issue to be determined by international cooperation.

In practice, certain national agencies have already taken relevant action, in particular with regard to the geostationary orbit. Furthermore, INTELSAT has adopted certain practices to minimize the creation of space debris. The organization will boost its communication satellites at the end of their operational life into an orbit at least 150 km above the geostationary arc and will also discourage manufacturers from using designs that jettison spacecraft parts, especially near the geostationary orbit.¹²⁸ At the moment the use of grave-yard or disposal orbits seems the most feasible method to deal with the problem of the geostationary orbit, but on the long run it does not reduce the overall amount of debris in outer space. Whether the ITU has competence to deal sufficiently with space debris in view of its mandate limited to the regulation of telecommunications is an open question. However, certain steps have been taken with regard to the geostationary orbit.¹²⁹

9.3 Unilateral Right to Remove Debris

The question whether international law knows a unilateral right of states to remove a foreign inactive space object from orbit is controversial.¹³⁰ The possibility to retrieve satellites, such as Palapa and Weststar in 1984, has given rise to the discussion of whether it is possible to apply by analogy the rules of maritime salvage law to allow a state to remove "abandoned" space objects by comparing these to derelict sea vessels¹³¹. But without agreement of the state owning the inactive object this is not an acceptable avenue. Art. VII of the Outer Space Treaty clarifies that launching states retain jurisdiction and control over their objects in outer space and in many cases space objects may be regarded as state property attaching rules of

of Protection (1990), p. 221, writing in 1987, stated that "[a]ll technically conceivable ways of retrieval of debris from space are highly uneconomic."

¹²⁷ Frantzen, p. 632 with references.

¹²⁸ UN Doc. A/AC.105/593 of 1 December 1994, p. 21 (INTELSAT).

¹²⁹ These concern recommendations on the removal of satellites from the geostationary orbit before the end of their useful lives, Information Note by ITU, A/AC.105/C.1/CRP4, supported by the delegation of Poland, Statement on Items 8 and 10 of the 32nd Session of the Scientific and Technical Subcommittee of UNCOPUOS.

¹³⁰ Frowein contemplates this as a possibility, *supra* (note 60), p. 167, which could only be justified in extreme cases. In my view, there are still too many unclarities associated with the rights of third states regarding so-called *erga omnes* obligations, also in the work of the International Commission in connection with art. 19 of the Draft Articles on State Responsibility, dealing with "international crimes".

¹³¹ See H. DeSaussure, *An International Right to Reorbit Earth Threatening Satellites*, *Annals of Air and Space Law*, Vol. 2 (1978), p. 390. Christol..

immunity to it.¹³²

There is also difficulty in applying the concept of space debris to inactive complete satellite which is out of fuel and control.¹³³ 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.¹³⁴ Such action is not likely to find acceptance by the registration state as a unilateral measure without its consent, or it is otherwise clear that there is no interest.¹³⁵ Thus, either prior consent of the owner state or regulation by a multilateral international agreement is required. The ILA instrument provides no further guidance on this issue.

9.4 International Fund

Proposals to deal with space debris include the idea of the creation of an international compensation which fund may cover damages which cannot be recovered under the liability regime, either for reasons of substantive limitations or problems of evidence, to be financed by contributions of states according to the scope of their use of outer space.¹³⁶ [Reijnen with references, KHB]. The analogy to existing mechanisms of this type, for example, in the area of marine pollution, however, is not compelling, simply because of the very limited number of active players in outer space. There is no incentive for them to assume the administrative expenses and bureaucracy of such an international fund. Until a much broader international use of outer space occurs, comparable to the level of the international use of the high seas, or other more immediate direct threats to the territorial integrity of other states are visible on a larger scale, the creation of such a fund by the few powers active in outer space is likely to remain wishful thinking.

10. Conclusions

The general conclusion is that scientists and technical experts seem to agree that, at least with regard to low orbits and the geostationary arch, preventive and removal measures cannot be postponed for much longer. But it is not yet quite clear which methods are the most effective and equally economically feasible. This is to a large extent connected with the still incomplete knowledge on the space debris population and the problem of tracking it. The general conclusion from the legal discussion is that the present international rules and principles are not appropriate to deal with the problem of space debris. However, as noted by Böckstiegel, it is equally clear that a quick solution by codification is unlikely and that "one has to be realistic of what is at what time feasible technically, economically and

¹³² See Schwetje, *supra* (note 11), p. 38.

¹³³ I.H.Ph. Diederiks-Verschoor, *Harm Producing Events Caused by Fragments of Space Objects (Debris)* IISL Proceedings 1982, p. 1.

¹³⁴ See Schwetje, *supra* (note 11), pp. 36 et seq.

¹³⁵ China doc.

¹³⁶ Frantzen, 632 with reference.

politically."¹³⁷

The purpose of the ILA draft Instrument is to primarily contribute to the advancement of the discussion of the legal issues of controlling space debris in view of the urgency of the matter and the reluctance to take it up by the Legal Subcommittee. It is a modest step and its content needs further clarification in many respects. But it also reflects the idea that it is better to adopt a sectoral approach rather than seeking a more general solution of space environmental problems in a comprehensive convention and also refrains from making utopian suggestions on the creation of a new international organization. It leaves the specific form of adopting the Instrument, whether or not as a separate convention or a protocol to the Outer Space Treaty, to the political process.

The ILA approach is contrasted by other views which are more sceptical of finding timely political solution in UNCOPUOS. This has led to proposals either to avoid the Committee altogether and seek treaty solutions among the space powers only (Reifrath), or to start operating on the level of non-governmental organizations, such as COSPAR or the IAF, and the ITU¹³⁸. These considerations are based on the experience of the slowing down of the law-making process in UNCOPUOS since the early adoption of the five space treaties and the difficulties of finding consensus nowadays in view of the rather divergent positions and interest of states. They are based on the recognition of the resistance of major space powers to include space debris on the agenda of the Legal Subcommittee of UNCOPUOS and of the rather different priorities of developing countries. [question whether alternative to UN see Frantzen]

A differentiated approach on the basis of such scepticism has been suggested by Jasentuliyana, who, for example, starts from the premise that the subjects for international regulatory procedures must be chosen carefully, assuring that a reasonably clear need for broad international action is apparent and there are also reasonable prospects of achieving a result.¹³⁹ The problem of low earth orbit debris is in his view a matter to justify international concern, but not sufficiently understood to justify policy-making.¹⁴⁰ He also suggests that this problem may be better addressed directly by handful of states and international organizations (he counts seven) which are currently directly affected by it. The author considers some informal norms to be useful to reduce the growth of debris appropriate and emphasizes the desirability of a bilateral agreement between the two major space powers to avoid deliberate explosions which may later be expanded to a multilateral agreement. Otherwise, considering the difficulties in finding clear solutions and the small number of states directly concerned, the problems of low orbit debris

¹³⁷ K.-H. Böckstiegel, *supra* (note 17). p. 3.

¹³⁸ Frantzen with ref. to Jasentuliyana.

¹³⁹ N. Jasentuliyana, 'Priorities for International Protection of the Space Environment', in: K.-H. Böckstiegel (ed.), *Environmental Aspects of Activities in Outer Space. State of the Law and Measures of Protection* (1990), p. 232.

¹⁴⁰ Jasentuliyana, *ibid.* p. 233.

"might better be left, for the moment at least, to informal exchanges of information between countries with active space programmes and to informal agreements between those countries to limit such debris to the extent technologically practicable. The natural decay of low orbit debris allows the informally agreed principles to be adapted to the situation and the technology as it evolves. Indeed, the need for more or less continuous development of technological procedures for controlling debris generation supports the argument for informal regulatory principles rather than formal legal instruments which tend to be fixed in form and hence to discourage or resist adaption to new situations."¹⁴¹

Cooperation through COSPAR and IAF are mentioned as the currently most appropriate forms.

As regards the geostationary orbit, the matter is different. There are a larger number of actual and potential participants in the use of this resource and the problems seem better understood.¹⁴² Jasentuliyana proposes to consider a formal international agreement to encourage the systematic removal of inactive satellites from the orbit, either in UNCOPUOS or by the ITU. Noting the problems of such rule-making in both organizations, Jasentuliyana advocates the creation of a standing intergovernmental group of experts to develop a set of "recommended standards and practices".¹⁴³

My own view is that the most effective solution to specific problems of space debris will indeed be found in practice by those states engaged in space activities for reasons of self-interest. This is the level where actual solutions will be found and must be encouraged. On the other hand, the matter is too important, in the interest of the use of outer space by other nations and generations in the future, to simply leave it solely to the current space powers. There is also a need to integrate other members of the international community into the process of finding appropriate solutions. In this sense UNCOPUOS is the right forum for addressing the international protection of the space environment, but it is not necessarily the only forum. The main results are to be expected from a binding mechanism of continuing international technical standard setting which would provide the flesh for the bones of international space law in the area. With regard to the ordinary course of business of peaceful outer space activities, such detailed regulation is necessary before any reasonable decisions can be taken on issues such as liability for space debris and before any mechanism of international dispute settlement is truly able to function with some confidence of parties submitting to it.

Finally, with all respect, I believe it is better to adopt a parallel approach in the Scientific and Technical Subcommittee and the Legal Subcommittee. There is no reason, except time constraints and the necessity to decide on priorities, to delay consideration of the initial legal parameters. This seems conducive to focus the discussions in the Scientific and Legal

¹⁴¹ Jasentuliyana, *ibid.* p. 235.

¹⁴² Jasentuliyana, *ibid.*, pp. 236 et seq.

¹⁴³ Jasentuliyana, *ibid.*, p. 240.

Subcommittee properly also from the legal perspective. In the practice of the Committee as a whole this has also not happened for the first time without beneficial results and the ILA draft Instrument would provide a good starting point for the debate on space debris in the Legal Subcommittee.