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Alexander F. Cohen

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Cosmos 954 and the International Law of Satellite Accidents

Alexander F. Cohen†

I. Problem

Falling satellites¹ are an unavoidable hazard of space exploration: at the current level of technology, a certain number of satellites will inevitably fall out of orbit.² Nevertheless, the traditional sources of international law provide little help in determining what norms would govern a situation in which a falling satellite causes injury.³ The 1978 crash of the U.S.S.R.'s Cosmos 954 satellite has shed some light on the normative expectations of states concerning satellite accidents.

From the events leading up to and following the crash of Cosmos 954, four governing norms emerged: (1) A state that becomes aware that one of its satellites will crash has the duty to forewarn a state that is in danger; (2) The state whose satellite has crashed in the territory of another state has the duty to provide that state with information (regarding the

† B.A., M.A., Yale University.

1. A satellite is "[a]ny manmade object launched from and revolving around the earth." FUNK & WAGNALL'S STANDARD DESK DICTIONARY 593 (1977). I prefer this term to "space object." Despite its wide currency in legal writing and UN documents, "space object" poses various thorny problems of definition. For a discussion of these difficulties, see Foster, *The Convention on International Liability for Damage Caused by Space Objects*, 1972 CAN. Y.B. OF INT'L L. 144-47, 158-60; Wilkins, *Substantive Bases for Recovery for Injuries Sustained by Private Individuals as a Result of Fallen Space Objects*, 6 J. SPACE L. 162 (1978).

2. Telephone interviews with U.S. government officials (Mar. 1984).

3. The Cosmos 954 accident was the first instance in the history of space exploration in which the satellite of one nation caused significant injury to a second nation. Legault & Farand, *Canada's Claim for Damage Caused by the Soviet Cosmos 954 Satellite 25* (Jan. 1984)(unpublished manuscript available from Canadian Embassy, Washington, D.C.)(on file with the *Yale Journal of International Law*). Hence, no court cases, arbitral decisions, or any other formal judicial proceedings have dealt with satellite accidents. In addition, it is unclear if the one international treaty that addresses this problem is prescriptive. See *Convention on International Liability for Damage Caused by Space Objects*, Sept. 1, 1972, 24 U.S.T. 2389, T.I.A.S. No. 7762, reprinted in 66 AM. J. INT'L L. 702 (1972). Canada and the U.S.S.R. seem to have ignored most of the provisions of the Liability Convention during the Cosmos 954 incident. *But cf.* Schwartz & Berlin, *After the Fall: An Analysis of Canadian Legal Claims for Damage Caused by Cosmos 954*, 27 MCGILL L. J. 676, 705-12, (1982) (arguing that the 1972 Liability Convention is prescriptive). For a general discussion of the Liability Convention, see Foster, *supra* note 1, 137 *passim*; Schwarzschild, *Space Law—Convention on Liability—Procedure Established to Enforce Liability for Damage Caused by Space Objects*, 6 VAND. J. TRANS-NAT'L L. 262 (1972); STAFF OF SENATE COMM. ON AERONAUTICAL AND SPACE SCIENCES, 92D CONG., 2D SESS., CONVENTION ON INTERNATIONAL LIABILITY FOR DAMAGE CAUSED BY SPACE OBJECTS: ANALYSIS AND BACKGROUND DATA (Comm. Print 1972).

specifications of that satellite) to enable the endangered state to assess the dangers and act to counter them; (3) Special rules govern the duty to clean up the remains of a state's satellite that has crashed in another state's territory; and (4) The state whose satellite has crashed has the duty to compensate a state injured as a result of the crash.

II. Facts

The U.S.S.R. launched the nuclear-powered⁴ Cosmos 954 naval surveillance satellite on September 18, 1977.⁵ In late November or early December 1977, Cosmos 954's orbit became erratic.⁶ The U.S. soon calculated that the satellite would fall on or about January 23, 1978,⁷ although it was not known where it would land.⁸ In response, the U.S. initiated a series of secret meetings with the U.S.S.R. in mid-January 1978,⁹ during which the U.S.S.R. provided the U.S. with information about Cosmos 954's reactor.¹⁰ The U.S. also warned its NATO¹¹ and Organization for Economic Cooperation and Development (OECD)¹² partners that Cosmos 954 was expected to fall, and offered to help clean up any radioactive contamination that might result.¹³

Cosmos 954 crashed to earth on January 24, 1978:

[T]he satellite entered the earth's atmosphere intruding into Canadian air space at about 11:53 A.M. Greenwich Mean Time to the north of the Queen Charlotte Islands on the west coast of Canada. On re-entry and disintegration, debris from the satellite was deposited on Canadian territory, including portions of the Northwest Territories, Alberta, and Saskatchewan.¹⁴

4. A nuclear reactor containing some 50 kilograms of enriched uranium powered the radar and radio units with which the satellite tracked U.S. Navy ships. Krey, Leifer, Benson, Dietz, Hendrikson & Coluzza, *Atmospheric Burnup of the Cosmos -954 Reactor*, 205 SCIENCE 583 (1979); N.Y. Times, Jan. 25, 1978, at A1, col. 6.

5. N.Y. Times, Jan. 25, 1978, at A8, col. 2. See also U.N. Doc. A/AC.105/Inf. 365 (1977) (providing information about the launch of Cosmos 954).

6. N.Y. Times, Jan. 29, 1978, at A8, col. 1.

7. Aikman, *Operation Morning Light*, 1978 SENTINEL: MAG. CAN. FORCES, No. 2, at 5.

8. N.Y. Times, Jan. 29, 1978, at A1, col. 6. It is apparently quite difficult to predict where a satellite that is falling out of control will land. See Doyle, *Reentering Space Objects: Facts and Fiction*, 6 J. SPACE L. 107, 110 (1978). As one United States Air Force officer put it, "we are just not good enough to tell New York City, for instance, that a satellite is coming and will knock King Kong off the Empire State Building at 2 P.M.," quoted in N.Y. Times, Jan. 29, 1978, at A8, col. 1.

9. N.Y. Times, Jan. 25, 1978, at A1, col. 6.

10. Wash. Post, Jan. 27, 1978, at A18, col. 2.

11. N.Y. Times, Jan. 25, 1978 at A1, col. 6 and A8, col. 2.

12. Aikman, *supra* note 7, at 5; N.Y. Times, Jan. 26, 1978, at A5, col. 3.

13. Aikman, *supra* note 7, at 5; N.Y. Times, Jan. 26, 1978, at A5, col. 3.

14. Gov't of Canada, Dep't of External Aff., Note from the Secretary of State for External Aff. to the Soviet Ambassador, Jan. 23, 1979, *Annex A: Statement of Claim* [hereinafter cited as *Annex A*], at 1 (on file with the *Yale Journal of International Law*).

U.S. President Carter notified Canadian Prime Minister Trudeau within fifteen minutes of the accident, and repeated the U.S. proposal of assistance.¹⁵ Trudeau accepted Carter's offer.¹⁶

Some hours later, Canada asked the U.S.S.R. to provide information about the specifications of the Cosmos 954.¹⁷ The U.S.S.R. responded that day by offering to help clean up Cosmos 954's remains.¹⁸ In contrast to its reaction to the earlier U.S. proposal, Canada declined the Soviet offer.¹⁹

The joint U.S.-Canadian cleanup operation that resulted from this exchange, dubbed "Operation Morning Light," cost Canada nearly C\$14 million,²⁰ while the U.S. spent some U.S.\$2-2.5 million.²¹ Canada billed the U.S.S.R. for C\$6 million of its outlay²² on January 23, 1979,²³ but did not seek reimbursement for the U.S. expenditure.²⁴ The U.S.S.R. paid C\$3 million to Canada on April 2, 1981, "in full and final settlement of all matters connected with the disintegration of the Soviet satellite 'Cosmos 954' in January 1978."²⁵

III. Conflicting Claims

Canada and the U.S.S.R. asserted different versions of the facts of the accident. First, the U.S.S.R. blamed the fall of Cosmos 954 on a mid-space collision. Academician L. I. Sedov explained that:

On Jan. 6, 1978, for reasons that as yet remain unclear, sudden depressurization of the satellite took place outside the visibility zone of our facilities for tracking space objects. Judging from the fact that the depressurization process was very rapid, it can be assumed that the satellite collided in flight with some other body of natural or artificial origin. As a

15. Aikman, *supra* note 7, at 5; N.Y. Times, Jan. 26, 1978, at A5, col. 3.

16. *Annex A, supra* note 14, at 2.

17. Dep't of External Aff. Note No. FLO-0497 to the Embassy of the U.S.S.R. (Ottawa), Feb. 28, 1978, reprinted in Gov't of Canada, Dep't of External Aff., Note From the Secretary of State for External Aff. to the Soviet Ambassador, Jan. 23, 1979, *Annex B: Texts of Diplomatic Communications Between the Department of External Affairs and the Embassy of the Union of Soviet Socialist Republics* [hereinafter cited as *Annex B*] (copy on file with the *Yale Journal of International Law*).

18. *Annex A, supra* note 14, at 2.

19. *Id.*

20. *Id.* at 3.

21. Telephone interviews with U.S. government officials (Mar. 1984). See also *Canada Wants Cash for Cosmos 954 Cleanup*, 203 SCIENCE 632 (1979) (citing cost as U.S.\$2 million).

22. *Annex A, supra* note 14, at 3. See *infra* notes 46-47 and accompanying text for an explanation of why Canada did not seek recovery of the full amount.

23. N.Y. Times, Jan. 24, 1979, at A7, col. 1.

24. *Canada Wants Cash for Cosmos 954 Cleanup, supra* note 21, at 632.

25. Claims Protocol, April 2, 1981, Canada-U.S.S.R., Can. T.S. No. 8, art. 2.

Incidents: Cosmos 954

result the satellite's onboard systems went out of commission, it lost orientation, and began an uncontrollable descent.²⁶

Canada, in contrast, blamed the fall of the satellite on a faulty motor. "The U.S.S.R. admitted that Cosmos 954 had failed, and that it was not possible to lift the satellite into a much higher orbit, as had been planned in case of an emergency, because of failure of a rocket system."²⁷

Second, the U.S.S.R. claimed that Cosmos 954 had been completely destroyed during reentry. The official Soviet news agency (TASS) stated that, "in the afternoon of Jan. 24, 1978, the Kosmos-954 satellite entered the dense layers of the atmosphere over Northern Canada and ceased to exist."²⁸ Notwithstanding this claim, Canada found charred pieces of the satellite that had returned to the ground.²⁹

Finally, the U.S.S.R. declared that the remains of Cosmos 954, if any, posed a minimal radiation hazard. According to Sedov, "[i]t was emphasized [to the Canadian government] that if individual fragments of the satellite did reach the earth's surface, only limited local pollution might occur, and only in the immediate area of the fall, and that this would require the application of ordinary decontamination measures."³⁰ Canada, in contrast, found that "all but two of the fragments recovered were radioactive. Some fragments located proved to be of lethal radioactivity."³¹

IV. Conflicting Conceptions of Lawfulness

The Cosmos 954 incident suggests that elites in Canada and the U.S.S.R. held divergent expectations of how states that are involved in satellite accidents should behave. These expectations concerned the substantive content of four governing norms: the duty to forewarn, the duty to provide information, the duty to clean up, and the duty to compensate for injury.

A. *The Duty to Forewarn*

It appears from the record that Canadian elites expected the Soviet

26. *Izvestia*, Feb. 5, 1978, at 3, reprinted in 30 CURRENT DIG. SOVIET PRESS, No. 5, at 1 (1978).

27. Gov't of Canada, Dep't of External Aff., Note from the Secretary of State for External Aff. to the Soviet Ambassador, Jan. 23, 1979, *Annex C: Schedule of Costs Phase I*, at 35 (on file with the *Yale Journal of International Law*).

28. *Pravda*, Jan. 25, 1978, at 4, reprinted in 30 CURRENT DIG. SOVIET PRESS, No. 4, at 7 (1978).

29. *Annex A*, *supra* note 14, at 1. The Soviet claim was contradicted both by the existence of charred chunks of metal in Canada and by the U.S.S.R.'s later offer to help clean up the remains of the satellite. See *supra* note 18 and accompanying text.

30. *Supra* note 26, at 1.

31. *Annex A*, *supra* note 14, at 4.

Union to warn Canada as soon as the U.S.S.R. had discovered that Cosmos 954 might conceivably land in Canada:

In the course of the day January 24, 1978, an official of the Department of External Affairs expressed to the Ambassador of the Union of Soviet Socialist Republics the surprise of the Government of Canada that the Government of the Union of Soviet Socialist Republics had failed to give notice of the possible re-entry of the satellite into the earth's atmosphere in the region of Canada, and, subsequently, of the imminent re-entry of the satellite.³²

Elites in Canada thus seemed to believe that the U.S.S.R. was obligated to forewarn all potentially endangered states of the hazards posed by its falling satellite, no matter how remote the possibility of injury.

Soviet elites³³ viewed the norm differently. They claimed that the U.S.S.R. had an obligation to warn only the United States of the impending crash of Cosmos 954:

Calculations made on the basis of [Cosmos 954's] last orbits within the visibility range of our tracking facilities showed that if, because of the satellite's emergency condition, individual parts of the satellite were not fully consumed in the atmosphere and reached the earth's surface, they might fall into the open sea in the region of the Aleutian Islands. In this connection, the appropriate information was given to the U.S. government.³⁴

Two possible conceptions of the duty to forewarn may explain this assertion. First, Soviet elites may have interpreted the norm as a requirement that the U.S.S.R. warn the state in whose territory the satellite was most

32. *Id.* at 2. See also N.Y. Times, Jan. 25, 1978, at A8, col. 1 (reporting that unnamed Canadian government officials were angry at the U.S.S.R.'s failure to warn Canada of the impending crash of Cosmos 954); telephone interviews with Canadian government officials (Mar. 1984). But see Scientific and Technical Sub-Committee of the Committee on the Peaceful Uses of Outer Space, 33 U.N. GAOR (190th meeting of the Subcomm.) at 9, U.N. Doc. A/AC.105/C.1/S.R. 190 (1978). U.S.S.R. representative Federov claimed that the U.S.S.R. had notified Canada as soon as it realized Cosmos 954 would enter the atmosphere over Canadian territory.

33. It was not possible to gauge Soviet elite expectations through direct interviews. I have therefore relied on statements in Pravda, among other sources. Analysts of the Soviet Union generally consider such information to provide authoritative indications of official Soviet policy.

34. *A Tass Correspondent Interviews Academician L.I. Sedov*, *supra* note 26. Sedov's assertions seem to contradict statements by U.S. officials that it was unclear into what countries Cosmos 954 would fall until shortly before the actual crash occurred. As the U.S. Department of Energy report on Operation Morning Light stated:

The satellite was being continually tracked by all available U.S. assets until it reentered the earth's atmosphere. Originally it was relatively easy to predict orbital decay, based on prior observation, as long as the satellite remained horizon stable. Later, when the satellite began to tumble, planners were dealing with an uncertain entry window because the geometry, mass, and altitude were unknown. This uncertainty of entry window location precluded the possibility of prior action to protect the health and safety of specific population clusters.

U.S. DEPARTMENT OF ENERGY, OPERATION MORNING LIGHT 5 (1978).

likely to crash.³⁵ Alternatively, the U.S.S.R. may have agreed with Canada that the duty to forewarn required the notification of all *potentially* endangered states. Elites in the U.S.S.R. may not have believed, however, that they were required to notify these states directly if they were part of a political and military alliance hostile to the U.S.S.R.³⁶ Rather, Soviet elites may have believed that the U.S.S.R. could discharge its duty under the norm by notifying the leading state in the hostile alliance—in this case, the U.S.—which would relay the warning to the other members of that alliance.

B. *The Duty to Provide Information*

Consistent with their position regarding the duty to forewarn, Canada's elites believed that the U.S.S.R. was under an obligation to disclose information. Canada repeatedly questioned the U.S.S.R. about Cosmos 954's specifications, and expressed frustration at the U.S.S.R.'s refusal to answer their inquiries:

In this regard, Canada has requested the assistance of the Soviet authorities in furnishing information about the nature and characteristics of the nuclear core contained in the satellite. These requests have been conveyed on several occasions The Canadian authorities regret that they have not to date received answers to these questions.³⁷

Elites in Canada also expected that this information be publicly disclosed. Indeed, "Canada decided to publish the documents establishing the claim together with texts of its diplomatic exchanges with the Soviet Union on the matter. In so doing, the Canadian government departed from normal practice regarding the confidentiality of diplomatic communications."³⁸

Under the Soviet interpretation, however, the duty to provide information imposed a more limited burden. According to this interpretation, the U.S.S.R. was required to provide only the minimum degree of information that Canada needed to conduct a cleanup. In addition, the Soviet Union reserved the right to determine what that minimum included:

In connection with the request made by the Canadian side for information

35. This interpretation of the duty to forewarn would appear to ignore the difficulty of predicting where a falling satellite will land. See Doyle, *supra* note 8, at 110; OPERATION MORNING LIGHT, *supra* note 34, at 5.

36. It would be interesting to know if the U.S.S.R. warned the members of the Council on Mutual Economic Assistance (CMEA) or the Warsaw Treaty Organization (WTO) about Cosmos 954. Unfortunately, I have been unable to discover an answer to this question.

37. Dep't of External Aff. Note No. FLO-0497 to the Embassy of the U.S.S.R. (Ottawa), Feb. 28, 1978, reprinted in *Annex B*, *supra* note 17.

38. Legault & Farand, *supra* note 3, at 14-15.

regarding the power unit which was on board the Cosmos-954 satellite, the Embassy would remind that the necessary information about the satellite was already made available which, in the opinion of the Soviet side, is sufficient to organize and carry out effective search for possible consequences of its cessation to exist over Canadian territory.³⁹

The statements made in *Pravda* show that the U.S.S.R. also believed that any information it provided should be transmitted secretly. The Soviets chided Canada for the highly public manner in which Canada had handled the Cosmos 954 incident;⁴⁰ they were particularly displeased at the fact that Canada did not notify them officially of its findings concerning the wreckage for two weeks, a considerable time after such information was released to the press.⁴¹ Indeed, the U.S.S.R. charged that Canada was using requests for information as a pretext for intelligence gathering. "The Soviet side finds it also necessary to note that some of the questions put by the Canadian side obviously relate to information which is outside the scope of the amount [sic] necessary to secure the health and safety of persons and the environment."⁴²

C. *The Duty to Clean Up*

In the the Soviet view, the cleanup should be undertaken jointly by the injured state and the state that had launched the satellite. As the Soviet representative to the Scientific and Technical Sub-Committee of the UN Committee on the Peaceful Uses of Outer Space stated soon after the crash of Cosmos 954, "[i]f a satellite or any spacecraft, when it goes out of control should cause damage to another State, then the launching State is duty-bound to compensate for this damage: it is duty-bound to participate in the search and recovery of the debris of the satel-

39. Embassy of the U.S.S.R. Note No. 2 to the Dep't of External Aff. (Ottawa), Mar. 21, 1978, reprinted in *Annex B, supra* note 17.

40. See *supra* note 38 and accompanying text.

41. The Russian statement read:

Likewise one cannot but express regret with regard to the fact that the official notification of the Soviet side about the discovery on Canadian territory of objects which are presumed by the Canadian side to be fragments of the Cosmos-954 satellite was made two weeks after the time the satellite ceased to exist and considerably later [than] the information about these objects had been made available to the press and experts from other countries.

Embassy of the U.S.S.R. Note No.18 to the Dep't of External Aff., Ottawa, Feb. 20, 1978, reprinted in *Annex B, supra* note 17.

The fact that the Soviets had complied with the secret U.S. requests for information in January 1978 suggests that they might have been more forthcoming with information had Canada been more discreet in its demands. See *supra* notes 9-10 and accompanying text.

42. Embassy of the U.S.S.R. Note No. 37 to the Dep't of External Aff. (Ottawa), May 31, 1978, reprinted in *Annex B, supra* note 17.

lite. . . .”⁴³ Indeed, the U.S.S.R. repeatedly expressed frustration at Canada’s refusal to allow it to participate in the cleanup.⁴⁴

Under the Canadian version of this norm, the injured state is entitled to choose which country or countries will carry out the cleanup. Accordingly, Canada turned down the U.S.S.R.’s offer of assistance but permitted its American ally to participate in the operation.⁴⁵

D. *The Duty to Compensate for Injury*

Canada evidently considered there to be a norm requiring the U.S.S.R. to make full payment for the cost of repairing the injury caused by its satellite. Although Canada eventually demanded only C\$6 million in damages out of an expenditure of C\$14 million,⁴⁶ it clearly based its claim on the total cost of cleaning up the radioactive debris.⁴⁷ Canadian elites also believed that the U.S. would help pay for the cleanup. If one conceives of the unreimbursed U.S. expenditure on the cleanup of US\$2-2.5 million as a form of payment to Canada, the U.S. “paid” Canada C\$2.5-3.125 million as a result of the crash of Cosmos 954.⁴⁸ Canada never offered to repay the U.S. for its outlay on the cleanup, nor did it

43. Statement of Academician Federov, Scientific and Technical Sub-Committee of the UN Committee on the Peaceful Uses of Outer Space (Feb. 14, 1978), *reprinted in* Legault & Farand, *supra* note 3, at 17.

44. *Id.* at 16.

45. *See supra* notes 15-25 and accompanying text.

Elites in Canada felt that the country it designated must be a close political ally. One could conclude that Canada never seriously entertained the Soviet offer:

On that occasion [January 24, 1978], the [U.S.S.R.’s] Ambassador expressed his government’s readiness to render urgent assistance by sending to Canada a group of specialists to ameliorate the possible consequences and evacuate remnants of the satellite. Canadian officials replied that their urgent need was for immediate and complete answers to the questions posed earlier on January 24, 1978.

Annex A, supra note 14, at 2.

46. Canada reportedly felt that the U.S.S.R. would reject a claim larger than C\$6 million. Telephone interview with Canadian government official (Mar. 1984).

47. For example, it refused to present its claim to the U.S.S.R. until it had determined exactly how much the entire cleanup operation would cost:

In this regard, the Department of External Affairs wishes to inform the Embassy of the U.S.S.R. that the Government of Canada will submit to the U.S.S.R. a claim for damages, including search and recovery costs incurred by Canada as a result of the presence on Canadian territory of hazardous component parts of the Soviet satellite. . . . Since the necessary search and recovery operations are still underway, the full amount of damages are not yet known. The claim will be submitted in due course.

Dep’t of External Aff. Note No. FLO-0497 to the Embassy of the U.S.S.R. (Ottawa), Feb. 28, 1978, *reprinted in Annex B, supra* note 17. Indeed, the Canadian claim included two lengthy memoranda that detailed the entire cost of all aspects of the cleanup, down to such items as car rental and photocopying. *See supra* note 27.

48. *See supra* note 21 and accompanying text. U.S.\$2-2.5 million is approximately C\$2.5-3.125 million at a rate of exchange of U.S.\$1/C\$0.80.

press the U.S.S.R. to do so.⁴⁹

Actions by Soviet elites showed partial disagreement with this interpretation. Unlike Canada, the U.S.S.R. viewed the duty to compensate for injury as an obligation to reimburse only the incremental costs⁵⁰ that the injured state incurred in repairing the injury.⁵¹ Thus the Soviet officials who negotiated the U.S.S.R.'s payment to Canada "made it very clear that they wouldn't pay [Canadian] fixed costs."⁵² At the same time, the U.S.S.R.'s elites seemed to concur in the Canadian view that the U.S. should not be reimbursed for its role in the cleanup. The U.S.S.R., therefore did not offer to reimburse the U.S. expenditure. Indeed, the Soviet refusal to pay Canada's "fixed costs" tends to suggest that the U.S.S.R. would have rejected a claim for U.S. cleanup expenditures.⁵³

V. International Appraisal

The conflicting expectations of elites in Canada and the U.S.S.R. were never appraised in a formal judicial setting. Nevertheless, their claims of what constitutes proper action by states that are involved in a satellite accident did receive widespread informal evaluation by a broad range of state and media elites.⁵⁴ From the standpoint of norm creation, the crucial appraisals were those of elites in the United States.⁵⁵

The legal conceptions expressed by U.S. elites were much closer to those of Soviet than to those of Canadian elites. The United States assumed the burden of notifying its NATO and OECD partners, appar-

49. Indeed, Canadian elites were convinced that the U.S. did not wish to be repaid. Telephone interviews with Canadian government officials (Mar. 1984).

50. The term "incremental costs" refers to the costs over and above those that Canada would have borne had Cosmos 954 not fallen, such as salaries of Canadian armed forces personnel.

51. This interpretation would appear to exclude nonphysical injury such as mental anguish.

52. Telephone interview with Canadian government official (Mar. 1984).

53. U.S. elites felt that the U.S.S.R. would reject any such claim. Telephone interviews with U.S. government officials (Mar. 1984).

54. See, e.g., Wash. Post, Jan. 27, 1978, at A18, col. 2; N.Y. Times, Jan. 27, 1978, at A24, col. 1; Can. Embassy Pub. Aff. Div., *Canadian Press Comment*, Feb. 8, 1978. Indeed, Russell Baker commented that:

it turns out some fool had put a lot of nuclear reactors in orbit around the Earth while all the environment lovers were distracted down on the ground keeping the electric companies from putting nuclear reactors into power plants. It was a good joke on the environment crowd, I guess. . . .

N.Y. Times, Jan. 28, 1978, at A21, col. 1.

55. The U.S. and the U.S.S.R. have a near monopoly on space exploration. These two states, for example, launched 98% of all satellites that were orbited between 1957 and 1978. Hosenball, *Nuclear Power Sources in Outer Space*, 6 J. SPACE L. 119 (1978). Thus while the views of elites in other states as to what constitutes lawful behavior may be interesting, they are not particularly relevant: these elite expectations are unlikely to exert much influence on the outcome of future satellite accidents.

ently without the U.S.S.R. having asked it to do so.⁵⁶ Furthermore, the U.S. government never joined in Canada's public criticism of the U.S.S.R.⁵⁷ for having failed to notify Canada of the impending crash of Cosmos 954.⁵⁸ From this it would appear that the U.S. shared the Soviet view that the launching state was under a duty to forewarn only the leading state of a hostile alliance, and was not responsible for warning each of its political adversaries individually.

The United States also appeared to agree with the U.S.S.R. on the issue of how to interpret the second norm, the duty to provide information. U.S. elites interpreted this norm as an obligation to provide only that information needed to conduct the cleanup. Unlike Canada,⁵⁹ the U.S. chose to question the U.S.S.R. about the specifications of Cosmos 954 in secret,⁶⁰ and evidently expected only minimal compliance with American requests for information:

[M]any American specialists were skeptical that the Soviet Union would provide any information about its out-of-control space satellite, when national security advisor Zbigniew Brzezinski, on Jan. 12, first raised the issue with Soviet Ambassador Anatoly F. Dobrynin. "Frankly, I thought they were likely to tell us to go to hell," said one administration specialist.⁶¹

Again, the United States seemed to take the same view as the Soviets of the duty to compensate for injury. The U.S. never joined Canada in criticizing the U.S.S.R.'s payment to Canada as too small,⁶² apparently conceiving of the norm as imposing an obligation to reimburse the injured state only for the incremental cost of repairing the injury.⁶³ Since the U.S. did not ask reimbursement for its share of the cleanup expenses

56. See *supra* notes 11-12 and accompanying text.

57. See *supra* note 32 and accompanying text.

58. U.S. elites were also unwilling to criticize the U.S.S.R.'s behavior in private interviews. Telephone interviews with U.S. government officials (Mar. 1984).

59. See *supra* note 38 and accompanying text.

60. See *supra* notes 9-10 and accompanying text.

61. Wash. Post, Jan. 27, 1978, at A18, col. 2. The attitude of U.S. elites is comprehensible in light of the extreme secrecy that normally enshrouds reconnaissance satellites. For both the U.S.S.R. and the U.S., any information about surveillance satellites—no matter how seemingly trivial—is closely guarded. The U.S. did not officially acknowledge the existence of its reconnaissance satellite program until 1978. T. KARRAS, *THE NEW HIGH GROUND: SYSTEMS AND WEAPONS OF SPACE AGE WAR* 99 (1983). The U.S.S.R., for its part, has never admitted that Cosmos 954 was a surveillance satellite.

62. When asked if Canada was satisfied with the settlement, one Canadian official replied; "[w]ell, its better than a poke in the eye with a stick." Telephone interview with Canadian government official (Mar. 1984). U.S. officials, in contrast, expressed surprise at how large a sum the Soviets paid. Telephone interviews with U.S. government officials (Mar. 1984).

63. Later U.S. behavior seems to suggest that U.S. elites also do not believe that claims for nonphysical injuries are valid under the duty to compensate. The U.S. uniformly rejected the claims for mental anguish that arose from the crash of Skylab in 1979. Telephone interviews with U.S. government officials (Mar. 1984).

from either Canada or the U.S.S.R., it would seem that the U.S. elites agreed with both countries that the U.S. was obliged to pay Canada under the norm.⁶⁴

While concurring generally in the Soviet formulations of the first three norms, the United States rejected the Soviet interpretation of the fourth, concerning the duty to clean up. There is no indication that the U.S. ever expected Canada to permit the U.S.S.R. to play any part in the cleanup operation. Nevertheless, the apparent difference in legal conceptions obscures the possibility that the two superpowers were motivated by similar concerns. It is not unreasonable to suppose, as did some Canadian observers, that each was anxious to participate in the cleanup chiefly to gather intelligence, or to prevent the other from doing so.⁶⁵ The U.S. eagerness to examine what was left of Cosmos 954⁶⁶ was surely matched by Soviet desires to deny the U.S. just such an opportunity. It would therefore seem misleading to characterize the U.S. appraisal as an affirmation of free choice for the injured state. Rather, it appears to be an assertion of the right of the injured state to invite only its political allies to participate in the cleanup.⁶⁷

VI. Outcome

The norms established by the Cosmos 954 incident provide that the major satellite-launching nations — the U.S. and the U.S.S.R. — notify each other of hazardous events due to satellite failure, relay information to facilitate damage control, assist their political allies in cleanup operations, and share the cost of compensating the state injured by a falling satellite, regardless of whose satellite caused the injury⁶⁸ and regardless of fault.

The critical norm is that of joint compensation. This norm would appear to provide compensation only for the incremental costs of cleanup associated with the accident.⁶⁹ It may also be limited in application to

64. *Id.*

65. See T. KARRAS, *supra* note 61.

66. Telephone interviews with Canadian government officials (Mar. 1984).

67. It is unlikely that the U.S. would have quietly acquiesced had Canada decided to allow the U.S.S.R., rather than the U.S., to assist in the operation.

68. Joint compensation may not apply to accidents in all situations. If a Soviet satellite fell on a CMEA or W.T.O. nation, it is unlikely that the U.S. would contribute to the cost of the cleanup. Similarly, if a U.S. satellite fell on a NATO country, the U.S. probably would not expect the U.S.S.R. to pay. It is unclear what would happen if a satellite of either country fell on a non-aligned country: the outcome would probably depend on how "non-aligned" that country truly was.

69. See *supra* notes 50-52 & 63 and accompanying text.

surveillance satellites.⁷⁰

Although it is possible that the payments made by the U.S. and the U.S.S.R. were *ex gratia* and, hence, devoid of normative content, at least the size of the Soviet payment tends to argue otherwise; in the context of negotiations with the U.S.S.R., a fifty percent settlement is apparently quite high.⁷¹ Indeed, that the U.S.S.R. paid anything is striking in light of the fact that it was not obligated to pay under the 1972 Liability Convention.⁷² That the U.S. paid its share without being at fault lends further support to the existence of this norm.

VII. Writer's Appraisal

The Cosmos 954 incident illustrates the paradox of satellite utilization: satellites simultaneously protect and endanger the international community. Reconnaissance satellites play a crucial role in maintaining the stability of the U.S.-U.S.S.R. nuclear balance.⁷³ At the same time, nuclear-powered satellites present clear hazards, as the Cosmos 954 incident demonstrated.

One response to this problem would be to prohibit the use of those

70. This norm may not govern the crashes of all types of satellites. For example, the U.S. reportedly made extensive preparations to pay for injuries caused by the crash of Skylab in 1979, even to the extent of printing standardized claims forms. U.S. elites did not expect that the U.S.S.R. would make payments as well. Telephone interviews with U.S. government officials (Mar. 1984). This suggests that compensation for injuries caused by well-publicized scientific satellites may be the responsibility of the state that launched these satellites, whereas joint compensation is the rule for accidents involving secret reconnaissance satellites.

71. Telephone interviews with U.S. and Canadian government officials (Mar. 1984). More generous settlements are generally expected from the U.S. *Id.*

72. It is not clear that the radioactive remains of Cosmos 954 injured Canada under the Liability Convention's definition of injury. See Haanappel, *Some Observations on the Crash of Cosmos 954*, 6 J. SPACE L. 147, 147-48 (1978). But see Schwartz & Berlin, *supra* note 3, at 692-93, 695-98. Article I(a) of the Liability Convention provides that, "[f]or the purposes of the Convention: (a) The term 'damage' means loss of life, personal injury or other impairment of health; or loss of or damage to property of states or of persons, natural or juridical, or property of international intergovernmental organizations. . . ." Liability Convention, *supra* note 3, at article I(a). Canadian elites were relieved that the U.S.S.R. chose not to avoid payment on these grounds. Telephone interviews with Canadian government officials (Mar. 1984).

73. By reducing the potential for a successful surprise attack, these satellites allow both states to keep their nuclear forces at a relatively low level of alert. Any preparations for surprise attack would be difficult to hide, because reconnaissance satellites allow each state to scrutinize the other's territory. For a discussion of the capabilities of current U.S. reconnaissance satellites, see T. KARRAS, *supra* note 61, at 102-16. In addition, early warning satellites would provide quick notice in the event that a nuclear attack were launched. U.S. satellites can detect Soviet ICBMs within three minutes of their launch. Lecture by U.S. government official (Mar. 1984). The Soviet Union similarly employs nuclear powered satellites for early warning of U.S. nuclear attacks. See *infra* note 78. Satellites also enhance stability by making arms control agreements verifiable, and hence, meaningful. Communications satellites also play an important role in the prevention of accidental war, by offering a reliable means for the leaders of the U.S. and the U.S.S.R. to communicate. The U.S.-U.S.S.R. "hotline", for example, is satellite-based. N.Y. Times, Jan. 17, 1978, at A2, col. 3.

satellites that are most hazardous. At the time of the Cosmos 954 incident, President Carter suggested a ban on nuclear-powered satellites: "If we cannot evolve those fail-safe methods, then I think there ought to be a total prohibition against [nuclear-powered] earth-orbiting satellites. I would favor at this moment an agreement with the Soviets to prohibit earth-orbiting satellites with atomic radiation material in them."⁷⁴

A ban on nuclear-powered satellites does not seem a realistic solution. In the first place, the U.S. and the U.S.S.R. are unlikely to consent to a prohibition, because certain satellites must carry an on-board nuclear power source⁷⁵ in order to perform their missions.⁷⁶ Indeed, Canada's attempt, in the wake of the Cosmos 954 incident, to impose a new regime on the use of nuclear power sources in space through the United Nations Committee on the Peaceful Uses of Outer Space, has made little progress.⁷⁷ In addition, the costs of such a ban might well outweigh its benefits in that restrictions on nuclear-powered satellites could conceivably destabilize the nuclear balance.⁷⁸

74. N.Y. Times, Jan. 31, 1978, at A10, col. 5.

75. Most satellites are powered by solar panels or chemical fuel cells. These sources are, however, too weak for satellites that carry power-intensive electronic equipment such as radar. N.Y. Times, Jan. 25, 1978, at A1, col. 6; N.Y. Times, Feb. 1, 1978, at A8, col. 3.

76. As a leading aviation weekly noted:

If the Soviet Union were to agree to such a ban [on nuclear-powered satellites] the effect on its ocean surveillance program would be severe. At least 10 Russian fission reactors have been launched into low earth orbits on 16 ocean surveillance missions since 1967.

. . . Any U.S. decision not to pursue development of earth orbiting reactors could limit potential major future programs. . . . A joint Defense Dept./Energy Dept. committee created two years ago to assess future military space power requirements identified almost a dozen missions that might need electric power levels of 10-100kw. These power levels could be provided most easily by nuclear reactors in space.

Cosmos Debris Examined in Canada, 108 AVIATION WEEK AND SPACE TECHNOLOGY, No. 6, at 22-23 (1978).

77. See Legault & Farand, *supra* note 3, at 23-25.

78. The U.S. deploys nuclear weapons-capable aircraft aboard two of its aircraft carriers in the Mediterranean Sea. These aircraft form part of the "forward based systems" (FBS). See NEGOTIATING SECURITY: AN ARMS CONTROL READER 127 (W. Kincaid & J. Porro eds. 1979). The U.S.S.R. has apparently long been concerned with the threat of the seaborne component of the FBS, particularly because the aircraft carriers from which the planes are launched are extremely difficult to locate if they maintain radio silence, turn off their radar, and move under cover of clouds. N.Y. Times, Jan. 25, 1978, at A8, col. 2. As a staff report to the now-defunct Senate Committee on Aeronautical and Space Sciences declared in 1976:

We must assume the Russians would have a strong motive to develop a technology to locate United States naval vessels at sea even when they maneuver to stay under cloud cover and when they keep their radio transmitters and radar sets turned off. An obvious approach would be to put into space radar equipment capable of making rapid wide area searches in any weather.

Reprinted in N.Y. Times, Jan. 25, 1978, at A8, col.2. Cosmos 954 seemed to provide the U.S.S.R. with precisely this capability. Soviet behavior at the time of the 1980 U.S. hostage rescue mission may indicate that at least some of the later Cosmos satellites function in early warning surveillance of U.S. aircraft carriers:

The military significance and timing of the Soviet launching [of Cosmos 1176], however,

The norm of joint compensation that appears to emerge from the Cosmos 954 incident is a better answer to the paradox of satellite utilization. The states with the greatest investment in satellites are exposed to the greatest potential of liability, but that liability is limited,⁷⁹ and is not such as to discourage satellite use. This norm takes into account the probability that some satellites will inevitably fall, by requiring payment regardless of fault.⁸⁰

The outcome of the Cosmos 954 incident may well have had a positive effect on world order. The U.S. and the U.S.S.R. apparently recognized that it was in their mutual interest to cooperate rather than to turn the incident into a propaganda battle.⁸¹ The U.S. and the U.S.S.R. thus demonstrated their ability to take joint steps to deal with the dangerous items over which they exercise control. Their cooperation helps to increase the security of the two states and the world. While a price is paid for this security by the unlucky victims in such third states as Canada, the norm established by the incident provides at least for the payment of substantial reparations.

The use of nuclear-powered satellites will continue to threaten the earth with falling debris. The Cosmos 954 incident offers hope that cooperative measures can be taken to offset the damages that result, and to enhance global security in the satellite age.

may have more immediate significance. The launching came on April 29, four days after the aborted U.S. effort to rescue the American hostages at the Teheran embassy. Just before launching the rescue attempt, the U.S. aircraft carrier Nimitz sped away from a Soviet spy ship that had been trailing it, and apparently was able to launch the rescue helicopters on their secret mission without notice.

Wash. Post, May 2, 1980, at A6, col. 1. Cosmos 1176 was reportedly a twin of Cosmos 954. *Id.*

79. See *supra* notes 68-72 and accompanying text.

80. *Id.*

81. U.S. elites were reluctant to exploit the Cosmos 954 incident for its propaganda value, recognizing that the next falling satellite might well belong to the United States. Telephone interviews with U.S. government officials (Mar. 1984). Elites in the USSR were relieved that the U.S. chose to handle the Cosmos 954 incident in this way:

A realistic approach to the incident has been evident in Washington, Ottawa, and a number of other capitals. Unquestionably, the climate of international detente has had an effect here.

But not everyone likes this. Some press organs and individuals in the West are attempting to present the matter in a different light, from anti-Soviet positions. They would like to take advantage of any occasion, including the Kosmos-954 incident, to fan the flames of mistrust, fear and mutual recrimination. But such a policy is fruitless.

Gubarev, *In a Businesslike Fashion*, Pravda, Jan. 28, 1978, at 5, reprinted in CURRENT DIG. SOVIET PRESS, No. 4, at 7 (1978).