

An Escalating Competition

The Militarization of Space. U.S. Policy, 1945–1984. PAUL B. STARES. Cornell University Press, Ithaca, NY, 1985. 334 pp. \$25. Cornell Studies in Security Affairs.

Paul Stares has given us a thorough, balanced, and revealing history of the Soviet-American "space race" at a time when it is particularly important to have such a study. In *The Militarization of Space* he takes us step by step—with helpful tables and charts—through the developing competition, from the origins of the American military space program after World War II to the struggle raging today, nationally and internationally, over the Anti-Satellite Weapons (ASAT) and Strategic Defense Initiative (SDI) policies of the Reagan administration. In so doing Stares makes a genuine effort to do justice to the interests and doctrines of the contending parties (such as the several military organizations on both sides) and to examine the strategic implications of their attitudes and technologies. He also strives mightily to break down the barriers of secrecy and to tell the full story—much of which has not been told before. He presents his work at an especially crucial moment, for there are reasons to believe that our leaders are taking us across an ominous watershed with regard to space weaponry.

The Militarization of Space is the enlargement of a doctoral thesis Stares undertook at Lancaster University in England during the early 1980's. It is based upon study of numerous governmental materials, including congressional hearings and reports, speeches and press releases of the Executive Office, and documents pried loose from various agencies under the Freedom of Information Act. It is strengthened by research in the Eisenhower, Kennedy, and Johnson libraries and by more than 100 interviews with former members of the bureaucracy and armed forces (who, unfortunately for the record, are identified in the notes by only a Greek letter). It profits further from careful probing of the *New York Times*, the *Washington Post*, and technical journals like *Airion Week and Space Technology*.

The central point of the book is that, contrary to widespread impression, "space has been an integral part of the superpower arms race for over 25 years" (p. 13). Indeed, according to Stares, since the launching of Sputnik in 1957 the United States and the Soviet Union have steadily expanded their military use of space, to the point where both now rely heavily on satellites in sup-

port of their defense establishments. Since the early 1960's approximately two-thirds of the 3000 payloads put into orbit by the two countries have been of a military nature, consciously designed to increase the effectiveness of terrestrial weapons by means of reconnaissance, early warning, communication, navigation, weather forecasting, or geodetic data gathering. As Stares notes, "Military satellites not only play a crucial role in the maintenance of the armed peace. . . but are also vital to the planning and prosecution of warfare at almost every level" (p. 14).

All this has happened despite, or at least in accompaniment with, extreme secrecy on the part of the governments involved. The Soviet Union refuses to this day to admit the existence of a military component to its space program, and the United States releases only very limited information about its military operations beyond the atmosphere. From 1962 to 1978, for example, the American government refused to acknowledge that it was engaged in military reconnaissance from space. Between 1972 and 1979 the Department of Defense classified every reference to the fact that it was conducting antisatellite research.

Yet, Stares contends, even with change and secrecy on both sides, the military exploitation of space remained remarkably stable and uncompetitive until the late 1970's. Despite a flurry of American weapons research immediately after Sputnik, both Russia and the United States have tended until recently to develop space systems in accord with their own informational requirements rather than in response to the activities of the other. American anxiety following Sputnik gave way by 1967 to a more relaxed attitude as the Soviet space program matured slowly and the Kremlin dropped its opposition to satellite reconnaissance while agreeing to a United Nations resolution (later a multilateral treaty) banning deployment of weapons of mass destruction in space. Subsequently, from 1968 to 1975, even the testing of a Soviet ASAT (until 1971) could not disturb American equanimity as the Vietnam War, better superpower relations, and greater efficiencies in our space program came into play. It was only after 1976 that the decline of détente, Russia's new strategic parity, and its interventionist policy in the Third World (as well as growing American dependence on satellites and the rise of new defensive weapons technologies) rendered the United States sensi-

tive to the Soviet decision of that year to resume satellite interceptor testing.

Thus, Stares argues, in contrast to a number of observers, the long absence of "active" armaments in space was due not so much to tacit understandings or informal bargains as to "a convergence of national interests, military disincentives, and technical constraints, which were buttressed at important times by formal agreements" (pp. 237–238). There was clearly no guarantee that this historical configuration would continue to exist. Indeed, Stares asserts, in the late 1970's the factors that had stymied the growth of an arms race in space began to change, as, in particular, technological innovation occurred and incentives increased for both sides to create antisatellite weapons. As a result, we are faced today with a weapons competition which, because of the pace of research and development, is increasingly difficult to stop or control and will be destabilizing to the international system in the extreme.

Plausible and thoughtful, *The Militarization of Space* is an impressive if disturbing book. Though the author might have done more to examine the broad political-economic context of decision-making, he makes a good case for his view that a multiplicity of factors is responsible for the level of intensity in the arms race. Though he suggests that it will be extremely difficult to reverse the current trends regarding ASAT's in the same way the momentum for an ABM system was curtailed, Stares offers hope that there is still a chance for meaningful moratoriums or limitations. In sum, he shows us the configuration of factors, he underlines the burgeoning dangers, and he puts it to us to close the Pandora's box of space weaponry before all its evils have escaped.

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Pollution and Politics

Acid Rain and Friendly Neighbors. The Policy Dispute between Canada and the United States. JURGEN SCHMANDT and HILLIARD RODERICK, Eds. Duke University Press, Durham, NC, 1985. xiv, 333 pp., illus. \$45. Duke Press Policy Studies.

If yet another illustration of the problem of pollutants transported long distances through the earth's atmosphere were needed the recent nuclear accident at Chernobyl has provided it. However well recognized the scientific aspects of long-range transport phenomena, though, the political and insti-

tutional aspects remain little examined and poorly understood. This book on the problems of and solutions to acidic precipitation is thus a welcome addition to a scanty literature.

The book incidentally represents an innovative approach to teaching policy analysis. Comprising a collection of papers written by graduate students in a special seminar at the University of Texas Lyndon B. Johnson School of Public Affairs, with an introduction and conclusion written by the editors, it provided a mechanism and objective for more than a year's worth of intensive study into a current and complex public policy issue by each contributor, including field research, capped by an international conference at which each of the papers was subjected to intense scrutiny. This is, perhaps, the public policy equivalent of a language immersion program and a pedagogical model to be emulated.

The breadth of the treatment is impressive, including the physical, chemical, and biological nature and effects of acid rain, American and Canadian air pollution policies and domestic political interests, existing intergovernmental institutions and negotiations, and precedents in international environmental cooperation. With a developing issue such as acid rain, however, the decision to produce a book through a university press may have given rise to the perhaps predictable problem of datedness.

In some respects that problem is a serious one here. Not only was mention of some recent key scientific assessments, including a new National Research Council study of whether there is or is not a long-term trend in acid precipitation, impossible, there is no mention of the 1985 appointment, let alone the 1986 report, of the Canada-U.S. special envoys on acid rain or of the 1985 federal-provincial agreement in Canada to reduce SO₂ emissions. Missing too is analysis of what has now emerged as the control technology most likely to be adopted—the so-called “clean coal” or cleaner burning techniques for smelters and thermal power plants. In a contribution to an ongoing science and policy debate, these are unfortunate casualties of publication lags.

The book also makes strongly the argument that, as is stated in the title of the introductory chapter, “acid rain is different.” As a result there is a need to “consider alternative regulatory concepts and control strategies” (p. 29). This conclusion appears both too grand and too little, too late at a time when even an advisory committee to the president's science adviser has called for an immediate start to control actions. The undertaking now embarked upon by both countries to test and presumably to imple-

ment clean coal technologies, however slow, appears by comparison a good deal more direct and less problematic. Acid rain is different in degree, to be sure, from other air pollution problems, but probably not so different in kind that it requires a completely new approach to regulation.

If the overview chapters overstate the extent to which acid rain is a novel policy problem, they also understate and even misstate the extent to which Canada is a different policy and political environment from the United States. Arguing for a fundamental change in the nature of U.S. environmental policy-making, the editors suggest that “EPA and similarly Environment Canada . . . should be involved in policy formulation, because field experience is needed for the legislature to write a detailed acid rain statute” (pp. 29–30). This statement both implies wrongly that EPA officials never participate in policy formulation processes and indicates a failure to appreciate that in the Canadian parliamentary system it is virtually always the civil service and not the legislature that drafts legislation for cabinet and parliamentary approval. The authors recognize and emphasize some key political factors in the search for solutions to the North American acid rain problem—that international agreement must await domestic policy action, that what actions the U.S. government takes will largely determine the international outcome, and that Canadian politicians and diplomats are severely limited in the measures they can take to encourage American actions. They also overlook or understate others. For example, the inattention to policy responses on the part of the bilateral working groups was due less to “caution” than to political constraints, most of them from senior U.S. administration officials. And the lack of a U.S. control program to date is due less to a lack of public support than to strong opposition from interest groups, congressional factions, and the administration. Moreover, the proposal for a Canada-U.S. agreement that would not include control commitments overlooks the position of most experts that an immediate start on reductions is both warranted by existing knowledge and needed for environmental security.

Acid Rain and Friendly Neighbors is a commendable and useful effort for the information it provides on the environmental problem; it is, however, flawed as a guide to policy solutions. Its prescriptions seem unlikely to hasten either a reduction in acid rain or an increase in neighborliness.

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An Astrophysical Concept

Accretion Power in Astrophysics. J. FRANK, A. R. KING, and D. J. RAINE. Cambridge University Press, New York, 1985. x, 273 pp., illus. \$59.50. Cambridge Astrophysics Series.

The 1940's and 1950's were the years in which astronomers came to understand the structures of real stars, from stellar model calculations based on well-founded physics. From the 1960's onward, more sophisticated evolutionary models have made it possible to trace how stars age and change with time, as a consequence of the nuclear reactions that convert their hydrogen to helium and then to heavier elements.

Now in our decade astronomers are coming to understand the very late stages of the evolution of some stars, in which the even more powerful energy “source,” gravitational energy release, is important. Of course it is only when the objects are very compact, so that the gravitational binding energy per unit mass is very large, that this mechanism can be of primary importance. Thus it is in binary stars in which mass flows from a normal or giant companion star to a white dwarf, neutron star, or black hole that the energy release in an accretion disk leads to observable consequences. Many of the “peculiar” binaries and variables, almost incomprehensible to the previous generation of observational spectroscopists, are now understood quantitatively in these terms.

Even more interesting, accretion disks around much more massive black holes appear to be the most likely interpretation of the energetic inner nuclei of Seyfert galaxies, radio galaxies, quasars, QSO's, and other active galactic nuclei. Observational and theoretical studies based on this working hypothesis seem to many researchers to be the most fruitful paths of advance to understanding these objects.

Up to now, the basic ideas of accretion disks in astrophysics could only be found scattered through many research and review papers. In this little book, three active specialists in the field have collected and systematized them for the graduate student or beginning research worker. The concepts and equations of gas dynamics and plasma physics necessary for understanding accretion disks are first reviewed. Then the special ideas of interacting binary systems and the Roche lobes about a star, equivalent to equipotential surfaces in the rotating system in which material can stream from one star to the other, are discussed. This leads naturally to a thorough investigation of the accretion disks that are then expected to form, their structure and stability, and the observational properties that may be pre-