OUTER SPACE

A Source of Conflict or Co-operation?

Edited by
Bhupendra Jasani

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Published in co-operation with the Stockholm International Peace Research Institute (SIPRI)

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Note to the Reader from the UNU

This book is the outcome of research conducted jointly by the United Nations University (UNU) and the Stockholm International Peace Research Institute (SIPRI) within the framework of the University's Programme on Peace and Global Transformation. The Programme sought to redefine the concepts of peace and security from the standpoint that there can be no peace without transformation and that there also can be no transformation without peace. It undertook to identify the causes of insecurity, violence, and war and examined the underlying political, ecological, and cultural aspects.

Foreword

Outer Space: A Source of Conflict or Co-operation? is the outcome of research conducted jointly by the United Nations University (UNU) and the Stockholm International Peace Research Institute (SIPRI) within the framework of the University's Programme on Peace and Global Transformation. The Programme sought to redefine the concepts of peace and security from the standpoint that there can be no peace without transformation and that there also can be no transformation without peace. It undertook to identify the causes of insecurity, violence, and war and examined the underlying political, ecological, and cultural aspects. This volume on high technology in outer space highlights, together with another book, *Military Technology, Military Strategy, and the Arms Race,* by Marek Thee (1986), the Programme's concerns with the human and social dimensions of peace and conflict.

The first part of this volume gives an overview of the technological developments in remote sensing, satellites, and space weapons, and of the legal and treaty background concerning outer space and its peaceful use. Ensuing parts review civilian space activities in meteorology and communications, and the issue of militarization of outer space, focusing on the strategies of the United States and the Soviet Union. The final part examines the possibilities of utilizing space technology for peaceful purposes, such as verification by satellite observation and a proposal for an anti-satellite treaty.

Dr. Bhupendra Jasani, editor of the volume, is an internationally renowned expert on space technology. In this publication, Dr. Jasani has brought together various research reports, written by the leading experts in their respective fields and addressing crucial issues of outer space. We wish to express our deep appreciation to him and to the contributors to the volume for their papers as well as to SIPRI for its co-operation and assistance in this research project.

It should be noted that, for technical reasons, the publication has taken more time than originally expected. We trust that the scientific substance of the book remains as significant and relevant as ever, despite the recent drastic changes that culminated in the end of the cold war. The fundamental question of outer space—a source of conflict or co-operation?—is and will be with us beyond the twentieth century. Hopefully, humankind will opt for co-operation.

Takeo Uchida
Senior Programme Officer
United Nations University

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Part 1

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Bhupendra Jasani

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Introduction

In 1903, the founder of Soviet space engineering, Konstantin Tsiolkovsky, said "Mankind will not remain forever on the earth, but, in a quest for light and space, will, at first timidly, penetrate the atmosphere, and later conquer the whole of the solar system." While, after nearly eight and a half decades, mankind has not conquered the solar system, it certainly has penetrated, and not so timidly, the earth's atmosphere and has begun to orbit the globe.

Artificial earth satellites, space probes, sounding rockets, and manned spacecraft have been used to explore the physical conditions in space, on stars, and on planets and their moons. Such scientific prowess in the use of outer space, however, has been by and large overshadowed by the more aggressive uses of the environment: that is the military uses. The latter uses basically fall into two categories: the use of satellites—military satellites—to enhance the performance of weapons on earth and the development of space weapons to counter such spacecraft and missiles and their nuclear warheads travelling towards their targets.

Military satellites contribute considerably to the accuracy with which nuclear as well as non-nuclear weapons can be navigated to their targets. The prediction of weather conditions using meteorological satellites not only facilitates bombing but also contributes to improved accuracy by constantly refining the missile trajectory through the atmosphere. Communications satellites provide better centralized command and control of forces, and geodetic and reconnaissance satellites help to determine the position of potential targets with great precision. The latter type of satellites are used to determine the characteristics of targets as well and, hence, they have played an important role in monitoring compliance with the terms of a number of arms control agreements.

While issues related to potential space weapons have recently attracted considerable attention, relatively little has been said about the use of military satellites, although they have been in operation for at least two decades. Moreover, as indicated in Chapter 12, they are, for example, "having a profound impact

. . . on warfare in general".[1] France, the People's Republic of China, Britain, the United States, and the Soviet Union deploy such military spacecraft. The latter two nations use military satellites extensively, as was recently confirmed in a Soviet report.[2] It was stated that "The communications, navigation, early-warning and other satellites that are being used by both sides are not weapons in the generic sense of the word." The military satellite programmes of both big powers are described in Chapters 11 and 12.

Military satellites are now being given a new role. A report to the Congress, for example, stated, "There is sufficient confidence in surveillance technologies that a space-based sensor system can be developed to support boost-phase intercept requirements. . . . Midcourse surveillance needs may be provided by space-based platforms carrying multiple sensors for multiple functions."[3] Moreover, as part of defensive weapons systems, spacecraft such as those used to give early warning of missile launches or for target tracking, damage assessment, and communications are likely to play an even greater role.

As the dependence on space systems increases, their continued availability and the capability to destroy an opponent's satellites are likely to be given greater emphasis.[4] In fact, at least in the United States, it is known that military satellites are already on target lists.[5] It is also known that target lists for most strategic weapons and weapons systems on earth have been made. On such issues, information from the Soviet Union has, so far, been scanty. No doubt it has also drawn up a similar list. Recently, it was reported by the Soviet Union that "At various times before 1983, both the United States and the Soviet Union tested anti-satellite weapons in space."[6] There is increased interest in anti-satellite (ASAT) weapons because new ballistic missile defence (BMD) weapons are likely to be land-, air-, and space-based. The latter are considered in Chapter 13. Together with military satellites, these defensive weapons may become targets of ASAT weapons. These are considered in Chapter 16. Moreover, space-based defensive systems may carry weapons to counter space-based ASAT weapons. Thus, the spiral of the arms race may be accelerated.

This brief overview of the use of outer space would indicate the necessity for a closer examination of the technical aspects of various space systems, so that efforts so far to check military activities in this environment could be better understood and future actions could be meaningfully proposed. In the following chapters, therefore, some of the characteristics of outer space, launching techniques, and satellite orbits are considered. While the discussion here is by no means exhaustive, it is nonetheless hoped that there is enough information for making responsible decisions, particularly in the field of space-related arms control measures.

An important element in arms control negotiations is verification of compliance with agreements in order to create confidence in international relations.

Criteria for verification were already indicated in the Final Document of the first special session of the General Assembly of the United Nations devoted to disarmament. It was stated that "The form and modalities of the verification to be provided for in any specific agreement depend upon and should be determined by the purposes, scope and nature of the agreement. Agreements should provide for the participation of parties directly or through the United Nations system in the verification process."[7]

Observations from satellites offer a unique opportunity for the verification of international agreements and also for the monitoring of crises throughout the world, mainly because of their non-intrusive nature. Whereas the most advanced technology for reconnaissance from outer space is classified because it is used on board military satellites, the level of detail and accuracy in remote sensing by civilian satellites has in recent years increased to the extent that a new potential emerges for international co-operation in the verification of arms control treaties and in the monitoring of crises. Thus, in Chapters 4 and 15, this aspect of space technology is also discussed briefly. Because of this potential for the use of civilian outer space technology, a review of the state of the technology of remote sensing and meteorology and the national programmes of various countries is given in Chapters 7 and 8.

Another important issue is the increasing probability of serious accidents occurring due to collisions in outer space. This might become a source of conflict on earth as more and more nations use outer space. A number of accidents have already occurred, highlighting the urgency for studying the question. This is considered in Chapter 10. Yet another source of conflict is the crowding of the geostationary orbit, which is dealt with in Chapter 9.

Finally, Chapter 17 summarizes the present status of international law related particularly to civilian use of outer space. As a rule, politics and popular perceptions cannot be separated in human activities; outer space is no exception, as indicated in Chapter 18.

Notes

1. Commodore R.H. Truely, Prepared statement in *Department of Defense Authorization for Appropriations, Fiscal Year 1986*, Hearings, Committee on Armed Services, US Senate (US Government Printing Office, Washington, DC, 1985) Part 7, Feb.–Mar. 1985, p. 4257.
2. *Star Wars' Delusions and Dangers* (Military Publishing House, Moscow, 1985), p. 8.
3. *Report to the Congress on the Strategic Defense Initiative* (Strategic Defense Initiative, Department of Defense, 1986), June 1986.
4. R.J. Hermann, Statement, *Department of Defense Authorization for Appropriations for Fiscal Year 1981*, Hearings on Military Posture, Committee on Armed Services, US House of Representatives (US Government Printing Office, Washington, DC, 1980), Part 2, Feb.–Mar. 1980, p. 265.

5. *Department of Defense Authorization for Appropriations for Fiscal Year 1980* (US Government Printing Office, Washington, DC, 1979), Part 6, Mar.–Apr. 1979, p. 3037.
6. "Parallel restraints in the testing of anti-satellite weapons: A step towards preventing an arms race in outer space," *Joint Papers from the Fourth Conference of the Lawyers Association of Soviet Lawyers*, 24–31 Mar. 1986 (Lawyers Alliance for Nuclear Arms Control, Boston, Mass., 1986), p. 3.
7. *General Assembly, Official Record: Tenth Special Session, Supplement*, No. 4, (A/S-10/4), Resolution S/10-2, paragraph 81, 23 May–30 June 1978 (United Nations, New York, 1978), p. 6.

2

Space Flight: Some Basic Concepts

The potential mission of a spacecraft is generally deciphered by considering its orbital characteristics and its behaviour in orbit. By and large, the orbital characteristics of a satellite are optimized for a particular mission. Before considering this aspect, it is worth summarizing at this stage current thoughts on the nature of outer space.

Where Does Outer Space Begin?

The 1967 Outer Space Treaty, which established an international legal status for outer space, is totally silent on the meaning of outer space. Nowhere in the treaty is this term defined and it has been the subject of debate for over 20 years without a solution.[1] The issue will have to be resolved because parties to the treaty "undertake not to place in orbit around the Earth . . . any objects carrying nuclear weapons or any other kinds of weapons of mass destruction . . . or station such weapons in outer space in any other manner" (1967 Outer Space Treaty, Article 4). Among the new generation of space weapons, there are two which may be regarded as weapons of mass destruction. It has been suggested that lasers could be used to start large fires on earth from outer space.[2] Also x-ray lasers are based on nuclear explosives. Should these weapons become a reality, it would be essential to know when Article 4 of the treaty could be applied. It would be important to know where airspace ends and outer space begins.

A number of proposals have been made within the United Nations. All of these essentially have been on certain atmospheric effects on any craft travelling through it. For example, airspace would end at an altitude at which the momentum imparted to the vehicle was insufficient to maintain it in its flight because of the lack of support from the atmosphere. This would give a fairly well defined boundary between the atmosphere and outer space. With the emergence of the Space Shuttle, however, a clear formulation for this boundary no longer exists.[3] Nevertheless, an altitude of 110 km above sea level has often been discussed as a possible end of airspace and the beginning of outer space.

Another approach is to say that the medium surrounding the earth is coninuous without any demarcations. This means that the atmosphere is part of this medium which merges with outer space. Under this scheme, the beaviour of nations would be judged by the function of the vehicles they operate. The questions of sovereignty would be resolved by an international agency.

While the debate may continue, there is no doubt that a solution has to be found soon. Much discussion is taking place on keeping outer space a peaceful environment and yet we do not even know clearly where outer space begins.

Some Basic Orbital Concepts

So far satellites have been orbited using launchers based on missiles developed to carry nuclear warheads. In a separate trend, some countries outside the group of nuclear weapon states have developed launchers primarily for orbiting satellites. Spacecraft are usually placed in orbit by large multi-stage rockets that apply accelerating forces over a period of several minutes. In the initial phase of the flight, it accelerates through the atmosphere in a vertical direction and gradually bends over into a horizontal path. The vertical phase lasts for about 10 seconds. The first stage of the rocket takes the spacecraft to the upper atmosphere at an altitude of about 60 km. The spacecraft is then gradually brought to its orbital height by the second and the third stages of its launcher. Once this is achieved, the spacecraft is turned into a horizontal position and given sufficiently high velocity in this direction so that it will not fall back to earth. Instead, it will continue in an elliptical path around the earth (see fig. 2.1). The satellite is then said to be in orbit.

There are several characteristics that describe orbits of a satellite. Perhaps the most important orbital parameters are the orbital period, the apogee, and the perigee. The period is defined as the time required for the satellite to complete one revolution around the earth. The apogee is the furthest distance and the perigee is the closest distance between the spacecraft and the earth's surface. The orbital velocity of a satellite is largest at the perigee and smallest at the apogee.

Another significant orbital element is called the orbital inclination. This is the angle between the orbital plane of the spacecraft and the equatorial plane of the earth (that is, a plane through the earth containing the equator). If the satellite is launched so that the orbital plane contains the north and south poles of the earth, that is, the orbital inclination is 90 degrees, then the satellite is said to be in a polar orbit. The orbital inclination determines the range of latitudes over which the satellite travels on each revolution. Thus, the choice of a particular