THE WORLD IN FOCUS

MANKIND'S ROAD TO THE STARS

VITALI SEVASTYANOV
VLADIMIR PRYAKHIN

The *Bhāgāvādgīta* says that even if we reach *Brahmaloka*, the highest planet in this material world, we will still find the temporal inconveniences of death, disease and old age. But one who reaches *Kṛṣnaloka*, the supreme planet within the spiritual sky, will not meet these inconveniences...

Of course, in real life there is no choice between *Brahmaloka* and *Kṛṣṇaloka*. Man is engaged in a parallel effort to explore outer space and to form a consciousness that would measure up to the realities of the space age—the age that should be one of material and cultural abundance, one devoid of weapons and wars.

How great is the danger that man will master space technology sooner than new political thinking, sooner than the need for creating a non-violent and non-nuclear world is realised?

The authors of this book attempt to answer this and a score of other questions concerning the advent of man into outer space. Among other things, the authors conclude that to be able to preclude war, to eliminate the threat of mankind's self-destruction, it is essential that we clearly understand not only how dreadful this threat is, but also how wonderful our future world—which we are all building and to which we all have a right—can be.

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Contents

Introduction

There is a legend dating back to the 21st century BC about King Etana of Sumer, a priest, who used the wings of an eagle "to rise into heaven and arrange peace among nations".

Now, on the threshold of the 21st century AD, cosmonautics has given mankind the wonderful ability to view the international community from space as a single whole. Needless to say, the advent of the space age cannot in itself "arrange" for all nations to live in peace and harmony. Nonetheless, cosmonautics is playing a significant and diversified role in promoting international cooperation, in tackling global problems and in forming and implementing the new thinking — the cornerstone of a non-nuclear and non-violent world.

Magellan's round-the-world voyage, which took 3 years, stunned his contemporaries by revealing the vastness of the oceans and the inhabited lands. The one hour and forty-eight minutes of Yuri Gagarin's space flight showed mankind the precise spatial dimensions of its common home, while the 73 fatal seconds of Challenger's ascent proved the fragility of this home and that its security cannot be entrusted to automatic devices, no matter how reliable they may be.

Cosmonautics is playing a large part in the formation of the three pillars of the new thinking, i.e., faith in the unlimited possibilities being opened up by scientific and technological progress, the development of a cautious approach towards the use of modern technology, and the understanding that international cooperation is essential for the exploration of outer space, as well as for the solution of other global issues, especially the question of mankind's survival in the nuclear-missile age.

In trying to grasp the intrinsic logic of our sophisticated and contradictory, yet integral world, the philosophers of the 21st century will probably note the fact that the evolution of political thinking in the era before historical materialism was mainly characterised by a retrospective assessment of global catastrophes, wars and other social calamities. Such thinking prompted Hegel, the founder of the systematised theory of dialectics, to make his famous analogy about Minerva's owl, that only leaves her ear at dusk. By that he emphasised that consciousness typically lags behind the realities of life.*

Still, man's desire to see into the future so as to preclude a perceived impending danger before it strikes is equally natural. The Soviet Union's course of *perestroika* exemplifies preventive political thinking in the face of an unprecedented danger — that of a nuclear holocaust. The potential energy in the world's stockpile of nuclear armaments is enough to send all its inhabitants on a space flight; every minute one and a half million dollars is being spent on the production of lethal weapons.

"We cannot take 'no' for an answer to the question: will mankind survive or not? We say: the progress of society, the life of civilisation, must and will continue". These words from the Political Report of the CPSU Central Committee to the 27th Congress of the CPSU reflect the main imperative of our time. They are the quintessence of mankind's entire political experience during the period when the achievements of the scientific and technological revolution are being broadly implemented and realised.

As the acme of man's technological genius, cosmonautics forms a part of the material foundation of the new political thinking, for it means that humanity's productive forces have reached such a level of advancement that this new thinking becomes absolutely indispensable. As Mikhail Gorbachev said in his statement of January 15,1986, outlining a programme for the establishment of a non-nuclear world by the year 2000: "Mankind is at a crucial stage of the new space age. And it is time to abandon the thinking of the stone age, when the chief concern was to have a bigger stick or a heavier stone".

The crucial question of mankind's continued survival is

*The flight of Minerva's owl represents humanity's attainment of complete understanding of its own history and the wellsprings of its actions. This flight will take place only at dusk, i.e., at the end of human civilisation.

inexpicably connected with the question of whether or not the militarisation of space will be prevented.

The struggle for peace and the struggle to ensure that space is used exclusively for peaceful purposes go hand in hand. This coincidence between the quest for knowledge on the part of space explorers and the interests of the entire world was affirmed by the historic treaty between the USSR and the USA on the elimination of intermediate- and shorter-range missiles. "People want to live in a world," Mikhail Gorbachev stressed in his speech at the treaty's signing ceremony, "in which American and Soviet spacecraft would come together for docking and joint voyages, not for Star Wars".

One of the main applications of scientific and technological achievements throughout has been in weapons improvement. The new political thinking is destined to change this.

The spreading and promoting of new political thinking in the practice of international relations, a way of thinking based on an awareness of our global integrity, is the main priority as regards the world's development. What is now urgently needed is a fresh understanding of the present stage of the development of civilisation, international relations and the world. The world, though complex and contradictory, is nevertheless objectively held together by bonds of interdependence. International relations, given all the differences and conflicting interests, can no longer be conducted according to the age-old traditions of the "law of the jungle". Civilisation, which is witnessing unprecedented achievements of man's thought and creativity, is, at the same time, becoming more fragile, more vulnerable to those forces being released by human genius that serve the purposes of destruction. All this necessitates and calls for the eradication of many habitual approaches to foreign-policy making, for a cardinal change in traditional political thinking, in views on the problems of war and peace, defence and domestic and international security.

In the light of the above-defined task, the new political thinking is apparently a system of views and ideas encompassing politics, law, philosophy, morality, religion and aesthetics. This system calls for a new way of looking at the totality of the knowledge accumulated by humankind, and dictates that the attainments in all spheres of science must be made to serve the main imperative of survival.

Political thinking is unquestionably the key element in this system.

It is sustained by rational ideological trends and views which rest on a solid foundation provided by modern natural sciences. The tremendous scope of the latter's achievements allows for this foundation to be used for building a common home for humankind in the 3rd millennium. Born of the scientific and technological revolution, and made up of a combination of advanced scientific and technological branches, cosmonautics, or astronautics, as it is also called, occupies a special place in the natural science foundation of the new thinking. The bonds and the interaction that exist between new political thinking and cosmonautics are diverse and dynamic.

First, cosmonautics has helped give a concrete basis to the awareness of the irrefutable fact that the Earth and the space surrounding it are mankind's common home.

Second, the level of scientific and technological advancement needed for space flight is indicative of an abundance of material wealth, an abundance that is not just the stuff of a beautiful fairytale but a reality.

The great Russian scientist and the founder of theoretical cosmonautics, Konstantin Tsiolkovsky (1857-1935), wrote that the advent of the space age would bring mankind "mountains of bread and oceans of power". Although relatively speaking mankind has now only just entered this age it is already clear that if it were to concentrate its resources for peaceful purposes, it could satisfy the vital needs of the Earth's entire 5-billion population.

Third, by expanding the spatial and related temporal boundaries of knowledge, space flight contributes to humanity's spiritual wealth, filling its existence with boundless possibilities of cognition.

Finally, the conquest of space signifies a qualitatively new stage in the evolution of man himself, who represents "the highest level of organised matter within the known part of the universal framework",[1] as well as of intellect, which is the ability of matter for self-awareness and for cognitive activity that unveils the essence of reality.

Though space flight, man ceases to be a slave of nature, which he was only a century ago, and starts to become the real master of the cosmic vastness. The task now is to choose the most rational and efficient way of handling this power and this vastness.

These basic features of cosmonautics at the turn of the 2nd and 3rd millennia make it an important part of the natural science foundation of the new thinking, enabling a correlation of the latter's philosophical and political principles. It can be asserted without exaggeration that cosmonautics is among those fundamentally new material factors that have imposed a new measure of answerability in taking national decisions, in correlating the process of cognition and the methods of using scientific achievements, and in maintaining a balance between time and space. Through space flight, mankind comes, by way of experiment, to realise the existence of quantitatively new limits of time and space, limits, compared to which the absurdity of modern militaristic thinking and the barbarity of primitive cannibalistic tribes are categories of the same order.

One can only realise one's responsibility for the future of the world by feeling oneself a part of this world. Carl Sagan, a prominent US space researcher, feels that political involvement is an expression of his duty as a citizen of the planet Earth.

When political activity was confined to a single country, region or continent, politics was merely a profession for a privileged caste of individuals, such as those who altered international borders "in between two turns of a waltz" at the Congress of Vienna in 1815, when the European monarchs reshaped the political map of Europe after Napoleon's defeat. But nowadays, when millions of people are being drawn into the vortex of political activity, and the stakes involved in the political struggle have become so high as to threaten the existence of mankind, politics has ceased to be the prerogative

[1] A.G. Spirkin, Entry under "Man", *Philosophical Encyclopaedical Dictionary, Moscow*, Sovetskaya Entsiklopedia Publisers, 1983, p. 770 (Russian edition).

of professional policy-makers and started being the duty of every sensible and responsible person. The result has been the birth of people's diplomacy.

Cosmonautics makes one realise the intellectual heights man has reached, as well as the enormous power that has been gained over nature. Looking at the Earth through the porthole of a spaceship makes the viewer feel himself a part of a single entity — mankind — and really brings home the absurdity of war as a means of solving international disputes. An ancient Indian postulate has it that persons of noble deeds look upon the entire world as their family. This is especially easy to believe when looking at the Earth from space.

Outer space is quickly becoming mankind's common laboratory and workshop, and, in this sense, is an ideal sphere for the realisation of new political thinking. Since we are now in the age of nuclear weapons and supersonic speeds, the age of growing economic and political interdependence, no one can build his own security at the expense or to the detriment of someone else's security, and this imperative of new political thinking is most perceptibly reflected as regards outer space, because it is, *a priori*, the province of all mankind, regardless of any differences that traditionally have hindered communication between people. Speaking theoretically, but with a high degree of probability, one can say that within the vastness of the universe, humanity is an integral interstellar communicator with hypothetical extra-terrestrial civilisations.

The distant light of celestial bodies, which has been reaching the Earth since times immemorial, has always given man the clearest proof that he is a member of the human race. This subject was dwelt upon by philosophers and poets long before the advent of the space age, as this classical example from Russian poetry by Valeri Bryusov shows:

> The night reveals all secrets of creation,
> Its starry eyes are contemplating human passions
> To tell us there are many other Earths,
> Oh, millions of worlds with myriads of nations
> With their joys and sorrows and births
> And loves and lives and deaths. But whose?
>
> (Translated by N.M. Shevyrina)

And here is a poem by Rabindranath Tagore, full of serene dignity:

> At dusk the sky is dim, and its blue sari
> Enveloping the world cannot conceal its dirt.
> It's like a handful of wretched people inside a poor house.
> Oh, grief, descend upon my poor bleeding soul,
> The way a quiet evening comes upon the world,
> And wrap my life and sorrow up in your black veil.
> (Translated by N.M. Shevyrina)

Following the launching of the first Soviet artificial Earth satellite and especially after the first manned space flight by Yuri Gagarin, space exploration became a subject not only of philosophical studies and poetry, but also an object of major international politics. The status of outer space as a domain of human activity is stipulated in about 30 multilateral treaties and agreements. For example, Article I of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies states: "The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.

"Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all states without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.

"There shall be freedom of scientific investigation in outer space, including the moon and other celestial bodies, and states shall facilitate and encourage international cooperation in such investigation".[1]

If the programme proposed by the USSR for the peaceful exploration of outer space through joint international efforts were to be implemented, near-Earth space could become a

[1] *The United Nations and Disarmament 1945-1970*, United Nations, New York, 1970, p. 454.

sphere of economic activity for all the countries of the world, and real prerequisites could be created for converting our civilisation into an interplanetary one from the beginning of the third millennium.

Such a concept obviously serves to promote broad international cooperation in the exploration of outer space for the benefit of all countries of the world. This kind of cooperation among states, as Nikolai Ryzhkov, Chairman of the USSR's Council of Ministers, wrote in a letter to UN Secretary General J. Pérez de Cuéllar, could in its turn "become a bridge for stronger trust and mutual understanding among them on Earth as well".[1]

International cooperation in the exploration of outer space is of special significance to the developing countries. Their participation in it can give them acess to scientific and technological achievements, enabling them to skip various stages of such development.

It is equally important that within the international brotherhood that is being born in the world today, those bonds that unite nations in the name of the common goals of progress and prosperity are ever more clearly identified. Soviet-Indian relations represent an important link in the infrastructure of our integral and interdependent world.

"Many initiatives of the non-aligned movement have been explicitly supported by Mr. Gorbachev. He is a friend of the third world and developing countries and he has always stood firm for any cause that would enhance their well-being. We, in India, regard him as a 'comrade-in-arms' and leader of a country which has stood by us in difficult times. Exchange of visits and views between Mr. Gandhi and Mr. Gorbachev have further cemented friendship between the two countries", noted Dr. Govind Narain Srivastava, General Secretary of the Indian Institute for Non-Aligned Studies, in the Foreword to the Institute's edition of *Mikhail Gorbachev on India, Non-Alignment and World Peace.*

It should also be added that scientific and technological cooperation in general, including cooperation in space exploration, plays an important part in Soviet-Indian relations.

[1] Supplement to *Moscow News*, No. 25, 1986, p. 5.

Given all the above-mentioned considerations, the conclusion can be drawn that the establishment of reliable international cooperation in space exploration, as well as the creation of a relevant international mechanism, such as the World Space Organisation (WSO) proposed by the Soviet Union, would signify a qualitatively new stage in the further mastering of the universe. Along with numerous other international organisations, in particular the United Nations, the WSO could become an embryo of a sort of world government, and be assigned, albeit with limited authority, various functions of administration and control.

* * *

There is an intriguing scripture in the *Mahābharata*, which can be regarded not only as the philosophical foundation of one of the world's leading religions, but also as a narrative of an advanced cosmological theory. According to it, getting to *Brahmaloka*, the highest planet of the material world, "through some sort of mechanical contrivance by maybe travelling for forty thousand years", is less important and necessary than approaching the supreme planet, *Kṛṣṇaloka* within the spiritual sky. There, the scripture says, one will not meet "the material inconveniences of death, disease and old age".[1]

This idea is consonant with a central concept of "Russian cosmism" concerning the continuity of thought. "One ought to go into outer space to be able to understand Earth", declared the Russian scientist Vladimir Vernadsky, one of the founders of cosmism, 100 years before the first space flight. The great veracity of these words can be felt inside the cabin of a spaceship. Everything that is done by man in space should serve the interests of man on Earth. "Man," said the Greek philosopher Protagoras, "is the measure of all things". And that includes outer space. The labyrinths of the human mind are more intricate and enigmatic than the workings of the

[1] A.C. Bhaktivedanta Swami Prabhupāda, *Bhagāvādgīta As It Is*, The Bhaktivedanta Book Trust, New York, Los Angeles, London, Bombay, Manila 1982, p. 20.

cosmos, for the former encompasses everything, in the same way that the cost of a spaceship includes the cost of the materials from which it is made.

The exploration and use of outer space in itself contributes to the formation of the new individual, an individual imbued with a new way of thinking, a citizen of the planet Earth who understands the meaning of human existence as it relates to the principles of intenational cohabitation.

We must not delay in working out the ideology of peaceful coexistence, an ideology that would be able to keep up with the pace of the advancement of space technology. According to Sebastyan von Horner, US astrophysicist, the period of technological maturity of our civilisation will be short-lived. His colleague Alexander Rapport estimates that the man-made "technosphere" will collapse before the year 2030; if not from a nuclear cataclysm, this could be caused by an ecological catastrophe, the existence of ozone holes or some other such reason. The tragedies that occured in Chernobyl and Bhopal, the horrors of the fratricidal war between Iran and Iraq, etc., are cited to corroborate this hypothesis.

We are optimists. We believe human civilisation to be an extension of the law-governed development of cosmic processes. Having discerned and realised the impending dangers and challenges, man should therefore be able to take vigorious measures to prevent the end of civilisation.

The purpose of this book is to prompt the reader to join in the implementation of those measures.

CHAPTER ONE

Outer Space and Global Problems

The beginning of the space age coincides in time with the aggravation of the problems of the world's development that later came to be termed as "global". It was not too long before space exploration itself started being included among the global problems that exist in the sphere of the interrelationship of nature and society. This reflects an objective law that governs the genesis of global problems. It helps to determine the place of the issue of space exploration in the sphere of social relations and in the sphere of man's interrelationship with the environment.

The scientific and technological revolution, the qualitative leap forward in the development of basic sciences and the emergence of a number of fundamentally new fields of natural sciences culminated in space flight, in the unprecedented possibility of including near-Earth space in the world economy, of making it a source of material and cultural well-being for mankind in the third millennium.

But at the same time, a global problem emerged in the sphere of social relations that overshadowed everything else — the threat of nuclear destruction. In this respect, the answer to the central question of our time — whether mankind will survive or not — is connected with the answer to another question — will outer space and technology be used for peaceful or military purposes?

The issue here on Earth of preventing mankind's self-destruction and the question of using outer space for peaceful purposes are being resolved in parallel, for they mirror one another, as it were, within the context of the creative and the destructive aspects of the historical process. While the former embodies favourable opportunities for using science and technology for man's benefit, the latter can be compared with the monster created by Frankenstein (the hero of a novel by English writer Mary W. Shelley) threatening to destroy his creator, in our case, mankind as a whole.

Being an important element of the scientific and technological revolution, cosmonautics vigorously stimulates the pace of advancement in science and technology. Space research has led to major breakthroughs in exact and natural sciences, in addition to the emergence of fundamentally new fields of applied science, such as space biology, space medicine, space materials science and so forth. Each of them offers new opportunities to mankind. In the future, the industrialisation of near-Earth space will make it possible for various production facilities to be set up there. Also, the zero gravity and high vacuum of space can be used for manufacturing new kinds of materials and various industrial products.

The development of space-based manufacturing is inseparable from the self-repayment of the research conducted in space. Not all of it will start bringing revenues in the near future. For example, since the cost of ensuring safety does not fit into an economic category, it is difficult for the present to speak about manned space flights in terms of self-repayment.

Meanwhile, some space applications, such as the manufacture of rare drugs and semiconductors in conditions of weightlessness, and map-making, are already profitable. Every rouble invested by the Soviet Union in map-making with the help of artificial satellites, for example, brings in a five-rouble return.

Space-based communication means are becoming a major element in the global infrastructure of the world economy. Geological studies conducted by satellites allow mankind to better estimate the Earth's mineral and organic resources. In their space laboratories, cosmonauts create prototypes of materials that will be used in the 21st century and carry out biotechnical experiments to produce superpure biologically active preparations. After being sent back to Earth they set the standards for purity in the manufacture of vaccines and serums and also of new, more effective medicines.

The affinity of the peaceful use of outer space with environmental protection here on Earth holds a great deal of promise. "What matters now", Soviet scientist Arkadi Ursul points out, "is not so much the use of outer space, as its bearing upon the world's social development, as well as upon the solution of urgent global problems, particularly the ecological problem".[1]

The placement of satellites to provide complete coverage of the Earth's atmosphere calls for a coordinated international effort. Cooperation in this area has been envisaged by virtually all of the international agreements on space exploration. Of special importance in this respect are the agreements and projects that pool the efforts of the USSR and the USA, the world's two most advanced states, having the most powerful potentials for space exploration. An agreed list of projects in an annex to the Agreement Concerning Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes signed in April 1987 includes the commitments of the parties to coordinate efforts in studying the global changes occuring in the environment (cl. 11).

A fresh impetus to this vital area of common interests was given in the course of the USSR-USA Summit in December 1987. The two leaders gave further support to the Soviet-American initiative for carrying out joint research into global climatic and environmental changes, particularly within the framework of the cooperation to protect and preserve the atmosphere's ozone layer, an issue of concern to both parties.

Returning to this subject during the Moscow Summit, General Secretary Mikhail Gorbachev and President Ronald Reagan expressed their satisfaction with the progress that had been made, particularly as regards the protection and preservation of the ozone layer and the study of the tendency towards a warmer global climate.

To define the place of the peaceful exploration of outer space and of space-based manufacturing among global priorities, it should be realised that the first three decades of the space age represent only the beginning of a lengthy historical process, in

[1] A.D. Ursul, *On the Role of Space Technology in Tackling the Ecological Problem*, in *The Marxist-Leninist Concept of the Global Problems of Our Time* (Edited by V.V. Zagladin and I.T. Frolov), Moscow, Nauka, 1985, p. 434 (Russian edition).

the course of which mankind will, so to speak, emerge from the prelude to its real history.

Throughout this period, the role of space will become ever more important both in tackling social problems and the question of mankind's continued viability.

A survey of scientific and technological progress corroborates this maxim as a decisive factor of the future. A shift has occurred in this advancement placing chemistry and biology on a radically new level in the sphere of fundamental research immediately after physics. Thus in the long-term perspective, it is possible that today's problems of life-support may be reduced to the problem of developing a new kind of energy obtainable through a chain of chemical or biotechnological transformations to make up for the shortage of many mineral and organic materials.

Orbiting solar power plants will make it possible to convert the virtually inexhaustible energy from the Sun into electrical energy. Notably, these space-based power plants will remain ecologically "clean" for long periods.

The importance of space exploration goes far beyond the provision of life-support systems here on Earth. The use of outer space will continue to be an issue in the more distant future as well, when other problems, such as those connected with food, energy and raw materials, and overpopulation will have been solved, and cognition, as put by the US astronaut Edgar Mitchel, will have become a "way of life".[1]

In the process of making cognition a way of life, the global problem concerning the use of outer space is a specific manifestation of the paramount problem — that of man.

The problem of man, as Soviet globalists have more than once pointed out, is a global problem which serves to focus attention on numerous other problems. Its deep-lying essence is rooted in the crisis of man as the highest form of matter's organisation within the framework of the known part of the universe. The origin of this problem is in the objective growth of scientific information. According to Frederick Engels, one of the founders of dialectical materialism in the first half of the 19th century, "science advances in proportion to the

[1] *Sovetskaya Rossia*, Sept. 10, 1987.

knowledge bequeathed to it by the previous generation, and thus under the most ordinary conditions also in a geometrical progression".[1] Later, he defined that regularity even more accurately by pointing out in his *Dialectics of Nature,* that from the time of Nicolaus Copernicus "the development of the sciences proceeded with giant strides, and, it might be said, gained in force in proportion to the square of the distance (in time) from its point of departure".[2]

It has been determined that over 90 per cent of all scientific knowledge existing in the world has been accumulated over the past 75 years.[3] Human intellect is proving to be less and less capable of "processing" incoming information in order to draw practical conclusions. What people now need, according to Konstantin Tsilkovsky, the father of theoretical cosmonautics, is "a cosmic world view",[4] that is, an adequate picture of the dynamic world at the new stage of the scientific and technological revolution dated by scientists as having begun in the middle of the 20th century.

At this stage man has gained unlimited and truly cosmic power over nature, though, admittedly, he has not yet learned how to use it effectively or rationally. A science fiction writer, Sri Lanka's representative at the Geneva Conference on Disarmament, remarked that people in the space age often remind him of little boys who argue who has more matches while standing in a pool of petrol. In other words, man does not measure up to the significance of today's scientific discoveries and technological breakthroughs.

Albert Einstein, the world-famous physicist and author of the theory of relativity, said that "the release of atom power has changed everything except our way of thinking". By saying this, the great physicist was in his own way expressing the need for a "cosmic world view".

It is only logical that a "cosmic world view" can best be gotten from outer space. Outer space is the best place from

[1]K. Marx, F. Engels, *Coll. Works*, Vol. 3, p. 440.
[2]K. Marx, F. Engels, *Coll. Works*, Vol. 25, p. 320.
[3]I. Frolov and M. Marois, *New Times*, No. 50, 1987 (Russian edition).
[4]K. Tsiolkovsky, *Coll. Works*, Moscow, 1964, Vol. 4, p. 87 (Russ. ed.)

which to monitor the human environment, as well as compliance with arms-limitation agreements undertaken by states. Outer space serves as a unique link enabling communication between people living tens of thousands of kilometres apart.

But the use of outer space will bring more and more practical benefits to mankind only if there is active international cooperation in this field. The overwhelming majority of the world's nations cannot yet enjoy these benefits unaided. Meanwhile, the world's leading space powers can only succeed in conquering near-Earth and far-distant space if they coordinate their space exploration efforts.

CHAPTER TWO

International Cooperation in Outer Space

The working structure of the international cooperation in the exploration and use of outer space has been taking shape under the impact of two diametrically opposed factors:

1) the objective necessity for cooperation, on the one hand;

2) the realities of the Cold War, which has seriously impeded such cooperation on the other.

The objective necessity for international cooperation originates in the explosive development of space-based communications and information systems, as well as in the growing production of expensive space equipment.

The quantitative dynamics characterising space research and space-based manufacturing is reflected in the following data, quoted at the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space held in Vienna on August 9-21, 1982.

From 1957 to 1982, 3,125 artificial Earth satellites (AES) and other man-made objects were launched into space, including 2,069 by the Soviet Union and about 1,000 by the United States. From 1961 to 1982 nearly 100 manned spaceships were orbited.

Those figures have doubled in the past five years. Accordingly, the use of satellites in long distance communications and in relaying information has increased. About 60 per cent of all artificial satellites being launched today (with the exception of satellites used as national means of arms-control verification) are used for communications. These account for more than 70 per cent of all intercontinental phone calls, and radio and television transmissions.

The appearance of satellites gave birth to a new industry, which, according to the Foreign Policy Society of West Germany, annually produces 400 tons of equipment, termed "satellite mass", at a market price of 40,000 dollars per kilogramme. For the sake of comparison, the price for aircraft is 400 dollars per kilogramme, for TV equipment, 40 dollars; and for automobiles, 4 dollars. The annual output of satellite-related products by the world's aerospace industries is estimated to be worth about 20 billion US dollars.[1]

The following figures will give an idea of the funds that were earmarked for space research in various countries in 1984 (in billion dollars): USA — 17.5; France — 0.57; West Germany — 0.35; Britain — 0.12; Japan — 0.53; USSR — 23.[2] These and similar data permit one to estimate the world's expenditure on the exploration and use of outer space at 500-550 billion dollars (between 1957 and 1987).

The political and socio-economic effect resulting from the coordination of the world community's efforts in the exploration and use of outer space could clearly be felt as early as 1959, i.e., 2 years after the first artificial Earth satellite was launched by the USSR, with the establishment of the Committee on the Peaceful Uses of Outer Space by the UN General Assembly. The Committee's original membership of 24 UN member states, grew to 53 countries by 1980, including the five permanent members of the UN Security Council — the USSR, the USA, Britain, China and France. The Committee's establishment signified that the UN had become a coordinating centre for international cooperation in the exploration and peaceful uses of outer space. In the practical plane, the UN, via the Committee, serves as a liaison between governmental and non-governmental bodies dealing with space issues; it sponsors, on a voluntary basis, exchanges of information between governments concerning national space activities; and drafts international agreements stipulating the rights and obligations of states as regards the exploration and use of outer space, and the applications of space technology.

[1] K. Kaiser, H.P. Schwarz, *Weltpolitik. Strukturen-Akteure-Perspektiven,* Stuttgart, Klett-Gotta, 1985, S. 230.

[2] *International Cooperation and Competition in Civilian Space Activities,* Office of Technology Assessment, Congress of the United States, Washington, July 1985, pp. 65-66, 73, 75, 83; *Space Policy,* February 1987, Vol. 3, No. 1, p. 78.

The UN sponsored two world conferences, in 1968 and 1982, on the exploration and peaceful uses of outer space. They had a major influence on the promotion of international space cooperation. The UN Programme on Space Applications was the immediate outcome of the first conference, which was considerably broadened in scope by the second conference to provide for the training of specialists from developing countries, to render technical consultation services and to run UN-sponsored training courses and specialised seminars.

The day-to-day running of affairs is handled by the Outer Space Affairs Division of the Department of Political and Security Council Affairs, established as part of the UN Secretariat in 1968.

Aside from the Outer Space Affairs Division, space-related issues within the UN Secretariat are handled by the Department of Technical Cooperation for Development and by the Centre for Science and Technology for Development. In addition, there is the Regional Remote Sensing Programme, operating under the aegis of the Economic and Social Commission for Asia and the Pacific (ESCAP); space cooperation programmes within the framework of the Economic Commission for Latin America and the Caribbean (ECLAC); the African Regional Remote Sensing Programme, run by the Economic Commission for Africa (ECA); and the Office of the United Nations Disaster Relief Coordinator (UNDRO), which handles the use of satellite systems. Assistance in the use of space within the framework of the UN is also rendered by the United Nations Industrial Development Organisation (UNIDO), and the United Nations Environment and United Nations Development Programmes (UNEP and UNDP).

Finally, space-related assistance is also rendered by specialised UN agencies, such as the Food and Agriculture Organisation (FAO), the United Nations Educational, Scientific and Cultural Organisation (UNESCO), the International Civil Aviation Organisation (ICAO), the World Health Organisation (WHO), the International Telecommunication Union (ITU), the World Meteorological Organisation (WMO), the World Intellectual Property Organisation (WIPO), etc.

This organisational infrastructure is so ramified because of the high production costs in space industries, alongside the growing worldwide demand of national economies for the benefits of space exploration and use.

CHAPTER THREE

The Orbits of Cooperation

Although the working structure of international cooperation in space exploration began to be formed at the dawn of the space age, the first practical steps towards realising this cooperation were taken by the socialist states.

Having paved the way to outer space for mankind 30 years ago, the Soviet Union, at the same time, initiated broad international cooperation in the peaceful uses of the results of space exploration.

The cooperation between scientists and cosmonauts of the socialist countries began immediately after the launching of the first artificial Earth satellite by the Soviet Union. In 1967, after having gained some practical experience, the multilateral Intercosmos programme was adopted. It envisaged conducting comprehensive research into the physical properties of outer space, along with studies in meteorology, communications, biology and medicine. Later, the programme's scope was extended to include joint studies in remote sensing of the Earth.

Over the past 20 years, scientists in 10 socialist countries have implemented major projects and conducted experiments to solve the most urgent problems in space studies. These entailed the launching of 23 Intercosmos satellites, 11 high-altitude Vertikal rockets and several hundred weather rockets of various types. Instruments developed within the framework of international cooperation were installed in Soviet manned space stations and spaceships, space vehicles of the Kosmos, Meteor and Prognoz series, and in the Venera and Vega interplanetary probes. Additionally, a number of major theoretical studies have been carried out during this period, as well as numerous comprehensive experiments involving the use of ground-based equipment, airplanes and space-based facilities.

The space flights of cosmonauts from socialist countries using Soviet spaceships and stations heralded a radically new stage in international space cooperation. Nine such flights were carried out between 1978 and 1981.

In 1988, the socialist countries resumed joint space flights. Alexander Aleksandrov of Bulgaria was a member of the crew of the Mir space station together with Vladimir Titov, Musa Manarov, Anatoli Solovyov and Viktor Savinykh of the Soviet Union.

The joint space studies and experiments conducted under the Intercosmos programme have enriched world science. Their results not only have a fundamental scientific significance, but are also widely used in the economy.

Each socialist country taking part in the Intercosmos programme contributes to it according to its specific needs and scientific and technological potential. The results of the space research conducted under the programme are shared. Cuba's participation in the programme, for example, provides better possibilities for experimenting with long-distance satellite communications; that of Mongolia to work out geodesy and map-making techniques for vast areas of the Earth's surface; and that of the GDR, to use up-to-date optical facilities in performing visual observations from space and for photographing the Earth from space. Scientists in Hungary and in Czechoslovakia contribute to the programme developing the fundamentals and practical techniques in the field of space biology and medicine; researchers in Bulgaria and Romania are active participants in the programme for monitoring the ecological balance of the Black Sea, while Vietnam has since the early 1960s been monitoring spacecraft from its territory. The Polish satellite named after the great Polish astronomer Copernicus, Bulgaria's satellite named Bulgaria, and Czechoslovakia's Magion, have also become integral elements of Intercosmos.

The separate "faces" of Intercosmos serve to give scientists in different countries access to the entire spectrum of space research.

For instance, the People's Republic of Bulgaria has conducted research in the field of space physics, worked out a very accurate analytical theory for forecasting the motion of artificial satellites, and developed astrophysical methods for processing the photographic monitoring carried out by artificial Earth satellites. Bulgarian specialists have developed methods and devices to improve remote sensing techniques, making it possible to examine the spectral ground-echo characteristics of the main types of soils. This provides a powerful new tool in forecasting crop yields and in preparing geological maps of various regions. A geological map of Bulgaria's entire territory has been made with the help of images relayed by satellites.

Bulgarian scientists are also conducting interesting studies in the field of space biology and medicine. The results of their studies of man's vestibular stability in space flight conditions were also applicable in assessing man's psychophysical condition in stress situations on Earth. Bulgaria's investigations in space meteorology are, for the most part, concerned with making routine weather charts with the use of data provided by artificial Earth satellites. Interpretation techniques have been worked out to "read" the satellite-made pictures of atmospheric clouds, along with a method of measuring the vector of upper-atmosphere velocities by means of chaff discharged from containers carried by weather rockets, and so forth.

In 1977 Bulgaria built its first ground-based station for satellite communications. Over the subsequent years, instruments for the timely and accurate processing of information relayed by communications satellites have been developed. Similar instruments have been designed in the GDR and field-tested in a joint effort by Bulgarian and GDR specialists. Studies have been made of a system to provide satellite broadcasting channels. Work is under way to use new frequency bands for radio transmissions.

Bulgaria produces instruments for space research. The first Bulgarian-made instrument was installed in the Intercosmos-8 satellite. Bulgarian specialists took part in the experiments conducted with satellites of the Intercosmos, Bulgaria, Kosmos and Meteor-Priroda series, as well as in developing instruments used in the experimental and research programme aboard the Salyut-6 orbital station. In 1979 Bulgarian cosmonaut Georgi Ivanov travelled to space on board the Soyuz-33 spaceship.

Hungary also produces instruments and electronic equipment for space studies. Hungarian-made instruments were mounted in satellites of the Intercosmos, Prognoz and Kosmos series, and in the Vertikal geophysical rocket.

Hungarian scientists study the effects of weightlessness; the interaction of the human organism with gases; the functions and disorders of the vestibular system; the psychological strain upon cosmonauts in space flight; the effects of radioactivity upon the human organism and biological objects. Use is being made of remote sensing techniques for studying the Earth. Under the Intercosmos programme Hungarian scientists are engaged in the study of the Earth's natural resources, including such aspects as the environment, geological conditions and the Earth's structure, thematic cartography and control over the quality and condition of soils, water and vegetation. As regards the future, Hungarian scientists are planning to do research into space-based manufacturing (metal-making and manufacture of medicines, etc.). This will signify the beginning of an advanced stage in the use of outer space, now termed "industrialisation". At this stage, profitability becomes the paramount criterion for assessing such projects.

The first Hungarian to make a space flight was Bertalan Farkas, who went into space on board the Soyuz-36 spaceship in 1980.

The Socialist Republic of Vietnam joined the Intercosmos programme on May 17, 1979—later than the rest of the participants. But already in 1980 the Vietnamese cosmonaut Pham Tuan went into orbit aboard the Soyuz-37 spaceship.

Vietnam's activity in the use of outer space and the application of its benefits in the national economy has run along two major lines: studies of the ionosphere and use of satellite-relayed data for making weather forecasts. Data relayed by satellites every 12 hours are important for detecting and assessing various weather systems (polar fronts, wave disturbances and, especially, the observation and tracking of typhoons).

The German Democratic Republic's contribution to the

Intercosmos programme has been multifaceted and significant. The GDR's scientists took part in studying the samples of lunar soil brought to Earth by Soviet spacecraft. They came up with creative technical solutions to the tasks connected with the remote sensing of the Earth by means of aerospace technology. The GDR has designed and manufactured about 200 different types of space equipment and instruments.

The MKF-6 and MKF-6M multispectral cameras and the MSP-4 multispectral projector were designed and are manufactured by the Karl Zeiss Jena plant. Photographs of the Earth's surface that have been taken with those cameras play a very important role in agriculture, forestry, hydrology, cartography and environmental protection.

In 1978 cosmonaut-researcher Sigmund Jähn became the first citizen of the GDR to perform a space flight. His scientific programme while in flight involved the Audio experiment aimed at finding out if any aberrations in hearing occur in conditions of weightlessness. The results obtained in the course of the experiment had a direct medical application on Earth.

A ground-based Intersputnik satellite communication station has been functioning in the GDR since 1971. A demodulator has been designed to improve the reception quality of colour TV images sent via communication satellites. Among the research underway in the field of long-distance space communications, studies are being made to use new frequency bands for radio transmissions.

A joint experiment will be staged in 1988 in the GDR's largest sea port, Rostok, involving research teams from the USSR, the GDR and Poland to test the COSPAS-SARSAT international search-and-rescue system.

A satellite-tracking station has been functioning near Santiago de Cuba since 1967 to monitor the movement of satellites orbiting the Earth at altitudes of 40,000 to 50,000 kilometres. A telemetric station was set up in 1976 as part of the integrated telemetric system to receive information from the Interkosmos satellite directly on Cuba's territory. As an island country, Cuba is intimately concerned with the problem of satellite telecommunications. An important practical achievement to that end was the construction in 1973 of the

Caribe satellite communication station, part of the Intersputnik network, near Havana.

As for application of space meteorology, Cuban researchers are involved in photographing weather conditions from weather satellites. The remote sensing of the Earth is being done in various fields. Maps are being made of sugarcane plantations and cattle-grazing areas. The first aerophotographic map of the island has been compiled from spectral photographs. The aerospace experiment called Trópico, whose purpose is to survey Cuba's natural resources, involves specialists from Cuba, Bulgaria, the GDR and the USSR.

Soviet and Cuban scientists have jointly undertaken a study to determine space crews' compatibility while in flight, as well as the psychological adaptability of cosmonauts to the conditions and schedule of work and rest on board an orbital station. Cuban cosmonaut Arnaldo Tamayo Mendez made a space flight aboard the Soyuz-38 spaceship in 1980 within the framework of the Intercosmos programme.

Mongolian researchers' participation in the Intercosmos programme takes the form of specialised studies connected with the objective opportunities offered by Mongolia's geographical position. A laboratory for taking magnetic measurements, established in Ulan Bator as far back as 1946, performs round-the-clock monitoring of geomagnetic field variations ranging from minor pulsations to violent magnetic storms. Studies are being made to create new fast and inexpensive geodesic measurement techniques to cover large territories by means of satellites and special probes.

An aerospace experiment called Gobi-Hanghay-81 was carried out in Mongolia in 1981 as part of these studies. It surveyed Mongolia's natural resources and was jointly conducted by Mongolian, Bulgarian, GDR and Soviet specialists.

Mongolia is also carrying out research programmes in the areas of basic biology and psycho-physiology, including studies aimed at improving human adaptation to space flight conditions. Mongolian experts mathematically study the data relayed from the Intercosmos-16 satellite. Mongolia cooperates with other socialist countries in interpreting the data relayed by the Soviet weather satellites of the Meteor series. The ground-based communication stations Orbita and Ekran-4M in Mongolia facilitate satellite communications. Mongolian-made equipment was installed in the Intercosmos-6 satellite. Mongolia's research institutions and industrial enterprises designed scientific instruments that were used for carrying out research and experiments on board the Salyut-6 orbital station. In 1981 Zhugderdemidiyn Gurragcha, a Mongolian cosmonaut-researcher, travelled to space on board the Soyuz-39 spaceship.

Polish scientists and researchers are involved in the entire spectrum of the Intercosmos programme. They conduct experiments in space physics, space biology and medicine, meteorology and space communications.

Inland Lakes-86 was the name of an aerospace experiment carried out in August 1981 at the Rybinsk reservoir (USSR) with the participation of Polish scientists to study the so-called "water bloom" processes in inland water bodies. The results of the experiment are of great importance for working out methods for maintaining the ecological equilibrium in nature.

Materials science is a promising area of space technology, and is yet another field in which Polish scientists are contributing to the joint programme. They study the processes occurring in materials at zero gravity and conduct very specific research into these processes, as well as a comparative analysis of the physical properties of materials manufactured on Earth and in conditions of weightlessness.

Techniques and equipment designed by Polish scientists for the remote sensing of the Earth are being used in the fields of geology, agriculture, forestry and hydrology.

A permanent satellite communications system is being developed and put into operation, along with a system to provide live television broadcasts by means of satellites. There is also a project to develop techniques and equipment for gathering and processing meteorological data.

As regards space biology and medicine, Poland has programmes to study the effects of space flight on the human organism and to improve methods of preventive treatment of functional disorders.

Poland's research organisations and industrial enterprises have jointly participated in a venture to make scientific instruments to be carried on board the Salyut-6 orbital station. Polish cosmonaut Miroslaw Hermaszewski made a space flight in 1978 under the Intercosmos programme.

Romania's participation in the Intercosmos programme was helpful in obtaining new data concerning various uses of space, both scientific and economic. Romania's scientists took part in studying the samples of lunar rock brought to Earth by Soviet spacecraft. They have designed and are improving special-purpose instruments to determine the chemical composition of extra-terrestrial space. These instruments can be used in particular for detecting traces of water in the atmospheres of other planets. Romanian scientists have also conducted a number of experiments to study space radiation, to accurately fix the location of ground-based tracking stations and to model the movement of artificial Earth satellites.

The Socialist Republic of Romania has been receiving the images relayed by Soviet and US weather satellites on a regular basis since 1971, which helps in making more accurate weather forecasts. Equipment has been designed to measure temperature and pressure in the upper atmosphere with the help of Soviet-made probing rockets. Research and design work are under way in space communications to create a Romanian multi-purpose artificial Earth satellite. Use is being made of the Intersputnik long-range satellite communications systems. Surveys of natural resources conducted by Romanian researchers are directed at identifying structural geological elements, making more accurate and better geological maps, and prospecting for promising deposits of non-ferrous ores and mineral fuels. The data obtained by remote sensing are used in Romania in working out irrigation plans. Measurements are made of soil humidity, and humid areas are identified and located and their origins are studied.

Romania has been taking part in space-related biomedical research since 1967, specifically, the study of the adaptability of living organisms to space flight conditions. Part of the work involves studies of vegetative reaction of adaptation to alternations in the "activity-leisure" biological cycle. The results of these and other studies were corroborated in the course of a space flight performed by Romanian cosmonaut Dumitru Prunariu on board the Soyuz-40 spaceship.

Czechoslovak cosmonaut Vladimir Remek's space flight aboard the Soyuz-28 spaceship in 1978 was the first of a series of manned space flights under the Intercosmos programme. Remek's flight was just part of the important contribution being made by Czechoslovakia's scientists and researchers. Czechoslovak-made scientific equipment and instruments were installed in virtually all the Intercosmos satellites, all the Vertikal rockets, many of the Kosmos satellites and on board the Prognoz spacecraft. The Czechoslovak Magion satellite undocked from the Intercosmos-18 satellite in November 1978.

Czechoslovak-made instruments were used in obtaining new data on the physical processes in the ionosphere, and on the electromagnetic wave propagation in the atmosphere, as well as in evolving the theory and a temperature model of the nocturnal heating of the upper atmosphere.

Owing to the efforts of Czechoslovak scientists new data have been obtained on the Earth's radiation belt, particularly on its structure, and the existence of an interdependence has been determined between the Earth's magnetosphere and the upper ionosphere. A complex chemical and mineralogical analysis was done in Czechoslovakia's research institutions of the samples of lunar rock brought to Earth by Soviet spacecraft. It involved the determination of the samples' age, as well as of the time during which the lunar rock was under the impact of various cosmic processes occurring on the Moon's surface. In another joint project of the Intercosmos programme, Czechoslovak scientists developed a laser-operated satellite range finder for accurately measuring the distance of a satellite from the observation point (with a measurement error of ± 0.5 m). The range finder was made in Czechoslovakia.

Czechoslovak scientists have since 1974 been taking part in investigations by means of biological satellites and in designing scientific instruments carried by such satellites. To give an example, a special-purpose instrument was designed and manufactured in Czechoslovakia to measure oxygen pressure in cosmonauts' body tissues. These measurements are important for creating the optimal atmosphere inside spaceships. Studies are being made of the impact of space flight stress factors upon the human organism. Czechoslovakia is cooperating with the Soviet Union in a study of the physiological effect of the decrease in muscular activity of cosmonauts in space. In radiobiology, priority is given to studying individual sensitivity to ionising radiation.

In tackling the tasks of using aerospace technology for studying the Earth's natural resources, Czechoslovakia is developing a scientific method for using aerospace photography for studying the chemical composition of the Earth's surface, of water bodies and for a cartography programme.

Czechoslovak scientists have made sizable progress in the area of space meteorology. Special antennas have been built to receive signals from the Soviet Meteor weather satellites. Much attention is being given to the cloud systems of the warm front; studies have been made to improve the accuracy of weather forecasting by using space photography, and an interdependence have been determined concerning the propagation of warm air masses over Europe. A method has been tested for partial correction of television images by optical means. In addition to the practical use of satellite-relayed data, a few theoretical models have been elaborated. Once these models are tested, it is anticipated that the use of satellite-relayed data in computerised weather forecasts will be enhanced.

CHAPTER FOUR

USSR-India: The Space Bridge of Friendship

Soviet-Indian cooperation in the exploration of space represents a colourful and sizable part of the experience of international joint efforts in this field.

Jawaharlal Nehru, India's first Prime Minister, was the initiator of the country's national space research programme. He was a man who fully realised the importance of the role space science and the peaceful use of outer space were playing in the development of science and technology. Himself a contemporary of the beginnings of aeronautics, while a schoolboy, he dreamed of the time when man would become the master of the air. In his younger years Nehru was a glider-plane pilot. In the autumn of 1961, which was a year of political turbulence in India, Nehru found time to receive and have a prolonged conversation with Yuri Gagarin, the world's first spaceman. "Mankind also needs cosmonautics, for it is unlikely that there will be any further progress without it",[1] Yuri Gagarin stated during his meeting with the Prime Minister, a sentiment consonant with Nehru's own views on space exploration. Nehru is known to have personally promoted Indo-Soviet cooperation in space research.

Soviet and Indian scientists have been maintaining regular contacts for nearly three decades, since the signing of an agreement on cultural, scientific and technical cooperation between the two countries in 1960. From that time on, as was noted by K.R. Narayanan, Minister of State for Science and Technology, in his address to the Indian Parliament on July 31, 1987, the Soviet Union and India have been steadily broadening their cooperation in this field.

[1] A. Gorev, V. Zimyanin, *Nehru*, Molodaya Gvardiya, Moscow, 1980, p. 399 (Russian edition).

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The two countries' joint efforts in space research received a fresh impetus with the signing of an agreement in 1972 to launch India's satellite Aryabhata with Soviet assistance. After that, the Soviet Union helped India in the launching of the Bhaskara and Bhaskara-II satellites. At the same time, a broader scope was given to the exchange of scientific information and ideas. In a TASS interview given on March 21, 1988, Professor U.R. Rao, Chairman of the Indian Space Research Organisation (ISRO), commented that it would not be an overstatement to say that India's space technology was developed with the assistance of the Soviet Union.

India became one of the states participating in manned space flights in April 1984. Rakesh Sharma, India's first cosmonaut, went into space together with his Soviet crewmates Yuri Malyshev and Gennadi Strekalov.

The launching into orbit of the IRS-IA remote sensing satellite by the Vostok rocket marked an important new achievement in Soviet-Indian space-research cooperation. The Indian press reported that the quality of the photographs relayed by the satellite had surpassed all expectations.

The IRS satellites are being used as part of the national programme for the optimum development of India's agriculture and forestry, for prospecting for mineral resources, for surveying water resources and soils and for warning about droughts, floods and other natural calamities. The launching of the IRS satellite was a milestone, for it heralded the commercial stage of cooperation, beneficial for both India and the USSR.

Cooperation with the USSR has enabled Indian scientists to take part in the Phobos Project for studying the satellites of Mars and in the programme for the building and operation of orbital stations. Professor U.R. Rao noted in an interview following the launching of an IRS satellite that further contacts with the Soviet Union in space exploration provided India with brilliant prospects.

The IRS-IA satellite marks a crucial point in the implementation of India's national space research programme. As Indian Prime Minister Rajiv Gandhi pointed out in an address to the country's Parliament: "India now becomes the fifth nation in the world after the USA, the USSR, France and

Japan to have accomplished the remote sensing of the Earth's resources from space".

Numerous other Indian statesman and politicians, public figures and specialists, as well as the country's mass media also emphasised the paramount importance of the launching of the new satellite for India. Chandra Shekhar, spokesman of the Department of Space, for example, stated that it would permanently provide the country's scientific bodies with valuable information widely applicable in various scientific fields and in the national economy.

Cooperation with the USSR, according to Srinivasa Setti, who is in charge of a programme for developing booster rockets, "would effectively mean that India would become self-sufficient in space technology. The Indian space programme", he continued, "has reached this level in many way thanks to the help of the Soviet Union, which was the pioneer in space research".

A powerful Indian-made booster rocket represents the next move towards the country's self-sufficiency in space technology. The first launching is scheduled for 1989. The rocket will be capable of putting IRS satellites and other spacecraft weighing up to 1,000 kg into orbit.

It seems appropriate to mention here that Indians themselves have said that the Soviet Union does not lay down any conditions in rendering technical and other assistance to the country's national space programme. For example, ISRO Chairman, Professor U.R. Rao, speaking at a press conference in New Delhi in May 1987, stated that India's cooperation with the Soviet Union in space was based on the principle of mutual benefit and equality, and that it fully accorded with the aim of India's space programme to build communication satellites, and to observe the Earth's surface, search for mineral resources and study weather. "We attach great significance to further cooperation with the USSR," Professor Rao continued, "Soviet space technology is precise and reliable".

Cooperation with the USSR allowed India to proceed with its national space programme during a period when the USA and six other Western powers imposed embargoes on the transfer of booster technology to India. "Washington," the newspaper *Navbharat Times* wrote, "is thereby trying to prevent India's participation in space exploration, in using the near-Earth space for the good of its social and economic progress".

The succesful outcome of the Soviet-Indian experiment—the launching of an IRS satellite in March 1988—enabled India, despite the difficulties, to keep up the pace of its national space programme.

The joint space programme of the Soviet Union and India was furthered with the signing on June 2, 1987, in Bangalore (capital of the state of Karnataka) of a cooperation protocol between the State Committee of the USSR for Hydrometeorology and Environmental Control and the Indian Space Research Organisation. The document provides for the continuation of joint experiments to study atmospheric phenomena by means of weather rockets, to explore the upper and middle atmosphere, to gather various scientific data for a global mathematical modelling of the world's climate and weather in different regions of the world.

Concurrently with the signing of the agreement, a seminar was held in Bangalore between scientists from the two countries to discuss the results of Soviet-Indian cooperation in space meteorology. The participants highly assessed the joint work that had been done on gathering meteorological data by means of weather rockets and radiosondes equipped with Soviet and Indian-made scientific instruments for studying the origin of atmospheric phenomena and monitoring the state of the ionosphere. The launching of these balloons from the Thumba Equatorial Rocket Launching Station provided the specialists involved with a unique opportunity to study the equatorial movement of ions in the upper atmosphere and to stage scientific experiments to forecast weather for the benefit of India's socio-economic development.

Cooperation with the Soviet Union in space exploration has enabled Indian scientists to accumulate valuable experience in weather studies, to better explore the country's natural resources, and to carry out more effective prospecting for mineral resources from space. These benefits, however, are not the only reason for the significance of the two countries' joint efforts in the peaceful uses of outer space. Cooperation with the USSR has made it possible for Indian scientists to achieve major successes in developing and creating national space systems in a short period of time. Without the assistance from Soviet specialists, without the utilisation of the USSR's experience in space exploration, the Indian newspaper *Financial Express* noted in this connection, India would have needed several decades instead of several years to be able to create its first artificial Earth satellite.

A Comprehensive Programme for Scientific and Technical Cooperation between the USSR and India was signed during Prime Minister Rajiv Gandhi's visit to the USSR in July 1987. This large-scale programme focuses on such fields of scientific research as biotechnology and medicine, laser technology, cybernetics and space exploration. The programme reflects the Indian specialists' great interest in deepening and broadening the scientific and technical cooperation with their Soviet counterparts. India's Central News Agency pointed out that the long experience of cooperation between the two countries had contributed to the rapid growth of India's major economic branches and to Indian science.

The growing activity in space research offers vast investment opportunities to India's industries. It has been estimated that a total of 100 billion rupees is likely to be spent in India on space research over the coming decade. This would make it possible to increase the turnover of the national space industry by 50 billion rupees or more, not to mention that the resulting products will be up to world standards.

The development of the national aerospace industry would make it possible for the Indian Space Research Organisation to cancel the import of several kinds of expensive space technologies and instead get them from local manufacturers. Major facilities for space-related tests could be set up by the national industry, including thermovacuum chambers, devices for vibration and acoustic tests, electromagnetic compatibility systems, and systems for preparing and carrying out tests of rocket engines and for operating chemical installations.

The technical standards attained by the national economy through collaboration with ISRO will have a long-term influence on the former's competitiveness. Industry can play the key role in the development of ground-based components of such systems as the INSAT communication satellites and the IRS remote sensing satellites. These satellites require a ramified system of ground-based facilities, including a network of large stationary and smaller mobile tracking stations. The operational costs needed to run these facilities for 5 to 10 years may very well reach 25 billion rupees. For instance, besides electronics, optical devices and computer software, the IRS system requires large-scale operations involving the use of aircraft to be carried out to obtain meteorological data and photographs from space.

Orders placed with Indian manufacturers for sophisticated technological support for the national space programme can and will spur the growth of India's industries, particularly its advanced branches, such as the production of up-to-date information technology, electronics and computer technology, scientific instruments and so forth. The *Financial Express* suggested in this connection that many national industrial firms could join together into consortiums in order to handle a number of tasks under the space programme, thus keeping imports at a minimum.

The interest displayed by India's national industries in orders for the manufacture of space research equipment and instruments has been fully taken into account by the Soviet-Indian cooperation programmes.

India's desire to diversify its cooperation with foreign countries in building up its own space research potential is quite natural and is met with understanding on the part of the USSR. This potential in conjunction with the potentials of other developing and non-aligned countries can serve as a powerful means for withstanding the attempts to dicate to them technologically.

A desire to make these efforts more effective underlies the Soviet proposal for establishing an international centre on Indian territory, with the assistance of the leading space powers, to conduct joint research and design space equipment according to the needs of the developing countries.

CHAPTER FIVE

Joint Efforts in Space Exploration

The experience of joint space research indicates that cooperation in space between states with different social and economic systems is not only feasible, but also mutually beneficial. A wonderful example of how international cooperation in space exploration should be promoted were the studies of Venus and of Halley's Comet done in 1986 under the Veha Project.

Scientists from many countries, including Austria, Bulgaria, Hungary, the GDR, Poland, France, the FRG, Czechoslovakia and the USSR, were involved in preparing the equipment and carrying out the project. Its work was coordinated with scientific programmes run by the USA, Japan and the European Space Agency. The interplanetary flight of the Soviet Vega 1 and 2 unmanned space probes to Venus and to a rendezvous with Halley's Comet was controlled by tracking stations in various parts of the world. Later on, the Vega probes acted as pathfinders, helping the Giotto space vehicle sent by the European Space Agency to close in more accurately on the Comet. The scientists participating in the project unanimously agreed that the results of the investigations surpassed all expectations. About 1,200 images of the comet were made and transmitted to Earth in the course of the rendezvous.

All this serves to reaffirm once again the expediency and effectiveness of uniting the scientific and technological potential of different countries for the peaceful exploration of outer space.

According to David Hughes, a senior lecturer in astronomy and physics at the University of Sheffield in Britain, who took part in designing the Giotto space probe, it was thanks to the joint project to study Halley's Comet that "many cherished models and hypotheses were converted from scientific pipe dreams to observational hard facts".[1]

The Veha Project finally resolved an age-old scientific dispute over the composition of the nucleus of Halley's Comet. The prevailing theory among astronomers a couple of centuries ago was that comets were of a "solar" origin. They were described as clusters of solar matter "knocked out" of the Sun by collisions with comets. This led to the conclusion that the greater the size of a comet the greater the mass of its body.

Although this viewpoint was more than once disproved over the subsequent centuries, it would always resurface. In particular, this theory was supported in 1951 by Fred Whipple, a prominent American astrophysicist.

The rendezvous of the Soviet spacecraft with Halley's Comet convinced scientists that the comet's interior was not formed by a heavy massive nucleus.

In this huge space experiment, the comet played the part of a source of plasma plunged into the solar wind, i.e., the stream of plasma continuously flowing from the Sun out through the solar system. Before the comet's external and internal parameters were measured from the spacecraft, there were several theories about the interaction between solar wind and the comet's plasma. Each theory was based on different abstract theoretical predictions. "Most of the theoretical predictions have been confirmed," David Hughes wrote, "but plenty of minor surprises have added spice to the results".[2]

During the joint study of Halley's Comet, scientific instruments were taken inside a comet for the first time. "Our hypotheses about the interior of a comet have changed drastically,"[3] David Hughes noted. According to him, Halley's Comet has shed new light on a comet's gases, its ionised plasma and its magnetic field.

The scientific impact of the studies of Halley's Comet, however, goes far beyond the confines of these special results. Judging by Fred Whipple's comments on the results of the Vega and Giotto missions, delivered at the symposium on

[1] D. Hughes, *Halley's Comet, New Scientist*, 5 February, 1987, p. 50.
[2] *Ibid.*, p. 55.
[3] *Ibid.*, p. 50.

Halley's Comet held in Heidelberg, West Germany, "the only surprise in the missions was their success".[1]

It may be, however, that these investigations will have an even greater impact upon the establishment of effective and broad cooperation between scientists in various countries on this frontline of modern science and technology. It is difficult to disagree with David Hughes, who, in a reference to the historic impact of the joint project to study Halley's Comet, wrote: "The space experiments were the result of cooperation between scientists of many nationalities. The reality of international collaboration—epitomised by the Soviet Vega probes acting as 'pathfinders' for Europe's Giotto—will not be forgotten".[2]

Progressive-minded scientists throughout the world rightly consider the international collaboration in space research to be an alternative to the sinister plans for the militarisation of outer space. This alternative has been expounded in detail in the Soviet Union's proposals known as the *Star Peace* programme.

The USSR put forward an initiative from the UN rostrum for a programme of international cooperation in the peaceful exploration and use of outer space, and for the establishment of a World Space Organisation.

The programme proposed by the USSR calls for the joint efforts of all states. Its cornerstone is the deep conviction that the promotion of broad international cooperation in the peaceful exploration of outer space represents a constructive alternative to the ominous plans to extend the arms race into space. The Soviet programme's immensity and great material scope, as well as the fact that it is directed towards stage-by-stage implementation within specified time limits, make up its distinguishing features.

The USSR has been consistently working for pooling the efforts of as many states as possible in the peaceful exploration of outer space. It holds that this pooling of efforts should take place on a just, equal basis with regard to the present-day level

[1] *Op. cit.*, p. 50.
[2] *Ibid.*, p. 55.

of space technology and future prospects, and should be tailored to the real needs of the countries taking part in it.

It was in this spirit that Mikhail Gorbachev made his proposal, while addressing the Indian Parliament, to create, with the assistance of the leading space powers, an international centre to conduct joint research and develop prototype spacecraft and equipment according to the needs of the developing countries, with a school attached to it for training specialists and cosmonauts from these countries and with a launching site for spacecraft.

Referring to a statement made in Parliament by K.R. Narayanan, India's Minister of State for Science and Technology, the scientific press noted with satisfaction in February 1988 that there had been some progress in the Soviet-Indian negotiations concerning the establishment of an international space centre. In particular, the Minister said that discussions had taken place between the two countries and that a decision would be made "after all details regarding the scope and financial arrangements are defined, and the acceptability of such a centre by the international community is clearly established".[1]

[1] K.S. Jayaraman, *India-USSR Collaboration, Nature*, Vol. 331, 4 February, 1988, p. 380.

CHAPTER SIX

On the Trajectory of Progress

The need for an international effort to train specialists for various space-related fields is today being felt worldwide. The creation in April 1987 of the International Space University at the Massachusetts Institute of Technology in the United States was a direct outgrowth of this need.

The university's primary goal is to provide training in every aspect of space-related disciplines: technology, management and law. It is planned that the university's total enrolment will be 100 of the most advanced students from all over the world. The university is also planned to serve as a meeting place for the heads of various space programmes, to be an international centre for the development of space technology and space law.[1]

The university's international advisory board is made up of Academician Roald Sagdeyev, Director of the USSR's Institute of Space Research; Arthur C. Clarke, the well-known science fiction writer; Yasuhiro Kuroda, cofounder of Japan's National Space Development Agency; Reimar Lust, Director-General of the European Space Agency; and Dean Burch, Director-General of Intelsat. The International Space University started offering 8-week summer courses beginning in 1988. The cost of training has been roughly estimated at 5,000 pounds sterling.[2]

The need for improving the coordination of the international community's efforts in the exploration of outer space is to varying degrees being felt by every country. Such development would be beneficial for the USSR, the USA, the member-states of the European Space Agency, as well as for

[1] *Space University Goes Around the World, New Scientist*, Vol. 116, No. 1589, 3 December, 1987, p. 38.
[2] *Ibid.*

industrialised countries elsewhere in the world, such as Japan and Australia.

But this need is more pressing for the developing countries, for without taking part in effective international cooperation they have no chance of gaining access to the practical uses of space research or the resulting benefits.

The economic stability of some of these countries, such as Argentina, Brazil, Indonesia and Thailand, is already dependent on a free access to space-related information, and this dependence is bound to become stronger in the future.

The developing countries are therefore showing understandable concern as regards the possible negative consequences the modernisation of the US satellite systems for the remote sensing of the Earth may have for them.

The roots of this issue go back into the history of the space age. Over 15 years ago, guided by political considerations, the USA began to transfer to the developing countries on easy terms information obtained by the remote sensing of their territories. The first Landsat satellite launched for this purpose was a huge success. The US government had in mind to provide the countries concerned with the information needed for setting up ground-based remote sensing stations to receive the signals sent by satellites.

For a while, the US cooperation with the developing countries and the sales to them of remote sensing data went very well. The buyer countries provided the territory, computer facilities, necessary equipment and the personnel for servicing the stations. Such industrialised countries as Canada and Japan welcomed the opportunity to receive satellite data, for it created an additional stimulus to their economic growth. Other countries, such as Brazil, Argentina, India, Thailand and Indonesia, used the satellite data in order to make more accurate maps of their territories, to make a detailed inventory of their natural resources, and to monitor crops.

Scientists were not slow to set up a databank based on the prodigious output of the Landsat multispectral scanner. Its archive material, dating back to 1972, helped them to measure changes in patterns of food production. Many countries were also able to forecast short-term food production with the data from Landsat, while countries like Brazil and Argentina monitored corn and soya-bean crops. Over the first 10 years, sales of data from Landsat increased more than 40 times, 12 ground stations were constructed around the world by interested governments and more than 100 countries began receiving information from the satellites.[1]

After that, however, the Landsat remote sensing service came up against certain difficulties. Desirous of improving the system technically, NASA began replacing the relatively simple multispectral scanning equipment with more sophisticated thematic mapping equipment, whose data, however, albeit unquestionably more promising, could not then be decoded by the existing ground stations.

Thailand is an example of a typical "victim" of this upgrading. This country had been using the remote sensing data from the US satellites beneficially since 1971. Thailand's government spent over 10 million dollars to build a ground station to process the remote sensing data together with data from weather satellites. Refitting the station to install the thematic mapping system would, of course, entail new expenditures. Following a wave of protest from the countries purchasing remote sensing data, NASA decided on a compromise, whereby the Landsat-4 put into orbit shortly thereafter carried both the new and the old system.

But the real difficulties being experienced by these developing ocuntries are not so much of a technical nature, as a commercial one. Initially, the prices for remote-sensing data were growing slower than the prices for weather-satellite photographs. By the end of the first decade of the Landsat operation, however, the prices for the former had grown to 200,000 dollars per ground station, which was certainly more than most of the developing countries could afford. And this was only the beginning. In 1983, the price for remote-sensing data underwent a threefold increase, i.e., to 600,000 dollars per ground station. In 1985, the price for a single multispectral image went up to as much as 730,000 dollars.[2] Naturally, although the purchase of remote-sensing data by the Third

[1] D. Baker, *Remote Future for Third World Satellite Data, New Scientist*, L., Vol. 116, No. 1583, 22 October, 1987, p. 48.

[2] *Ibid.*, p. 49.

World was done initially according to its needs, this means that, as of 1985, buying a single space-view image has to be regarded as a luxury.

Nonetheless, because the remote-sensing data had become an important tool in maintaining the balance of and managing a national economy, the demand for satellite-shot images has kept up. Satellite-mapping programmes, for instance, are playing a major role in the developing countries' forestry and agriculture.

With the accelerating process of deforestation going on in Central and South America and in Africa, soil erosion is becoming a major problem in these parts of the world. While satellite observations obviously cannot in themselves stop this process, they definitely help interested governments in obtaining objective information on the impending hazards and in allocating resources to combat erosion. For example, the first few times a remote sensing was done of Thailand's surface in 1972, it revealed that the country's forests were decreasing at a rate of 6,650 square kilometres a year, signifying that the country was on the verge of an ecological catastrophe. The data relayed by satellites helped work out a programme for planting additional forests and monitoring them. In Brazil and Argentina, two major timber-exporting countries, the data supplied by Landsat satellites were used to work out the optimum tree-felling schedules.

Incidentally, the data relayed by satellites are used by economic and financial groups not only to regulate production, but also to control the market. For instance, by being provided with accurate data on coffee plantations, international cartels have a powerful new tool in maintaining the level of the world prices for their product.[1]

Latin America, which at the end of the 1970s possessed a quarter of the world's forests, provides a vivid illustration of how space monitoring can be used to combat deforestation. Photographs relayed by satellites revealed that if the plans for deforestation continued at the same rate, Latin American forests would decrease by nearly half at the end of this century.

[1] D. Baker, *Op. cit.*, p. 50.

In Costa Rica alone, the forested areas are shrinking by 600 square kilometres a year.

Asian countries display the greatest interest in satellite data given their naturally high demand for food production. Indonesia provides a unique example of how satellite data can be utilised. The geographical position of the country which consists of nearly 3,000 islands stretching for over 4,000 km along the equator, makes the survey of its territory by any means other than satellites exceptionally difficult.

Indonesia's national economy is very vulnerable to droughts, which occur in the country every few years. The disastrous droughts of 1956, 1971 and 1976 inflicted serious damage to the country's economy. Owing to advances made in the recent decades, there are now techniques for regulating weather, including artificial rain making, i.e., causing clouds to give rain that would otherwise not have fallen. Of course, such artificial precipitation can only be effective if making it is decided on promptly and with regard to the direction of the wind, cloud patterns, and the state of the crops. All this requires relevant data from weather satellites. In conjunction with irrigation of arid land, the use of satellite data nearly doubled the output of rice.

Other countries' demand for remote sensing data is not as great as Indonesia's. But still, other developing countries are keenly interested in space research. One such country is Kenya, the base for the African Remote Sensing Council (ARSC), which has provided training in interpreting Landsat images to over 200 specialists. Kenya uses weather satellites launched from the USA to forecast hurricanes and study long-term climatic tendencies. Monitoring short- and long-term tendencies in weather-information is important in forecasting possible changes in the climate of Central Africa and of areas south of the Sahara desert. The regional Remote Sensing Centre in Nairobi is the controlling authority for the whole of East Africa.

Thus, over the 15 years that the developing countries have had regular access to remote sensing data, they have used this service quite effectively. A regular supply of such information now plays a vital role in their economic development. But, unfortunately, as the British journal *New Scientist* noted, "not all these conditions are likely to exist in the foreseeable future".[1]

At present, the US government has refused to control the Landsat programme, which it initiated 15 years ago out of political considerations as the first-ever "open-sky" remote-sensing service.

The cost of the "open-sky" programme was relatively low. Beween 1973 and 1978, the annual sales of Landsat data grew from 228,000 dollars to 2 million dollars, and then stabilised at 2.5-2.9 million a year for the next 5 years. In the years that followed, however, the high costs of space technology motivated the US government to revise the system of subsidising the satellite services rendered to the developing countries. As of September 27, 1985, the Landsat 4 and Landsat 5 programmes were taken over by EOSAT, a private company. This action made the developing countries' future access to the remote-sensing data quite problematic. As was mentioned earlier, the annual fee for the services of a ground station now stands at 600,000 dollars, and this will continue to be so until the launching of the Landsat 6. The price for the satellite data has also remained unchanged. But later on, as these tariffs come under the full sway of the free market, the Third World countries cannot be guaranteed that this market will be favourable to them. In this connection, David Baker, a former consultant to the UN on remote sensing for the Third World, voiced the apprehension that after 15 years of constructive application the whole business might become. unusable.[2]

All this reaffirms the need for the diversification of the developing countries' scientific and technological ties.

At the same time, efforts are needed to enhance the regional and international cooperation of these countries. For instance, out of a desire to keep up with scientific and technological progress, the Arab and the African states have established regional organisations to oversee the joint activities in various fields of space research. The League of Arab States established the Arab Satellite Communications Organisation

[1] D. Baker, *Op. cit.*, p. 50.

[2] *Ibid.*, p. 50.

(ARABSAT) in 1976 and in 1977 the African Remote Sensing Council (ARSC) was set up.

We believe, however, that the best way for the developing countries to withstand the pressure of "technological imperialism" in this important field of space research is to join efforts within the framework of an international research centre. A still shorter road to progress lies through the establishment of a World Space Organisation, whose charter, as proposed by the Soviet Union, would provide for the rendering of assisance from the leading space powers to the developing countries in gaining access to the benefits coming from the peaceful uses of outer space.

An example of such assistance was the space flight of the Soviet-Afghan crew consisting of Abdul Ahad Momand of Afghanistan and Soviet cosmonauts Vladimir Lyakhov, Vladimir Titov, Musa Manarov and Valeri Polyakov.

In the course of the six-day flight the planned joint studies and experiments were fully carried out, in particular, a large amount of geophysical research. No doubt, the results of this work will contribute to the development of various branches of science and economy of Afghanistan, in particular, geology and agriculture. As President of the Republic of Afghanistan Najibullah said in his message of congratulations to the Soviet-Afghan crew, a bright new page has been written in the history of friendship between the two nations.

CHAPTER SEVEN

The *Star Peace* Programme

Despite the fact that UN Secretary-General Perez de Cuellar said that there are currently a large number of cooperative space activities underway at international, regional and bilateral levels and that every country in the world is now to some degree involved in them,[1] there is a sharp need to improve the organisational structure of the international cooperation in space research and exploration and to give it a realistic scope.

The initiative advanced by the Soviet Union through the United Nations for carrying out a 3-stage programme of joint practical activities by the world's nations for the exploration and peaceful uses of outer space, and for the establishment of a relevant World Space Organisation (WSO) is aimed at fulfilling this need.

In proposing this, the Soviet Union proceeded from the positive experience of the International Atomic Energy Agency (IAEA), which uniquely combines the functions of a coordinator of joint activities and that of a controlling authority. This combination is fully consonant with the need to protect the technosphere born of the scientific and technological revolution, and to protect mankind and its environment from possible technological malfunctions.

The USSR representative in the Special Political Committee of the UN General Assembly's 42nd Session stressed that a World Space Organisation should be a highly efficient,

[1]*Space Activities of the United Nations and International Organisations.* A review of the activities and resources of the United Nations, of its specialised agencies, and of other competent international bodies relating to the peaceful uses of outer space, New York, 1986, A/A. C. 105/358, p. 111.

dynamic and universal organisation of a new type, one that would be free of bureaucratic structures and demagoguery.

In the interests of its member states, the WSO could assume the role of policy-maker and "global sponsor" of international cooperation in the exploration and peaceful uses of outer space. One of its functions could be to serve as a coordinator between its member states' national space programmes, promoting the exchange of the results of space research and rendering practical assistance to states in drawing them into space activities, and sponsoring commercially profitable and scientifically and technologically promising projects for the practical uses of outer space.

The WSO's chief concern would be to encourage multifaceted international cooperation and to render practical assistance to the developing countries enabling them to participate in space activities. Proposals were put forward at the international forum "Cooperation in Space for Peace on Earth" held in Moscow in October 1987 to create a special development fund to be used by the organisation in sponsoring major international projects, primarily those that would assist the developing countries.

The World Space Organisation, as envisaged by the Soviet Union, will not only coordinate scientific and economic activities in outer space, but also be an indispensable tool for maintaining international political stability. The WSO can and should serve as the controlling authority to monitor the observance of agreements on preventing an extension of the arms race to outer space and on the limitation and reduction of armed forces and armaments on Earth.

To this end, the WSO could make wide use of the existing experience in using space technology as national technical means for verifying the observance of the Soviet-American arms limitation agreements.

The procedures for using such means have been specified, e.g., by Article XII of the Soviet-American Treaty on the Elimination of Their Intermediate-Range and Shorter-Range Missiles, signed on December 8, 1987. In accordance with this Article, neither party shall "use concealment measures which impede verification of compliance with the provisions of this Treaty by national technical means of verification..."[1]

Delegating verification powers to the WSO would naturally require that it be provided with the appropriate technical means of verification. At the initial stage, the WSO could function with technical means of verification provided to it by the world's space powers, but eventually it would need its own pool of satellites, etc. This, in fact, was already suggested by some countries. France, for instance, put forward an initiative in 1978 to set up an International Satellite Monitoring Agency concluded that it would be a factor maintaining peace and international security.[2]

The future World Space Organisation will also play a constructive role in the mechanism of broad international verification of the compliance with the provisions of arms limitation agreements and control over the military situation in conflict areas. "There is a strong need for a World Space Organisation", Mikhail Gorbachev wrote in his article *Realities and Guarantees for a Secure World*. "In the future it could work in close contact with the UN as an autonomous part of its system".[3]

The idea of establishing the World Space Organisation won broad support from the 900 participants in the international forum "Cooperation in Space for Peace on Earth" held in Moscow at the Soviet Academy of Sciences' Space Research Institute (IKI) to mark the 30th anniversary of the space age. Commenting upon this idea in an interview given to the influential US journal *Aviation Week & Space Technology*, IKI's Director Dr. Roald Sagdyev said: "Cooperation becomes more important as the cost of missions goes up and up. We wanted to get this message across to the decision-makers both internationally and in the Soviet Union itself. This was my main goal for the forum, and I think it accomplished the task".[4]

[1] *USSR-US Summit*. Documents and Materials, p. 130, Article XII, paragraph 2(b).

[2] *Report of the Secretary-General*, A/AC. 206/14, August 6, 1981.

[3] M. Gorbachev, *Realities and Guarantees for a Secure World*, *Pravda*, September 17, 1987.

[4] *Soviets Stress Cooperative Ventures at Space Forum*, *Aviation Week and Space Technology*, October 12, 1987, Vol. 127, No. 15, p. 25.

The Soviet *Star Peace* programme is realistic and constructive. It fully takes into account both the objective need for cooperation and the particular difficulties that may rise in the course of its implementation.

The initial stage of the programme will chiefly consist of organisational measures and involve a 5-year study of the demand for space technology from the nations concerned, made with account taken of present-day potentials and the prospects for developing space technologies.

In order to make a comprehensive study of space-related problems and to coordinate complex space projects with the principles of a fundamentally new and wide-scale international level of cooperation in the exploration and peaceful uses of outer space, the Soviet Union proposes that an international conference, a special session of the UN General Assembly or any other relevant international forum be convened before 1990 to adopt a programme of space activities of the international community in the 1990s, along with the prospects for the subsequent 10 to 15 years. The forum would institute the World Space Organisation and launch specialised programmes under its auspices for the implementation of specific joint projects.

The implementation of the programme's initial stage, including the preparation for the conference, could be entrusted to the UN Committee on the Peaceful Uses of Outer Space.

Thus the initial stage of the programme's implementation should be focused on working out large projects for using space technologies to tackle the tasks of socio-economic development common to all nations, such as communications; navigation; rescue on the Earth, in the air and in outer space; remote sensing of the Earth for the benefit of agriculture and the exploration of land and of the world's oceans; studies and preservation of the Earth's biosphere; establishment of a world weather forecasting and warning service; utilisation of new energy sources; creation of new materials and technologies, including those for medicine and biology; setting up production facilities involving the use of high vacuum and weightlessness conditions. In proposing these projects, the Soviet Union believes that they should embody the best achievements of the world's technological thought, result in equal and mutually beneficial international cooperation, and bring real benefits to the world community, with special regard to the needs of the developing countries.

The Soviet Union's stage-by-stage *Star Peace* programme proceeds from the premise that it would be both realistic and fair for the international projects to be mainly financed by the space powers and other industrialised countries, while the developing countries would get preferential terms for participation in these projects, and the least developed ones would be granted the scientific and technological results as development aid. As for the Soviet Union, it has expressed its preparedness to share its achievements in space technology and to assist other countries and international bodies in launching civilian spacecraft with Soviet booster rockets on mutually acceptable terms.

The programme's second stage encompasses the first half of the 1990s. It is to consist of material preparation for wideranging cooperation in space, and be devoted to designing and building spacecraft and other space-related equipment to agreed specifications. These systems would be made operational as soon as they are available. Initially, major efforts and resources could be concentrated on priority projects, with an eye towards making them self-sufficient as soon as possible, and using the experience gained from them in tackling upcoming tasks.

One of the central objectives would be the comprehensive use of space technology for carrying out a global study of the Earth's biosphere, aimed at working out and implementing concrete measures for its preservation.

As soon as the programme's implementation advanced to its second stage, the World Space Organisation would start coordinating national space exploration plans; assisting member countries, especially helping those countries with little or no direct experience in space research to get their equipment placed and their experiments conducted aboard other countries' spacecraft; and promoting wide-ranging international space projects. The WSO would establish liaisons with other international bodies involved in the peaceful exploration and use of outer space. One of the WSO's main functions would be to coordinate specialised international programmes in order to ensure the maximum effectiveness and rationality of all joint efforts.

The third stage of the *Star Peace* programme—covering the period up to the year 2000—would see the implementation of large-scale international space projects involving the largest possible number of countries; at this stage the united efforts in research and exploration should be directed towards those areas that would yield the most fruitful results. Spacecraft would be launched systematically, coordinated with the creation of relevant ground-based systems, and specialised space-application programmes would become self-sustained and start producing practical benefits.

An organisational and material infrastructure would thus be developed to support a number of wide-ranging projects, involving the joint construction of spacecraft, including orbital stations, space-based research-and-production platforms, and interplanetary manned spaceships to make it possible as early as the first decades of the 21st century to start the exploration and use of the Moon. One such use could be to place facilities on the Moon for the launching of vehicles to other planets.

In other words, the implementation of the programme proposed by the USSR would make it possible to use near-Earth space in the interests of all the world's nations, and would create realistic prerequisites for turning terrestrial civilisation into an interplanetary one from the very outset of the third millennium.

As was noted at the 27th Congress of the CPSU, cooperation in the exploration and use of outer space, as well as in tackling other global problems makes "the need for effective international procedures and mechanisms, which would make for the rational use of the world's resources as an asset belonging to all humanity... increasingly apparent".[1]

The USSR's initiative presented at the Geneva Conference on Disarmament calling for the establishment of a system of international control to verify that no weapons are deployed in space represents a new move towards ensuring the peaceful uses of outer space.

[1] Mikhail Gorbachev, *Political Report...*, p. 24.

The controlling authority in this international system could be an International Space Inspectorate (ISI), which the states parties to the agreement would allow to conduct on-site inspections of any object to be launched into and orbited in outer space.

The USSR also suggested that this mechanism to verify compliance with such an agreement should be devised even before it was concluded and brought into force.

In the spring of 1988 the Soviet delegation in Geneva made this proposal more concrete. According to the Memorandum on Non-Deployment of Weapons in Space submitted to the Conference on Disarmament, the structure and the working procedures of the ISI could be amended through negotiations so that it would correspond to the provisions of specific agreements on the non-militarisation of outer space.

Meanwhile, the principal goal of establishing an International Space Inspectorate is to take measures to verify that any objects being launched into and orbited in outer space by the states belonging to the Inspectorate are not weapons or provided with any type of weapons. The simplest and most effective way of ensuring this is through on-site inspections of the objects immediately before their launching.

As the Soviet Union sees it, verification measures to enforce a complete ban on space weapons should include the following:

— information about an upcoming launch by the country making it should be submitted in advance to representatives of the International Space Inspectorate, including the date and time of the launch, type of booster rocket, orbit parameters, and general data on the space object to be launched;

— inspection groups should maintain a permanent presence at all launching sites to verify the non-weapon status of all space objects irrespective of launch vehicles;

—inspections should begin some days before the object to be launched into space is mounted onto the launch vehicle;

—inspections should be conducted at agreed-upon depots, industrial enterprises, in laboratories and at testing grounds;

— verification of unannounced launches from undeclared launch sites should be permitted through immediate on-site inspections.

For a number of years, the talks on preventing the arms race from spreading into outer space were being hindered by the absence of clear-cut and generally acceptable definitions of the spacecraft and space weapons not permitted to be launched into space.

The Soviet memorandum contains draft definitions of these key terms. In particular, any craft intended for launching into and orbiting in outer space is regarded as a space object, while systems and devices based on any physical principles which were either originally created to hit targets in outer space, in the Earth's atmosphere or on its surface or were converted to this purpose, are regarded as weapons and as such are banned from being launched into outer space.

CHAPTER EIGHT

Mars: A Common Goal, Not the God of War

The formulation of the problem of the peaceful exploration and use of outer space, as an alternative to the extension of the arms race there, serves as a powerful tool in mobilising broad public opinion in support of the new political thinking. Specialists at the Institute of World Economy and International Relations of the USSR Academy of Sciences have estimated that if the programme for a non-nuclear world put forward in Mikhail Gorbachev's statement of January 15, 1986, is implemented, the world community will save at least 1.3 trillion dollars. This would create a real opportunity for launching long-term socio-economic programmes, for making a joint international effort in tackling the problems common to all mankind.

The exploration and use of outer space is of paramount importance for the solution of other problems, such as the problems of energy, food and the ecology. In proposing the large-scale *Star Peace* programme to the world community, the Soviet Union also believes that the involvement in space research of the largest possible number of nations will give a powerful impetus to mankind's scientific and technological progress.

The programme includes a list of guidelines and principles of international cooperation in the exploration and peaceful uses of outer space. The underlying concept of the Soviet *Star Peace* programme is essentially constructive and humanistic. It counters every argument put forward by those who advocate an arms race in space, who assert that the militarisation of science and technology in general, and of space activities in particular is a steady and irreversible process. The keystone of this concept is that it can encompass any bilateral or multilateral space project of a constructive orientation as an organic component.

"Mankind", said the appeal of Soviet scientists to their counterparts in the USA, "is on the threshold of a giant leap in space exploration, which requires wide-ranging international cooperation. Ahead, in addition to many other tasks, lies the more intensive use of near-Earth space for the purposes of economic development and science, and the exploration of the solar system planets. But all these opportunities can only be realised if there are no arms in space, no matter what their alleged functions might be".[1]

The Soviet scientists' position is being readily shared by their foreign colleagues. They brought up the idea of carrying out joint space projects as an alternative to the arms race. A distinctive feature of these projects involving the USSR, the USA and many other countries is their constructiveness. Their initiators call for a thorough assessment of the space projects' content, for a meticulous evaluation of the probable impact of new technologies, and for early and reliable measures to minimise any negative effects, which are bound to occur in any field of technological activity.

Remarkably, the very fact of a worldwide discussion now under way about joint space projects is apparently taking mankind back to a turning point in the exploration of outer space, i.e., the time of detente and the normalisation of Soviet-American relations. It was back then that US space programme authorities kept telling the world that international cooperation was the only realistic way of accomplishing great projects, such as to create a large station in a near-Earth orbit; to set up a scientific base on the surface of the Moon; to make a manned flight to Mars; and to develop orbital systems for collecting and distributing data required to maintain international security, control armaments and assist the world nations in carrying out the programmes of socio-economic development.

When the new phase of the "cold war" reached its peak in the early 1980s, some prominent scientists and experts outside the USSR began calling for peaceful cooperation in the

[1] *Pravda*, February 8, 1986.

exploration of outer space as an alternative to an arms race there. Several American scientists proposed starting a Soviet-American project to make a manned flight to Mars in 1992, to be timed with the 500th anniversary of Columbus' discovery of America, and with the 75th anniversary of the Great October Socialist Revolution. According to Louis Friedman, Executive Director of the Planetary Society, which has over 125,000 members, the project would be of paramount importance for global security and international stability.

Sober-minded politicians support this initiative put forward by scientists who are worried about the planet's and mankind's future. Owing to their persistence, President Reagan signed Senate Joint Resolution 236, relating to cooperative East-West ventures in space, on October 30, 1984. The resolution recommends that cooperation with the Soviet Union in the exploration and use of outer space be resumed. President Reagan's endorsement of the resolution fostered new proposals concerning the scope and time limits of Soviet-American ventures in space. The most far-reaching proposal among them is contained in a resolution drafted by Senator S.M. Matsunagea and approved by the Congress in February 1985. It suggests that preparations be started for Soviet-American flights to Mars.

A really major space programme, such as a manned flight to Mars, would unquestionably be easier to accomplish if it was backed by the material resources and scientific potentials of a number of countries, and the more the better.

At the same time, most countries, having no chance to accomplish a similar programme on their own for the foreseeable future, would be interested in participating in such a project, for it would give them access to the "cream" of scientific and technological progress.

British scientists were among the first to show an interest in the Mars mission. Speaking on their behalf, David Southwood, professor of physics, voiced their preparedness to participate in the project in one way or another. The British scientists were especially interested in having an opportunity to study samples of Martian rock which, according to Academician Roald Sagdeyev, Director of the USSR Academy of Sciences Space Research Institute, could possibly be brought back to Earth as early as 1996. The British journal *New Scientist* noted that this and other experiments were important for they would "provide information for a manned mission around the turn of the century".[1]

In an attempt to block the promotion of cooperation between the USSR and the USA in space exploration, conservative circles in the USA have more than once made the accusation that an exchange in scientific and technological achievements was unfair in view of what they alleged to be the relative backwardness of the USSR as compared to the USA.

Life has more than once disproved these allegations. US scientists admit that the Soviet Union can be dealt with on equal terms, and that in some fields it even leads the USA. For instance, NASA was considerably interested in the Soviet Kosmos-1870 satellite, launched on July 25, 1987. Specialists see the Kosmos-1870 as an analogue of their own Earth Observing System, EOS, with the difference that EOS will not be ready for launch until the mid-1990s.[2]

Former NASA Jet Propulsion Laboratory Director Bruce Murray says that Soviet programmes for the exploration of Mars are "extremely elegant".[3]

The intermission in the US space exploration programme brought about by the Challenger tragedy caused some concern in America's academic community about a possible lag in the advancement of space technology. This concern grew in connection with NASA's decision to postpone from 1990 to 1992 the launch to Mars of a space laboratory to study by remote sensing methods the magnetic and the gravitational fields, the chemical composition of the planet's crust, and the circulation of currents in its atmosphere. The spacelab mission was to provide the answer to the scientific riddle as to why all the once-abundant Martian water sources have evaporated.

"Delaying the launch," an article in the US magazine *Nature*, pointed out "may put the United States behind the

[1] *Britain for Mars Mission, New Scientist*, February 5, 1987, p. 32.

[2] Vera Rich, *US Fears of Soviet Satellite Getting Ahead, Nature*, Vol. 328, August 20, 1987, p. 659.

[3] Carol Ezzell, *Planetary Scientists Appeal for 1990 Launch of Mars Observer, Nature*, Vol. 326, March 5, 1987, p. 7

Soviet Union in the exploration of Mars. The Soviets have recently brought forward from 1994 to 1992 plans to deploy a balloon probe to the surface of Mars, coinciding with the proposed launch date for Mars Observer".[1]

At the same time, the article continued, "Sagan, Murray and Congressman George E. Brown Jr. (Democrat, California) advocate a joint programme of Mars exploration with the Soviet Union. Sagan says a national commitment to put a man on Mars would have the same effect as the Apollo lunar programme".[2]

The delays in the USA's space programme resulting from the explosion of Challenger caused the Pentagon to speed up military space projects, such as Star Wars and the Navstar satellite series, which did not escape the attention of the scientific community. Shortly after the accident, the Pentagon gave McDonnel Douglas, the well-known aerospace company, an order worth 316 million dollars for seven Delta expendable rockets by which to orbit the Navstar satellites.[3] By so doing, it moved further away from a reliance on the shuttle fleet for launching its satellites.

Fantastically daring, yet realistic projects for space expeditions deeper and deeper into interplanetary space and, in the future, probably into other galaxies as well, stir the imagination of millions of people, making public opinion ever more in favour of cutting down military expenditures, curbing the arms race and preventing its extension to outer space.

It is a simple truth that without taking real steps to strengthen international security, the most breathtaking international space ventures will never get off the ground. Nor will there be any solutions forthcoming to other vital international projects, such as the struggle against famine, poverty, disease, the developing countries' indebtedness and so forth.

[1]Carol Ezzell, *Planetary Scientists Appeal for 1990 Launch of Mars Observer, Nature*, Vol. 326, March 5, 1987, p. 7.

[2]*Ibid.*

[3]*Military Satellites to Rockets, New Scientist*, January 29, 1987, p. 37.

CHAPTER NINE

The Prime Mover of Scientific and Technological Progress

The exploration and peaceful uses of outer space nourish the moral-ethical norms underlying the new political thinking, and shatter the old concepts according to which disunity and hostility are the natural state of human society.

The conviction that social inequality is natural, allegedly as a result of a scarcity of material resources, is largely responsible for the formation of the false notion that hostility and wars are also natural. "When the stomach urges we kill each other individually or collectively as convenient. There has hardly been a war that has not had empty stomachs in the background".[1] So goes the main thesis of the Malthusian theory, which makes a fetish of the deficit of material welfare in the life of modern society and worships the biological element of human nature. Wide-ranging industrial use of outer space becomes a powerful argument countering the theory of rational causes of wars. A conviction is growing worldwide that climbing the cosmic stairs is bound to bring mankind "mountains of bread and oceans of power", as Konstantin Tsiolkovsky put it.

For centuries, the origin of wars has been camouflaged by "objective causes", by allusions to this or that scarcity in nature. Exposing these allegations as early as the beginning of this century, Lenin pointed to the imperfections in production relations as the chief factor hindering the realisation of the huge potential of science and technology. "On all sides, at every step," he wrote in this connection, "one comes across problems

[1] C.C. Furnas, S.M. Furnas, *The Story of Man and His Food*, New York, The New Home Library, 1942, p. XVI.

which man is quite capable of solving immediately..."[1] Lenin was here specifically referring to the feasibility of a tunnel under the English Channel. This feasibility, which is being materialised only in our days, existed as early as the beginning of this century, but, as Lenin wrote, the inadequacy of social relations not only prevented the Channel tunnel project from being realised, but plunged the world into the inferno of World War One.

Clearly, cosmonautics and space research by themselves cannot free the world from social inequality or material privations. There is, however, sufficient evidence to convince us that now that man is able to travel into outer space scientific and technological progress has reached such a level that the material wellbeing of each and every person on earth is attainable.

As early as the 1990s, the uses of outer space were seen by Konstantin Tsiolkovsky and his associates as a real opportunity for tackling problems that we now term global or universal. Tsiolkovsky, for instance, realising that there would eventually be an energy crisis, suggested that solar energy be utilised by means of spacecraft. "Almost the whole of the energy radiated by the Sun is being wasted today without benefit to mankind... What's wrong with the idea of utilising this energy? There is nothing wrong with the idea of mastering near-Earth space either..."[2]

Beginning in the mid-1950s, Tsiolkovsky's prophesy began to come true. Fundamental breakthroughs in mathematics, physics, chemistry and biology started making the possibility of satisfying the essential needs of the Earth's population attainable in the foreseeable future, with the chance of ensuring overall material wellbeing also on the horizon. All this could be possible, however, only if international relations and social relations within countries were to become harmonised.

Not all the existing material problems can be directly solved by cosmonautics. For instance it now appears more practical to build, through an international effort, an ecologically

[1]Lenin, *Coll. Works, Vol. 19, p. 389.*

[2]*K.E. Tsiolkovsky on Interplanetary Travels. Collection*, Compiled by V.A. Monastyrev, Kaluga, 1959, p. 8 (Russ. ed.).

"clean" thermonuclear reactor rather than relying on solar energy from outer space, as Tsiolkovsky suggested.

In tackling global problems, however, spacecraft assume the role of powerful and compact scientific laboratories, in which the technologies developed on the Earth can be tested.

This being the case, within the political framework of the new political thinking, cosmonautics serves as the prime mover of scientific and technological progress, taking over the role that, according to the old thinking, was played by the advancement of military technology.

The new political thinking has its roots in Lenin's prediction that "having many times increased the destructive power of war, science and technology will make war impossible altogether".[1]

The veracity of this has been corroborated by the realities of the nuclear-space age. Nonetheless, even today, when the world is oversaturated with lethal weapons, the dangerous notion still exists that weapons development is a locomotive of scientific and technological progress. This dangerous doctrine has many adherents among scientists in capitalist countries, including those who generally profess a liberal outlook. Albert Ducrocq,[2] for instance, a French cyberneticist and science populariser, believes that military production provides prototypes of future technologies. The book *Military Enterprise and Technological Change* recently published in the USA characterises the military as "a de facto architect of high technology policy".[3]

The military-industrial complex subtly exploits the noble ambition of researchers to always expand their knowledge and make it more beneficial to humankind.

For example, scientists at Harvard Medical School have long been working on a laser to destroy cholesterol formations occurring in the arteries of animals. If the experiments prove

[1]N.K. Krupskaya, *On Lenin. Collection of Articles and Speeches*, Moscow, 1979, p. 87 (Russ. ed.).

[2]A. Ducrocq, *Le futur aujourd'hui 1985-2000. Les quinze annees qui vont changer votre vie quotidienne*, Paris, Plon, 1984.

[3]*Military Enterprise and Technological Change. Perspectives of the American Experience*, Merritt Roe Smith, Ed. MIT Press, Cambridge, Mass. 1985.

successful, a laser beam, like a surgeon's scalpel, will provide effective treatment against cardiovascular diseases—the number one enemy of human health. However, only a free electron laser, which operates in a broad band of wavelengths ranging inclusively from ultraviolet to infrared, is suitable for this purpose. High design costs had until recently prevented this type of laser from being constructed. The problem of costs, however, was "removed" by a contract worth 4.9 million dollars concluded between the Office of Naval Research, the Air Force Office of Scientific Research and the National Bureau of Standards within the framework of the Strategic Defense Initiative Organization. Under the contract, the development of the new type of laser is to be completed under the supervision of Samuel Penner at the Gaithersburg laboratories, Maryland, as early as 1990.[1]

A certain section of the scientific community still adhere to what is, in fact, a cynical view that the weapons development is the primary stimulator of scientific and technological progress. This view, which, in addition to being immoral, is anti-scientific, is used as justification by some scientists who employ their talent for personal gain by giving over their discoveries to the military-industrial complex.

British military historian Curtis Peebles interprets the position of these scientists, from the point of view of the development of directed energy weapons to be deployed in outer space, as follows: "Beam weapons belong to the world as it is... Disarmament seems as elusive and distant today as at the end of World War Two. Force still tends to prevail in international disputes and ours can hardly be called in this respect an age of enlightenment. If beam weapons are an authentic alternative to the current state of affairs and a prospective peace-keeping system, it is right to explore them".[2]

It seems appropriate to ask, however, whether there has ever been a breakthrough in weapons development in human history which was not seen by its authors as an "authentic

[1]S. Dickman, *SDI Gives NBS a Free-Electron Laser for Basic and Applied Research, Nature*, Vol. 326, March 5, 1987, p. 7.

[2]C. Peebles, *Battle for Space*, London, Blandford Press, Poole, Dorset, 1983, p. 184.

alternative" to the current state of affairs and as a "prospective peace-keeping system"?

The results of these good intentions are well known. The 20th century's two world wars, which lasted a total of ten years, cost mankind 65 million lives; in the wars fought in the preceding 3 centuries 25 million people were killed to say nothing of the suffering caused by horrible material privations, famine and devastation.

Is it not possible to regard nuclear disarmament and international cooperation in tackling global problems as an "authentic alternative" to the arms race and to the threat of nuclear self-destruction?

But so long as the idea, as espoused by Curtis Peebles, is propagated that it is right to create new and still more destructive types of weapons, scientists will continue to participate in the profit-making of arms manufacturers. Seen from the angle of space weaponry, such incentives for scientists at the start of a new spiral in the arms race are only too apparent. It was reported in the US press, for instance, that the Helionetics company had sharply increased its profits from research and development in laser technology. The company was on the verge of bankruptcy when Edward Teller, a prominent US physicist, who had invested 800,000 dollars in the company, became a member of its board of directors. In a week, after it was announced that the US was going to develop an ABM system, Helionetics' stock rose by 30 per cent, and the number of shares sold increased to 50,000 a day, 10 times more than in 1982. According to a journalist's conservative estimate, Teller alone increased his capital by at least 250,000 dollars.[1]

At the end of 1987 some new details surfaced concerning the machinations of Teller and his cohorts, who, in pushing through the idea of the "strategic defense initiative", showed complete scorn for the elementary norms not only of the code of honour of scientists, but also of common ethics.

Roy Woodruff, former head of the nuclear-weapon systems division at the Lawrence Livermore National Laboratory in California (the well-known research stronghold of the US

[1] Jeff Gerth, *Key Reagan Advisers Got Laser Firm Stock, International Herald Tribune*, April 29, 1983, p. 1.

military-industrial complex), accused Teller and his protege Lowell Wood of having misled the country's leaders about the feasibility of a powerful X-ray laser as an SDI component.

Woodruff claims that between December 1983 and October 1985 Teller and Wood made "technically incorrect" and "overly optimistic" statements about the X-ray laser to "the nation's highest policy makers".[1]

Woodruff's accusation, which Teller and Wood ignored, was made in the dramatic moments of the autumn of 1987, when, according to the American press, the US administration's refusal to discuss the Star Wars issue in connection with deep cuts in strategic offensive arms was a major stumbling block in the Soviet-American dialogue. Teller, who simultaneously was working as a consultant to the Livermore Laboratory and a White House science adviser had played a noticeable part in shaping the above-mentioned position and so had Wood, the head of an X-ray laser development group. It is these two persons who democratically-minded scientists in the US held responsible for inspiring President Reagan with the idea of SDI. Woodruff furthermore accused Roger Batzel, the Director of the Livermore Laboratory, of having knowingly permitted Teller and Wood to make these incorrect scientific estimates that had a strong political impact. In order to stop the "leak" of objective scientific information from the laboratory, Batzel assigned Woodruff to a secluded and windowless room, thus preventing the non-conforming Woodruff from having any contact with his colleagues.

Later, Woodruff was reassigned to an analytical job at a smaller salary. This was his reward for trying to furnish the US leadership with accurate and objective information. Woodruff later said: "Policy makers need to be able to come to laboratories and get objective advice. I hope the incident is isolated. We will lose something very special if it is not".[2]

As is known, the nuclear-pumped X-ray laser, the subject of

[1] Ian Anderson, *Teller's "Lies" on SDI Effectiveness, New Scientist*, Vol. 116, N. 1584, October 29, 1987, p. 24.
[2] *Ibid.*, pp. 24-25

the scientific dispute between Teller and Woodruff, which assumed such scandalous form, will use as its energy source nuclear explosions in outer space. Beginning in 1982, narrow government circles were made aware of the "unresolved technical problems" associated with the development of the X-ray laser. Nonetheless, according to what Theodore Postol, a former Pentagon science adviser, later said, these circles listened, but then themselves made optimistic statements, which gave the impression that these technical problems were of secondary importance.

Thus it can be seen that the decisions concerning SDI which were crucial for the security of the entire world, were being made in an atmosphere that was dubious from the point of view of both scientific and common ethical standards. This was specifically confirmed by a scandal that took place in March 1985 following the Super-Excalibur experiment.

An elated report was sent from the Livermore Laboratory to the White House after the test declaring that a laser beam had been produced with an intensity that was millions of times greater than in the previous experiments. However, the scientists at Livermore's "rival", the Los Alamos National Laboratory, were quick to refute this claim, saying that an error in calibration had been made.

The grounds for this accusation were in fact admitted by George Miller, head of the nuclear programme at Livermore. In November 1985 he prepared a statement acknowledging that there were "unresolved scientific issues associated with the difficulties of measuring some properties of X-ray lasers".[1] Livermore, however, decided not to release the statement.

The SDI programme not only does not promote scientific and technological progress, contrary to how Teller and other proponents of Star Wars would like it to appear, but in fact, hinders the development of civilian technologies, blocking exchanges of scientific information and knowhow between various institutions, companies and manufacturers.

Scientific research and development for military purposes automatically entails secrecy, which cuts off the natural channels of international information exchange, and

[1]Ian Anderson, *op. cit.*, p. 25.

ultimately leads to the dispersion of resources and the world's intellectual potential.

Cosmonautics does not in itself change the system of production relations. But as mankind increasingly uses outer space for its economic needs a new, science-intensive branch of the economy comes into existence that eventually may compete with the munitions industry both in terms of profits and investments. Cosmonautics, therefore, is beginning to be a prime mover of scientific and technological progress within the framework of the new political thinking.

According to Charles Sheffield and Carol Rosin of the USA, since the 1980s space applications have grown into a "multi-billion-dollar business with good annual growth and tremendous long term potential".[1]

Every step taken by mankind in the exploration and use of outer space demands more and more scientific discoveries, daring technical solutions and original innovations in production technologies. Each of these discoveries, solutions and innovations is in fact an embryo of new types of technology and of entire production cycles.

The peaceful exploration of outer space by the Soviet Union serves as a good example of how science, when used for the benefit of man, can become a powerful locomotive in the advancement of science and technology. It was the needs of cosmonautics and a personal "order" from Sergei Korolyov, the originator of practical space exploration, that gave an impetus to the wide-scale production of transistor radios in the USSR. The miniaturisation of electronic components, which, because of the need to do away with all extra space and weight, is indispensable in space applications, has also found its way into applications here on Earth, creating new technological opportunities.

A modern spaceship is an array of technological novelties, each being a specific prototype of future technologies. These include new materials, new miniature electronic devices and novel solutions of various tasks, such as that of creating a life-support system for the spacemen while in flight.

The adaptation of man to long sojourns in space, and the

[1]Charles Sheffield, Carol Rosin, *Space Careers*, Quill, New York, 1984, p. 8.

"adaptation" of outer space to terrestrial applications make up an integral concept of scientific and technological change and provide an alternative to research and development for military purposes.

The role of space research as a factor stimulating scientific and technological advancement is exemplified by foreign experience, particularly that of Australia. At the dawn of the age of space exploration, Australia was in the forefront of space technology development, becoming in 1967 the third country in the world, after the USSR and the USA, to launch an artificial earth satellite from its territory.

However, the situation changed in the years that followed. The Australian government chose to buy the cheaper American space technology rather than earmark resources to use its own, quite favorable opportunities for developing its national space-research potential.[1]

According to Australian scientists, this decision had a negative impact on the country's scientific and technological development. "We often talk in this country about a cultural cringe," said Ken McCracken, director of the newly created Office of Space Science Applications of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), "but I think we also have a strong technological cringe, a feeling that we cannot do things as well as other countries. This has to change; we must use our industrial opportunities, such as those offered by space, to lift our technological skills".[2]

Highly industrialised Japan also needs space research to be able to advance technologically. "Japan" the magazine *Business Week* noted, "wants access to space so that it can get a crack at in-space manufacturing of pharmaceuticals and special materials such as semiconductors, that need weightlessness for top-quality production".[3]

[1]David Dickson, *Australia Bids to Reenter the Space Race, Science*, Vol. 231, January 3, 1986, p. 16.

[2]*Op. cit.*

[3]Army Borrus, Seth Payne, *Look Who's Entering the Space Race, Business Week*, No. 2956-286, July 28, 1986, p. 22.

CHAPTER TEN

Progress for Everyone

The keystone of the new thinking is the recognition of the developing countries' right to independent political choice. Their political independence, after all, has been hard won. The Soviet Union sympathises with the desire of the non-aligned countries to raise their living standards to the level of the industrialised nations, and to cut off channels of unfair exchange that drain the developing countries of their rich natural resources, which end up instead in the vaults of transnational corporations and giant private companies.

The Soviet leadership believes, in the words of Mikhail Gorbachev, that the "sooner this reality is brought home to everyone, in all continents, the sooner international relations will become normal. The global situation will thus improve. That's crucial. That's the key issue".[1]

To establish a new international economic order and eliminate unfair exchange it is essential that the developing countries have full and unrestricted access to the benefits of the scientific and technological revolution and be given regular and systematic aid in updating their economies and in training national personnel, i.e., scientists, teachers, engineers and technicians.

The socialist countries are pursuing exactly this kind of policy, which, unfortunately, cannot be said of the industrialised Western countries, some of which lead the world technologically. The United States, for example, refused to attend the UN Conference on Disarmament and Development held to discuss proposals on assisting the developing countries

[1]Mikhail Gorbachev, *Perestroika: New Thinking for Our Country and the World*, Harper & Row Publishers, N.Y., 1987, p. 178.

in getting access to the benefits of scientific and technological progress and on aiding them in tackling vital economic issues.

Meanwhile, the insatiable munitions industry is demanding new tributes from its victims. Its "appetite" has noticeably improved since the funding of the Star Wars programme has become a reality.

A look at the correlation between the costs of weapons development and the money being spent to satisfy the most vital needs of the developing countries provides a very telling picture.

Here is a rather recent example. According to a UPI report on June 10, 1988, the United States, despite the most devastating drought in its entire history, sold over 402,000 tons of corn, wheat and barley to some Asian and Pacific countries. Although the terms of the transaction were never announced, it is likely that the grain was sold at 78 to 80 dollars per ton. On top of this, in accordance with a programme to promote exports, the exporters were entitled to government subsidies of about 18 dollars per ton.

Considering that the developing countries are constantly increasing their imports of cereals (from 16 million tons in 1969 to 85 million tons in 1985, and to about 100 million tons now), it can be easily calculated that these countries, which account for the greater part of the world's population and in which 75 per cent of people systematically suffer from malnutrition or outright starvation,[1] spend about 10 billion dollars a year on the import of cereals (this calculation takes into account the fact that there has been a substantial rise in cereal prices).

These expenditures, however, are nothing compared to the costs of Star Wars. A report published in June 1988 by a group of Democratic senators stated that the first phase of the SDI programme could not be accomplished before 1998. Its estimated cost is put at 171 billion dollars (the overall cost of SDI will be discussed later). Thus the attainment of the illusory goal of guaranteeing national security with the implementation of the SDI programme will require twice as much money in 10 years as would be necessary to cover the costs of the developing

[1]Bombard, *Sauver la vie!*, Paris, Laffort, 1984, p. 120.

countries' import of cereals, that is, to solve the main problem affecting the standard of living in these countries.

This, however, is only one side of the problem, and, though it is the most obvious, it is not the most dangerous one. It is more dangerous that SDI stands in the way of scientific cooperation, the export of advanced technologies and the application everywhere of scientific and technological achievements.

It should be noted that although SDI is considered by some to be "expedient" from a military point of view, it most definitely cannot be regarded as a defence system, for it is actually a powerful technological basis for the creation of such new types of directed energy weapons as laser and beam weapons, etc. According to the Report of the Committee of Soviet Scientists for Peace, Against the Nuclear Threat, an attack from space "may be characterised by the ability to strike at any point on the Earth with a relatively short flight time (close to 1-2 minutes)",[1] if any time is even involved at all. Thus the side having a monopoly on a space-based laser "sword" will be in a position to decide the opponents' fate.

At this point of international development it is difficult to accept the idea of a world power, even a great one like the USA, acquiring and using a space-based system of directed-energy weapons at its own discretion. This, however, is only part of the issue. The other part is that the projected SDI system has already been turned into a tool of "technological imperialism", into a means of gaining and keeping a monopoly on high technologies.

To complete the picture it should be added that the "technological gap" between the level at which the creation of SDI components becomes possible (including sophisticated cybernetic systems for controlling them) and the level at which the manufacture of the prototypes of nuclear weapons and rockets becomes possible is much wider than the gap between the scientific and technological level of the so-called near-nuclear countries and that of nuclear powers at the time when the latter began to develop nuclear technology. It can therefore

[1] *The Large-Scale Anti-Missile System and International Security. Report of the Committee of Soviet Scientists for Peace, Against the Nuclear Threat* (hereinafter referred to as "Report"), Moscow, February 1986, p. 37.

be concluded that the SDI development programme shows a strong tendency towards widening still further the technological gap between the industrialised and the developing countries.

There also exists a real danger of a world "technological elite" emerging that would not only monopolise "high technologies", but would also strive to protect this monopoly. It is not a good sign that, despite the considerable improvement in Soviet-US relations and in the international situation in general, and despite the growing cooperation in science, technology, culture and space exploration, the restrictions on the export of "advanced technologies" from the USA and allied states are tending to become even more stringent.

According to what the US administration says, it advocates "openness" in SDI research. President Reagan, for instance, has repeated his proposal to share with the Soviet Union the results of the work being done under the SDI programme once this work is over. This proposal, however, arouses strong scepticism in Moscow. Indeed, it is hard to believe that the US will simply hand over to the USSR the results of up-to-date scientific and technological research which is being kept secret even from its own allies. At a press conference held by the Soviet Foreign Ministry on October 13, 1987, it was recalled in this connection that quite recently American companies had vainly sought to get permission from the US administration for launching their commercial satellites by Soviet booster rockets. Despite the Soviet Union's firm guarantees not to violate the security of these satellites and to allow them to be under the constant observation of American representatives, Washington denied these companies permission.

Technological imperialism has a powerful tool—the Coordinating Committee for Control of Strategic Exports to Communist Countries (COCOM).[1] This offspring of the "cold war" has recently stepped up its activities. According to Stephen D. Bryen, Deputy Assistant Secretary of Defence, giving the Soviet Union greater access to high technology could "impair" the betterment of American-Soviet relations,

[1]COCOM was established in 1949 on US initiative. It includes the NATO states (except Iceland) and Japan.

because tne Soviet Union would use this technology to "catch up" with the USA, which would eventually aggravate tensions.

This is a very strange, or, to be more exact, a perverted way of looking at things. Nonetheless, there are as many as 300,000 items on COCOM's list of prohibited exports to socialist countries.

This highly discriminatory barrier in trade with socialist countries is causing some concern among Western businessmen, who view it as a means for US corporations to prevent their rivals in Western Europe and Japan from getting extra profits by tapping the vast markets of the USSR and Eastern Europe.

According to the British magazine *Nature*, which was quoting an "industry source", these quarters complain that COCOM's rules are being used to hinder the export of "yesterday's" technology rather than "tomorrow's" as they were originally supposed to do.[1]

The meeting of the Coordinating Committee of East-West Trade Policy (COCOM) held on January 28, 1988, in Versailles, outside Paris, became an arena of confrontation between the outright attempt to monopolise the trade in "high technology" and the desire of America's allies to safeguard their commercial interests.

According to press reports, US Deputy Secretary of State John Whitehead called for increased coordination between COCOM members in respecting existing restrictions and sanctions. But COCOM's European members, especially West Germany, put up serious resistance to this line. The West German businessmen noted, in particular, that exports by the computer and telecommunications industries to socialist countries would substantially enhance East-West trade. It called restrictions in this area particularly harmful.

A typical example of COCOM activity was the retaliation against the Japanese corporation Toshiba taken in 1987-1988.

A Washington-instigated trial was held in Tokyo to hear the charges against Toshiba of having sold to the USSR several milling machines that were allegedly used to manufacture

[1] *Nature*, February 4, 1988, p. 378.

"noise-free" propeller screws for Soviet nuclear-powered submarines.

The authors of this farce were not in least embarrassed by the fact that NATO's military experts had acknowledged that Soviet submarines were noise-free long before Toshiba's deal with the USSR.

In addition, it did not go unnoticed by the US Congress that the Pentagon, having kept the information about the Toshiba deal to itself for quite a long time, scheduled the retaliation against Toshiba to coincide with a time when the Congress, influenced by a breakthrough in Soviet-American relations, was close to lifting some export restrictions.

Washington's pressure on Tokyo to prevent any leaks of Western "technological secrets" to other countries is not merely confined to Japan's foreign trade, but also applies to its cooperation in scientific research. In the course of the eight-round US-Japan negotiations to work out a new agreement on scientific and technical cooperation (reached in the spring of 1988) the US negotiators demanded increased security for Japanese laboratories, especially those doing SDI-related research.[1]

The Toshiba affair was also used to intimidate other US partners. For instance, the French secret service, in response to the threat of tighter controls over France's imports of advanced technology from the USA, chose the first day of the COCOM meeting in Versailles to release details of the prosecution of six "techno-bandits" accused of selling sensitive electronic components abroad.[2]

The US position as regards Soviet "space chartering" is a convincing example of how the supposed need to safeguard the West's strategic interests is merely a pretext for restricting the mutually beneficial trade between Western Europe and Japan and the Soviet Union and other socialist countries.

The Soviet Union offers good terms for launching other countries' spacecraft with Soviet booster rockets. Many Western companies, including some in the USA, showed

[1] *Nature*, April 7, 1988, p. 475.

[2] *Nature*, February 4, 1988, p. 378.

interest in the offer. But every time a contract was about to be signed, the State Department would veto the deal.

The example of India, which used the services of Soviet "space chartering" in the spring of 1988 to launch its IRS-IA satellite, had a far-reaching impact upon business quarters both in developing and industrialised countries. West Germany, in particular, showed an interest in using Soviet boosters, whose cost is lower than for American ones. Thus, as was reported by the *Frankfurter Allgemeine* newspaper, West Germany's Foreign Minister Hans-Dietrich Genscher urged the European Parliament to revise the notorious "COCOM lists" in order to lower the barriers standing in the way of the development of Soviet-West German economic relations.

Genscher's position is shared by many businessmen and economists. According to Klaus Richter, President of the Federal Union of German Foreign Trade, the COCOM lists are a serious obstacle to the export activities of many West German companies. According to Hannes Jakobson, a prominent economist, the US demands for tighter controls to restrict exports to the socialist countries go far beyond what is required by the security interests of the Western states.

Prior to Genscher's speech in the European Parliament, the West German company Kayser Threde signed an agreement with the Soviet Union to launch three space vehicles, weighing from 100 to 150 kg each beginning in 1989. They will carry scientific equipment to conduct a series of biological and physical experiments in conditions of weightlessness.

Kayser Threde had originally been using the services of the US shuttle craft to launch its satellites. But because of the 2-year intermission in the shuttle programme resulting from the Challenger accident, the West German company was forced to turn to the Soviet alternative. This alternative was made all the more attractive by the fact that the Soviet agency in charge of the launching (Glavkosmos) guarantees total security of the vehicles to be launched, and also charges less for the launching. Though a de facto agreement was reached in

December 1987, the company only released details about it after the COCOM meeting in Versailles.[1]

The British business community has also shown a rather negative attitude to the COCOM lists. They call for the promotion of trade with the USSR and see great promise in the Soviet Union's policy of *perestroika* and in direct contacts between British companies and their counterparts in the USSR.

Commenting upon the above-mentioned statement by US Deputy Assistant Secretary of Defence Stephen Bryen, Britain's *Financial Times* draws the indubitable conclusion that the Pentagon was directly interested in the hullabaloo raised by the Reagan administration over the violation of COCOM's rules by West European countries and Japan. The Pentagon is trying to tighten the sanctions against companies that have been trading with socialist countries and to blacklist them. These measures being taken by the United States through COCOM are nothing but a brazen attempt to impose its own legislation on other countries.

On October 15, 1987, after the *Financial Times* statement, Alan Clark, Minister of State, Department of Trade and Industry, described the idea of the Soviet launch vehicle Proton being used to put British communication satellites into orbit as very interesting and as deserving of attention. Negotiations for this are already under way between the Soviet Union and the British aerospace companies. The British Minister pointed out, however, that certain components of space technology cannot be exported to the USSR because of COCOM restrictions.

In protesting against this form of discrimination in the use of material values and in contacts between people, the concerned government officials and policy-makers in the industrialised and developing countries are perfectly aware that it is not military considerations that are behind the Pentagon's motives. The latter's chief concern is to secure a US monopoly over the latest technological achievements in order to reap the highest possible profits from an unfair exchange with both socialist and, primarily, developing countries.

Because the SDI programme has led to the imposition of still

[1] *Nature*, February 4, 1988, p. 378.

tighter restrictions on the export of advanced technologies from the West, the plans for the militarisation of outer space are doing direct damage to the economic interests of the developing countries and to their plans for scientific and technological advancement.

Repercussions from the Toshiba affair were felt throughout the Asia-Pacific region. In October 1987 a new list of Japanese companies that Washington thought should be penalised for "illegal exports" to socialist countries, was presented by the US delegation during bilateral US-Japanese consultations held in Tokyo to discuss more stringent measures for discriminatory restrictions on exports. According to the Japanese press agency Kyodo Tsushin, the US had also wanted to compel Tokyo to "tighten controls" over the export of Japanese goods to the countries belonging to the Association of South East Asian Nations (ASEAN), since the CIA and the Pentagon believed that leaks of strategically important technologies could take place via those states.

Washington used the same pretext before this to block the sales of Japanese computers to India's weather service, claiming that the deal violated COCOM's restrictions.

All this goes to show that while expressing its preparedness to share the results of SDI research with the Soviet Union the US administration is pressuring the governments of America's allies to impose tighter controls over trade with socialist countries, as well as with developing countries, allegedly for reasons of military security.

It is not difficult to see that in trying to browbeat various governments for the sake of "Western military interests" the US Defence Department officials are dancing to the tune of the monopolies of the military-industrial complex, which have been made extremely nervous by the activity of their dynamic partner-rivals in the Asia-Pacific region. In particular, after the Washington instigated trial of Toshiba began in Tokyo, a moratorium was imposed on several thousand contracts with socialist countries. As a result there was a decrease in Japanese exports to a number of countries, which caused a public protest. Tsutomu Outi, a prominent Japanese economist and an honorary professor of Tokyo University, led a public campaign to collect signatures for a petition protesting the discriminatory restrictions on trade with socialist countries.

American dissatisfaction with Japan's behaviour was expressed shortly before Indian Prime Minister Rajiv Gandhi's visit to Japan. The US demand that controls over Japanese exports to India be tightened was bound to have an effect on Japanese-Indian relations—relations to which Japan rightly attaches importance. For example, Japanese businesses are interested in investing more money in India's economy. Japan furnishes India with low-interest loans. And India unquestionably would like to be able to purchase high-technology products and knowhow from Japan.

Such mutual interest on the part of the two major Asian powers had led to stable growth in every area of bilateral exchange throughout the 1980s. But these indices dropped in 1987 as compared to the previous year. That was the same year that Japan, under Washington's pressure, refused to allow the export of Japanese computers to India for that country's meteorological service.

Thus the SDI programme can aptly be described as a big padlock that is being used to keep the door to advanced technology closed for the overwhelming majority of nations, including the countries in the Indian Ocean basin.

Meanwhile, this area occupies a prominent place in SDI plans. According to one of its concepts ("pop-up defence"), nuclear-powered X-ray lasers are to be put in orbit by missiles launched at the last moment from submarines.[1] The authors of the project envision that the laser-carrying missiles will be literally "shot" by submarines to altitudes of up to 3,000 km to intercept the potential enemy's ICBMs while they are still in their boost-phase. Hence the figurative term for this system's operating principle—"pop-up". The idea of setting up this system was partly dictated by the unwillingness to breach in peacetime the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, which came into force as of January 27, 1967. This applies particularly to Article IV, which prohibits the states parties to the treaty "to place in orbit

[1] *Report*..., p. 53.

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[1] *Report*..., p. 53.

around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction".[1]

For the missiles to be shot to the required altitude, it is essential that US submarines be deployed as close as possible to the targets—Soviet ICBM launching sites. There are two patterns under the SDI programme for deploying them. One is to deploy them in the Norwegian Sea, the other in the northern part of the Indian Ocean. Wherever the submarines are deployed, the plan will obviously be vulnerable to anti-submarine warfare and could turn the vast expanses of the world's oceans into a gigantic theatre of war.

Peace activists everywhere have long been worried about the intensification of US military activities in the Indian Ocean, particularly as regards the island of Diego Garcia. Washington has for several years now been stubbornly resisting the UN decision to hold an international conference on turning the Indian Ocean into a zone of peace, which was to have been held as long ago as 1981. Meanwhile, the military presence of various Western powers in the Indian Ocean has been growing. The existing military bases, such as the one on Diego Garcia, have been expanded, and new base sites have been sought. According to press reports, the indigenous population of Diego Garcia Island was even deported, for this location may become involved in the American Star Wars programme. H.D. Malaviya, a prominent member of India's parliament, wrote that nuclear weapons were deployed on the island and that facilities were being built there for the SDI programme.

The progressive-minded public is also worried by the massive buildup of the interventionist rapid-deployment force in the Indian Ocean region which is accompanying the general strengthening of the American military presence there. H.D. Malaviya and other democratic figures in the region have expressed the opinion that in this situation the issue of holding an international conference on the Indian Ocean becomes all the more pressing.

The policy being pursued by the Soviet Union presents a sharp contrast to the position of the West as described

[1] *Arms Control and Disarmament Agreements*, ACDA, Washington, 1982, p. 52.

above. The USSR has been consistently working to demilitarise the Indian Ocean region. General Secretary of the CPSU Central Committee Mikhail Gorbachev, for instance, called for this during his visit to India in 1986. Earlier, the Soviet Union proposed to the US and to other large naval powers that an agreement be worked out on a substantial reduction of naval activities in this part of the world, which is home to a quarter of the world's population.

The issues of regional security and of resisting the presure of technological imperialism are closely interconnected. The public in the non-aligned countries is in general aware that by opposing the sinister Star Wars programme, the Soviet Union and other socialist countries are not only looking out for their own national interests, but are also working to strengthen international security against the West's elitist monopoly on advanced technologies. Addressing a symposium on June 14, 1988, organised by the Indian Council of World Affairs, Harcharan Singh Josh, the Chairman of the Council, stressed in this connection that the principled position of the Soviet Union, which has consistently called for an end to the American SDI programme, inspired confidence that the processes of disarmament would not stop half-way and that the elimination of all kinds of nuclear weapons would one day become a reality.

There is a growing understanding among the democratic-minded public in the West that the problems of the world's development are interconnected. These forces are opposed to artificial barriers and material obstacles being put in the way of free exchanges of material and cultural values. Special emphasis is being placed today on the urgent need to train an indigenous personnel of scientists, engineers and technicians in the developing countries who would be familiar with the latest technology.

The unevenness of the level of the scientific intellectual potential throughout the world was most revealingly illustrated by a conference of Nobel Prize winners held in Paris in December 1987. It noted with apprehension the growing danger stemming from the polarisation taking place today between the industrialised countries in the Northern

Hemisphere and the developing countries in the Southern Hemisphere. The Nobel laureates described the growing indebtedness of the developing countries to the "world elite" (i.e., the largest monopolies in the industrialised countries) as an intolerable situation. It is indicative that in their discussions on the issue of human rights the conference participants underscored the right to education and to access to modern technology.[1]

The policy being pursued by transnational corporations and by COCOM of keeping the developing countries technologically backward runs counter to the activities of the Organisation for Economic Cooperation and Development (OECD). These activities, officially aimed at coordinating economic policies and the programmes for economic aid to the developing countries as a whole, are being hindered by the reluctance of Western companies to share their technologies with the developing countries without expecting payment or proper licensing, as well as by various kinds of discriminatory restrictions on exports of modern technologies.

As was noted during a meeting of ministers for science and technology held under OECD auspices in October 1987, the organisation recommended three major ways to improve the flow of information across national boundaries: removal of trade barriers, promotion of basic research and dissemination of findings, and increased international cooperation through joint research programmes.[2]

Specifically, the OECD council recommended that member countries encourage advances in scientific and technological knowledge by supporting basic research and maintaining up-to-date research facilities; by promoting the education and advanced training of future generations of scientists, engineers and technical personnel and facilitating the exchange of students and scientists between member countries; and by facilitating the international mobility of scientists and engineers, in particular their access to major basic research facilities.[3] A few other of the council's recommendations are

[1] *Nature*, February 4, 1988, p. 382.
[2] *Ibid.*, April 28, 1988, p. 768.
[3] *Ibid.*, April 28, 1988, p. 768.

also important, such as promoting the dissemination of the results of basic research, particularly through publication in internationally available scientific literature, through free access to databanks and computer networks, and through open participation in scientific meetings. As was noted in the OECD Council's statement, the "so-called 'developing' countries are often at a disadvantage, not only because of limited facilities for advanced research, but because access to computer networks may be non-existent or restricted".[1]

Many people see the global problem of space exploration as being one of insufficient material resources. To a certain extent this is true. No country in the world today is able to take upon itself the entire range of space research. It must cooperate with other countries, and such cooperation helps to promote new thinking. This new thinking, according to Academician Roald Sagdeyev, was in fact born of international scientific movements, such as the Pugwash movement.[2] The scientists in different countries of the world who participate in the Pugwash movement condemn the plans for SDI and expose its dangers. They stress that the deployment of a spacebased anti-missile defence system by the United States will impede the promotion of international cooperation in the peaceful uses of outer space.

Special significance is being attached to the coordination of the efforts made by the Soviet Union and the USA in space exploration. According to the above-mentioned Report of the Committee of Soviet Scientists for Peace, Against the Nuclear Threat, it appears that because the Soviet and US space programme complement each other in many ways the potential economic, scientific and technological value of such cooperation is considerable. Such cooperation would also be of great political importance, for it would help to improve the entire climate of Soviet-American relations and ensure trust between the peoples of the two powers.[3]

Still more considerable would be the impact of such

[1] *Op. cit.*
[2] An international movement of scientists for peace, disarmament and international security. Established in 1955, it now has national groups in 36 countries, uniting about 15,000 scientists in various specialities.
[3] *Report...*, p. 68.

cooperation on other countries. The example of the European Space Agency (ESA) is quite illustrative in this respect. Britain's refusal in November 1987 to agree to an annual 5-per cent increase in the joint ESA budget, which is deemed necessary to support the agency's scientific research programmes, jeopardised the ESA's entire Horizon 2000 research programme. According to Roger Bonnet, the ESA's director of science, because the ESA was joined by three new members in 1987—Finland, Norway and Austria—it is not so much Britain's financial contribution that is crucial, but the fact that that country's veto overrides the otherwise unanimous support for the increase from the remaining 13 members.[1]

Aware of the threat posed by SDI to international cooperation, scientists throughout the world have done much to expose its militaristic essence as a means of gaining a real monopoly on "high technologies" under the pretext of ensuring security against a mythical threat.

The Report issued by the Committee of Soviet Scientists convincingly revealed the political, strategic and technological untenability of the SDI programme. Strong arguments against the feasibility of SDI were also brought up in a report published by the American Physical Society.

A number of the assessments made by the Soviet and American scientists concerning the feasibility and strategic role of the Star Wars programme were affirmed in the official report by the US Congressional Office of Technology Assessment (OTA), which was issued after a two-year study. The report concluded that any sort of space-based defence against Soviet missiles would most likely fail "catastrophically" if it were ever used. The two principal weak points of SDI, says the OTA, are that simpler and cheaper countermeasures can be easily devised and that coordination of combat operations by computer requires software of such complexity that its reliability could never be tested.[2]

Although the OTA report was finished by October 1987, it was mired in the declassification process at the Department of Defense, until an "unauthorised" copy was handed over to the

[1] *Nature*, March 31, 1988, p. 383.

[2] *Ibid.*, April 28, 1988, p. 767.

press by Congress employees. According to the Federation of American Scientists, the OTA report is the first comprehensive study of SDI as a complex system rather than a collection of "gadgets". John Pike, a member of the Federation, said that the OTA report may be enough to shatter the Star Wars dream after the end of President Reagan's term of office.[1]

In the Greek legend, Odysseus had to navigate his ship between Scylla and Charybdis—two horrible monsters on opposite sides of a narrow strait. Sailors trying to avoid one danger ran the risk of being overcome by the other.

The men who are navigating mankind's ship are faced with a simpler choice, but one that entails a great deal more responsibility—between the extension of the arms race to outer space or its use for peaceful purposes.

It would seem that the obvious choice is the latter alternative. Yet the threat posed by the SDI programme continues to be a very real one. Actually, said the great Russian writer Leo Tolstoy, the high degree of vision that science provides us with is sometimes the final stage of blindness, because of the erratic direction of scientific investigation.

Mankind's "vision" can only be regained through jointly tackling the problems of cooperation and the global tasks of world survival. The vanguard of mankind is not the "technological elite", which has fenced itself off from the rest of the world by discriminatory barriers, but the open, numerous, multilingual and democratic community of international scientists, and it is they who will lead the world into the third, space millennium.

[1] *Op. cit.*

CHAPTER ELEVEN

Starry Skies Above to Moral Law Within

Having taken the role of the locomotive in scientific and technological progress, civilian cosmonautics also contributes to the formation of new ethics in science, which, according to Academician Ivan Frolov, the originator of human studies in the USSR, represents a major prerequisite for mankind's survival in the nuclear age.

Every achievement in the exploration of outer space unprecedentedly widens the scope of human activity. While in the 19th century Frederick Engels wrote with justification that "our whole official physics, chemistry, and biology are exclusively *geocentric*, calculated only for the Earth"[1], the situation has today changed drastically. The exploration of outer space provides mankind with unheard-of opportunities for advancement in physics, chemistry, biology, the medical sciences, geology and in many other natural and social sciences.

Space research is providing a great deal of information. A single artificial Earth satellite is today capable of transmitting as much information in 24 hours as is contained in the world's largest libraries. These data enable man to enhance his knowledge of the spatial confines of the human habitat, and help to construct humanity's social memory.

What is even more important, however, is that the exploration of outer space, together with the philosophical and ethical realisation of scientific and technical progress in the exploration of outer space, offers boundless new opportunities for man's spiritual enrichment, for providing him with new guiding principles.

"Man," says Soviet author Yuri Bondarev, "cannot accept the idea of himself as a microscopic particle inhabiting the

[1]K. Marx. F. Engels, *Collected Works*, Vol. 25, p. 518.

molecule of Earth, invisible from orbital altitudes, and, without knowing much about his own self, he is boldly confident that we will solve the riddles and laws of the universe, and will definitely put them to everyday use".[1]

The contradiction between man's desire to explore the world around him and the need to know everything about himself is only superficial. Man needs to penetrate outer space not so much to see if there is life there, but, above all, to find a reason for existence relative to the dimensions of time and space opened by the space age.

As outer space becomes a sphere of human activity, the thirst for knowledge, which has always occupied a major place among man's moral values, is assuming new spatial and chronological dimensions.

With mankind's advancement along the road of social, scientific and technological progress, knowledge is increasingly coming to the fore among the factors serving to satisfy human needs. As US astronaut Edgar Mitchell put it in an address to the students and teaching staff of Leningrad University on September 9, 1987, man's desire to know and understand is an essential "way of life". Hence, a close connection between knowledge and morality. Of all domains of human activity, astronautics is one that best helps to convert the former into the latter. In this connection Edgar Mitchell said that he had come to the USSR for the third time, and each time he admired the morality which he saw in every person whom he talked to. It was particularly obvious when Soviet people spoke of their Motherland, or of their families. He believed that the Universe was made up of two components: one was something physical, the other was something different. We were all aware of this "something", he added. It was this "something" that united, led and elevated us; this moral element within us was destined to take mankind to a new level of cooperation.

The significance of this aspect of space exploration has not yet been acknowledged by modern science. Moreover, some ideologists assert that the advent of the space age has not

[1] Yuri Bondarev, *The Fleeting Moments of Life*, Moscow, Molodaya Gvardiya, 1983, p. 364 (Russ. ed.).

changed man's social consciousness. "Man", wrote Canadian historian Arthur Lower, "if and when he gets to outer space, will be the same wild animal he is today".[1]

This viewpoint has been contravened by Soviet scientists, who have developed the hypothesis that cosmonautics is bringing about a qualitative change in man's social existence and social consciousness. For instance, Soviet philosopher Arkadi Ursul, with regard to the new qualitative factors that are being introduced into mankind's existence as a result of the exploration of outer space, particularly through the expansion of "its living space"[2], has suggested that at a certain stage of evolutionary progress a new form of biological matter will emerge that may conveniently be termed as "postsocial".[3]

A similar opinion has been expressed by philosophers and biologists who are studying the possibilities and the social aspects of extending the speciational expectancy of human life. In the mid-1970s a team of prominent Soviet scientists led by Alexander Oparin became interested in establishing a special biological laboratory for such research. A hypothesis put forward at the Second All-Union Symposium, "Artificial Extension of Speciational Life Expectancy" (1980) was directly consonant with Arkadi Ursul's theory, except that it focused on the aspect of time instead of space. One of the reports submitted to the symposium stated: "With an extended speciational life expectancy, man will become a material carrier of a new form of motion of matter".

The theoretical groundwork and practical implementation of this hypothesis fill such age-old concepts as the meaning and purpose of life, national and global interests, and types and forms of motion of matter, with new content.

In the ancient Indian philosophy the concepts of the cosmos and the meaning of existence were closely interconnected. Ascent to *Brahmaloka*, the supreme planet of the material world, was believed to be less important, than reaching *Kṛṣṇaloka* or any other planet of the spiritual realm, all of which were free of death, disease and old age.

[1]*Queen's Quarterly*, Vol. LXVIII, Winter, No. 4, 1962, p. 542.
[2]A.D. Ursul, *Mankind, Earth, Universe (Philosophical Aspects of Cosmonautics)*, Moscow, 1977, p. 204 (Russ. ed.).
[3]*Ibid.*, p. 205.

This fundamental idea of the *Bhāgāvadgīta* is strikingly consonant with the philosophy referred to by world science as "Russian cosmism". Russian cosmism is associated with the names of such renowned scientists as Konstantin Tsiolkovsky, the founder of theoretical cosmonautics (1857-1935); Vladimir Vernadsky, the founder of geochemistry (1863-1945); Alexander Chizhevsky, the founder of heliobiology (1897-1964); and utopian philosopher Nikolai Fyodorov (1828-1903).

These thinkers professed the humanistic view that a global effort was necessary to solve universal tasks, such as the exploration of outer space, the elimination of diseases and the perfection of man as a biological species. The cornerstone of their theory was the growing unity of people, the global integrity of humankind, as opposed to the infinite vastness of the cosmos.

Possessing an ability for comprehensive scientific inquiry that was unique for his time, Tsiolkovsky sought clues to the solution of other global problems. In addition to the problems related to the universe in general, he attached great importance to the human and moral aspects of space exploration. To him it was clear that when man gained access to outer space, a drastic improvement of human qualities would be required.

Tsiolkovsky maintained that "higher animals" (man) were far from being perfect, e.g., their life expectancy was short, they had a small and inadequate brain, etc.[1] "Man", the great Russian scientist believed, "does not have a single decently built or flawless organ".[2] Tsiolkovsky understood the problem of man, often regarded today as that of "protecting man" against the negative consequences of scientific and technological progress, more profoundly and in a more realistic way. To him the problem was to improve the human organism through the achievements of science and technology. "Man has too many physical, intellectual and social defects to

[1]K.E. Tsiolkovsky, *The Cosmic Animal, Coll. Works.* Vol.4, Moscow, 1964, p. 262 (Russ. ed.)
[2]*Ibid.* p. 296.

remain what he is!"[1] he declared, anticipating a time when "man will finally start transforming his body".[2]

From the very beginning, Tsiolkovsky's philosophical views, many of which were never grasped by his contemporaries, connected the cosmos and theoretical cosmonautics with the need to transform the traditional world view.

In his idea of the Man-Universe system, the extension of the spatial confines of conscious human activity was harmoniously and inseparably connected with the cardinal extension of the individual's intellect.

Having continued the theory of his teacher — the Russian philosopher Nikolai Fyodorov — and put it on a materialistic basis, Tsiolkovsky forumulated his idea of religion as an emotional concept of scientific and technological progress fully consonant with the tenets of historical materialism.

Strictly speaking, the idea of the primacy of sense over reason in man's understanding of the universe was brought up by Immanuel Kant, the founder of German classical philosophy. "All our knowledge begins with sense, proceeds thence to understanding, and ends with reason, beyond which nothing higher can be discovered in the human mind for elaborating the matter of intuition and subjecting it to the highest unity of thought".[3]

From the point of view of today, this highest unity of thought is nothing but the arrangement of all of human knowledge into a system centred around man, with all his ambitions and aspirations.

The cosmists contributed to world science by attempting in a unique way to juxtapose the Biblical ideals and the attainments of science and technology. In their numerous works cosmists expressed the idea of accomplishing many of the religious ideals on Earth. This was most clearly formulated by Konstantin Tsiolkovsky in a conversation he had with Alexander Chizhevsky in 1932. Many years later science

[1] K.E. Tsiolkovsky, *The Beginning of Plants on the Earth and Their Evolution, Coll. Works*, Vol. 4, Moscow, 1964, p. 159 (Russ. ed.)
[2] K.E. Tsiolkovsky, *The Cosmic Animal*, p. 296.
[3] Immanuel Kant, *Critique of Pure Reason*, New York, P.F. Collier & Son, 1902, pp. 276-277.

fiction writer Yuri Medvedev published the details of this conversation, which Chizhevsky had recorded.[1]

During his conversation with Chizhevsky, Tsiolkovsky referred to religious symbols as "a vague conjecture about mankind's future". "We must take them at their face value," he said, "for we cannot possibly consider many millions of people to be halfwits or mere fools! We have to ponder hard over these symbols common to all religions ('soul', 'the other world', 'heaven', 'hell'.—*Authors*) in order to elucidate them from the cosmic point of view".[2]

The idea that it was possible and permissible to interpret religion as an emotional concept of scientific and technological progress had at various times been expressed by all cosmists. Vladimir Vernadsky also expounded this idea in a letter written to his wife on July 21, 1917: "Among the books I'm reading at the moment is the Bible. Oddly enough, it responds to the most incompatible and drastically different of my moods. I keep viewing it from irreconcilable points of reason, and I get a feeling of integrity. It has often occurred to me that one and the same person might think differently and irreconcilably about one and the same thing at one and the same time, yet feel integral about it. That's the feeling I'm getting now as I read the Bible..."[3]

This part of cosmist philosophy strikes a particular social key. The new thinking is not merely a system of ideas and views, but an ideological platform of the broadest social strata of today's world, the strate that are for peace and survival. Of the world's 5 billion people, about 2 billion are Christians and Moslems.[4] It would be unwise to ignore this active force for peace. Tsiolkovsky's interpretation of religion creates the ideological prerequisites for a political alliance between peace and religious movements. It does so without any concessions to

[1]A.L. Chizhevsky, *The Theory of Cosmic Eras*, in the *Collection: K.E. Tsiolkovsky, Dream About Earth and Heaven*, Tula, Prioksk Book Publishers, 1986, pp. 419-427 (Russ. ed.)
[2]*Ibid.*, p. 424
[3]B.M. Kedrov, A.L. Yanshin, K.P. Florensky (Ed.), *Glimpses of V. Vernadsky's Biography*, Moscow, Nauka, 1981, p. 287 (Russ. ed.).
[4]N.A. Kovalsky, *Religious Forces for Peace*, in the *Collection: Public Movements and War and Peace Issues*, Moscow, 1978, p. 250 (Russ. ed.).

idealism, without flirting with religious leaders, without everything that Lenin condemned as "coquetry with the deity".

This is being helped by the very nature of Russian cosmism, defined by Academician Nikita Moiseyev as a general idea of activities shared by "broad sections of the intelligentsia, involving people of various political and philosophical views, from naturalists and ardent materialists, such as Vernadsky, to ideologists of the Orthodox Church".[1]

Konstantin Tsiolkovsky and others who shared his views reasoned that if a magic carpet was, so to speak, the prototype of future aircraft, God must be the prototype of future man, created "in the image and likeness" of homo sapiens, but with a greater life expectancy.

Admittedly, Tsiolkovsky was neither a biologist nor a gerontologist, nor were the writers Leo Tolstoy and Maxim Gorky, nor was Norbert Wiener, the founder of cybernetics, nor were many other great thinkers who admitted the possibility of individual biological immortality. But is not progress stimulated by human impulses, aspirations and dreams? Of course it is. Arthur C. Clarke, the British science fiction writer, who now lives in Sri Lanka, has drawn up a list of parallels between the aspirations of the ancient thinkers and various contemporary achievements. The items on the list include submarines, aircraft, telephones, "death rays", telekinesis, conversion of metals, telepathy and immortality.

The long-cherished human dream of escaping death can be directly traced to a Greek myth about an exploit of Hercules in which he overcame Thanatos, the god of death, in a fight for the soul of Alcestis, the wife of Hercules' friend Admetus. Jawaharlal Nehru, the first prime minister of independent India, knew and shared the humanistic ideals of the Greeks. "India," he once wrote, "is far nearer in spirit and outlook to ancient Greece than the nations of Europe are today, although they call themselves children of the Hellenic spirit".

Jawaharlal Nehru's personal outlook was consonant with this appeal by Aristotle, which Nehru quoted in his book *The Discovery of India*: "We must not obey those who urge us,

[1]N.N. Moiseyev, *V.I. Vernadsky and the Natural Science Tradition, Kommunist*, 1988, No. 2, p. 80 (Russ. ed.).

because we are human and mortal, to think human and mortal thoughts; insofar as we may we should practise immortality, and omit no effort to live in accordance with the best that is in us".[1]

It is easy to see that this quotation from Aristotle, which Nehru found meaningful, serves to bridge the gap between the two cultures and outlooks. And while Aristotle may symbolise the Western side of this bridge, the Eastern side emerges from the following scripture in the *Brihadaranyaka Upanishad*, quoted by Nehru in another one of his works: "Lead me from the unreal to the real, lead me from darkness to light, lead me from death to immortality".[2]

The idea that religion can be interpreted as an emotional concept of scientific and technological progress is quite near to the traditional Indian outlook, which views religion as an appeal for vigorous social action, rather than as a passive dependence on divine providence.

This perhaps explains why the Indian enlighteners of the 19th century, concurrently with the Russian cosmists, came up with the idea of the congeniality and synthesis of science and religion. For example, Keshab Chandra Sen, the successor to the well-known public activist and reformer Raja Ram Mohan Roy, urged his disciples to regard science and religion as one whole. "In all your beliefs and prayers," he wrote, "faith and reason ought to harmonise with a true Science".[3]

It appears that this interpretation of religion is favourable not just for science alone, but for social progress as a whole. It helps in consolidating a political union of the people who are struggling to ensure the continuance of life on Earth. It was not without reason that Jawaharlal Nehru viewed the task of bringing about a synthesis of science and religion as the "high privilege of India",[4] for that country today is playing a key role in consolidating the world's peace-loving forces.

[1]Jawaharlal Nehru, *The Discovery of India*, The Signet Press, Calcutta, 1946, p. 685-686.

[2]Jawaharlal Nehru, *An Anthology*, Oxford University Press, Delhi, Bombay, Calcutta, Madras, 1983, p. 28.

[3]V.S. Naravane, *Modern Indian Thought. A Philosophical Survey*, New York, 1964, pp. 15, 16.

[4]R.K. Karanjia, *The Mind of Mr Nehru*, Ruskin House, George Allen & Unwin Ltd., London, 1960, p 34.

The all-embracing political versatility of the related ideas advanced by Russian cosmists and the Indian enlighteners of the 19th century gives solid grounds for optimism that these ideas can be accepted and interpreted as a clearly formulated objective of scientific and technological progress to be achieved by the end of this century. And there is no reason to think that this objective will not be matched by tangible achievements in science and technology.

Let us take, for example, the ancient religious ideal of immortality. From the point of view of natural science, "absolute" immortality is impossible. But the problem of the artificial prolongation of speciational life expectancy is being tackled by science. The President of the USSR Academy of Sciences signed a decision to set up a research unit for this purpose as long ago as 1975.

The fact that the problem of ageing and that of affecting the vitality of the human organism is the subject of serious discussion in modern biology is not accidental, nor is there anything utopian about it, for it is a logical offshoot of scientific and technological progress. In formulating the problem of the artificial extension of human life, Soviet scientists, aware of the possible anti-scientific speculations that could arise, reiterated that they were investigating the problem purely from a biological point of view. Thus, Vasili Kuprevich, President of the Byelorussian Academy of Sciences, wrote that once it was possible to artificially control the process of ageing, "it would not mean that people would stop dying altogether... But it would effectively mean that a normal healthy person would live for an indefinitely long period of time".[1]

Kuprevich's conviction that human life could be extended from ten to a hundred times was shared by another outstanding Soviet scientist, Iosif Shklovsky.[2]

Breakthroughs in biology and medical research in the West are often a source of sensational exaggerations, which can only damage the prestige of science. There have been some serious

[1]V.F. Kuprevich, *Immortality: A Fable?Nauka i religiya*, 1965, No. 9. p. 32. (Russ. ed.).

[2]I.S. Shklovsky, *Universe, Life, Reason*, Moscow, 1965, p. 256 (Russ. ed.).

studies of global problems, however, which admitted the possibility of extending human life. For instance, British gerontologist Dr. Christopherson asserted as far back as the 1960s that a man could live 300, 400 or even 1000 years, provided the life-sustaining elements were present.[1]

Some researchers believe that as early as 2005 science will have established enough control over the processes of ageing to extend the average human life span by 50 years. There are scientists who believe that within the next 15 years science will begin directly studying the problem of man's biological immortality, together with the factors which influence longevity. The book *No More Dying*, written by Joel Kurtzman and Phillip Gordon, a zoologist and geneticist, is among the well-known works dealing with this subject.

Equally valuable is the opinion of Norbert Wiener, one of the founders of cybernetics, who, in his last book, admitted that there could be scientific discoveries that would make death accidental, "as it seems to be with giant sequoias".[3]

The feasibility of extending human life was also suggested by Leonid Gavrilov, a Soviet biologist. "With age, man undergoes quite a few physical changes", he writes. "Most of them, though unpleasant, must be accepted, for they are unavoidable. There is, however, an ageing factor which is difficult to accept, and that with age the risk of death rapidly increases... In day-to-day life, people try not to think about this. Science, however, cannot possibly do the same. Therefore, the paramount problem facing the biological aspect of gerontology today is why there are more deaths among old people".[4]

[1]Justine C. Glass, *Live to be 180*, Taplinger Publishing Co., Inc., New York, 1962, p. 1.

[2]Joel Kurtzman and Phillip Gordon, *No More Dying: The Conquest of Aging, and the Extension of Human Life*, J.P. Tarcher, Inc. Los Angeles, 1976.

[3]Norbert Wiener, God and Golem, Inc. *A Comment on Certain Points Where Cybernetics Impinges on Religion*, The M.I.T. Press, Cambridge, Massachusetts, 1964, p. 66.

[4]L.A. Gavrilov, *Quantitative Regularities in the Duration of Human and Lab-animal Life. Scientific Groundwork for the Polis Programme*, Pushchino, 1984, pp. 5, 6 (Russ. ed.)

The position of Western academic circles as regards the feasibility of biological immortality is typified by this quote from Daniel E. Koshland Jr., the Editor of the *Science* magazine, the organ of the American Association for the Advancement of Science: "The time has come, it seems, when I can realistically refocus on the goal of achieving immortality. I do not refer to the old-fashioned sort of immortality... I am talking about living forever".[1]

A similar position in assessing the scientific feasibility of the artificial extension of human life is held by W. Basil McDermott, a scientist with the Division of Interdisciplinary Studies at Simon Fraser University (Burnaby, British Columbia, Canada). "Current scientific knowledge", McDermott writes in an article published in late 1987, "is developing at a rate and in directions, however, that tempt modern man to reconsider the necessity of death. As scientifc capacity increases to enable humans to postpone death indefinitely, we can anticipate a new range of thoughts, feelings and problems. The historic certainty that we all must die will be transformed into a new set of uncertainties surrounding the scientific gift of additional life on earth".[2]

At the same time, both Koshland and McDermott make a distinction between the biological and moral aspects of immortality, without knowing how to reconcile the possibility of living indefinitely with the "old-fashioned" moral idea of immortality as associated with "righteous deeds" and "good children".

The philosophy of Russian cosmism deals with this contradiction by suggesting the pioneering concept of "patrofication", or the resurrection of deceased ancestors, which was devised by Nikolai Fyodorov.

For more than half a century, this theory was considered shockingly outlandish by sensible people, which probably explains why Nikolai Fyodorov's name was for a long time absent from scientific literature.

[1]Daniel E. Koshland Jr., *Immortality and Risk Assessment, Science,* April 17, 1987, Vol. 236, No. 47999, p. 241.

[2]W. Basil McDermott, *On the Uncertain Future of Death,* in *Futures. The Journal of Forecasting and Planning*, Vol. 19, No. 6, December 1987, pp. 686-687.

The possibilities now being opened by biotechnology, genetic engineering, bionics and telecommunications, however, have revived interest in Fyodorov's ideas. Readings of Fyodorov's writings, for instance, were held in May 1988 in the picturesque town of Borovsk near Moscow, where Nikolai Fyodorov once taught Tsiolkovsky. The participants in the event noted the profound connection between the theory of the cosmists and the scientific and social changes of our times.

Strictly speaking, Frederick Engels identified man as the end goal of the intellectual quest before Nikolai Fyodorov came up with his theory.[1] Engels' thesis presupposes an objective regularity, whereby any human knowledge about the surrounding world is realised through the approximated functional models of the human organism termed effectors (muscles), receptors (eyes, ears, etc.) and finally the programmer (brain). It can be anticipated that at a certain point of cognition adequate anthropoidal models of a living organism can be built. "By consistently adhering to the functional view that life and reason are ways to organise a material system, we, quite naturally, arrive at conclusions that are somewhat surprising", Academician Andrei Kolmogorov, the founder of a scientific school of thought on the theory of probability and the theory of functions, wrote in this connection back in 1964. It must be realised that to model an organisation of a material system essentially means using different material elements to create a new system that would for the most part repeat the organisation of the prototype system. Therefore, a sufficiently complete model of a living being should justly be called a living being, and a model of a thinking being a thinking being.[2]

At a certain point, as man begins to understand himself better, he will bring about the possibility of synthesising human organisms abiogenetically, i.e., of creating humans (individuals, personalities) with predetermined characteristics. Modern science is already coming nearer to the

[1]Karl Marx, Frederick Engels, *Collected Works*, Vol. 1, p. 465.
[2]A.N. Kolmogorov, *Life and Intellect as Special Forms of Material Life, Collection: On the Essence of Life*, Moscow, 1964, Nauka Publishers, p. 52 (Russ. ed.).

accomplishment of this task. "Uniting the efforts of specialists in neurophysiology, psychology, linguistics and mathematics promises advancement in tackling one of the most exciting and complicated problems of science, that of revealing the essence of the processes and mechanisms of the cognitive faculties of the mind, which in turn, opens the road to the creation of a highly advanced artificial intellect, i.e., sophisticated cybernetic systems".[1] This is the opinion of Yevgeni Velikhov, Vice-Chairman of the USSR Academy of Sciences and Chairman of the Board of Directors of the International Foundation of the Survival and Development of Humanity.

The veracity of this forecast is being corroborated by the day-to-day practice of scientific research.

A qualitative change in the development of both basic and applied research occurred in 1986-1987 with a breakthrough in high-temperature superconductivity. It was less than a year after the publication of the sensational discovery by A. Muller, G. Bednorz and M. Takashige (IBM's Research Laboratory in Zurich), who observed a sharp increase in conductivity in merged samples of barium, lanthanum, copper and oxygen at a temperature of 30° K,[2] when similar results were obtained in scientific laboratories of Tokyo, Houston and Beijing.[3]

According to specialists, one of the most realistic uses to which the new discovery can be put is in computer technology and low-current processes. The new high-temperature superconductor can, in particular, be effectively used in studies of higher nervous activity, cognitive faculties of the mind, cerebral mechanisms of thinking and memory, that is, in everything that makes up human individuality.

An interesting attempt to integrate into a single material object (model) the available knowledge of man's biological nature has been made by Japanese scientists. A good-sized report (94 pages) identifying the prospects of scientific research in the field of life sciences published by them represents a

[1] Y. P. Velikhov. *Science for Life on Earth, Moskovskaya Pravda*, Nov. 1. 1983. (Russ. ed.).

[2] *Zeitschrift fur Physik B.*, Vol. 64, p. 189.

[3] Christine Sutton, *The Race for a High-Temperature Superconductor Hots Up, New Scientist*, January 29, 1987, p. 33.

challenge to the premises of the US Star Wars programme. In contrast to one version of SDI known as "sky frontier", the Japanese scientists have called their comprehensive programme for biological studies the Human Frontier Scientific Programme.

The report, which was prepared by the Science and Technology Agency of Japan's Ministry of International Trade and Industry (MITI), proposes, among other things, "the creation of all the necessary components of an android (artificial brain, eyes, organs, muscles and tissues) through the study of functions of the human body".[1]

The mere fact that such a bold task was undertaken involving major scientists (including Michio Okamoto, former President of Kyoto University, and Katsuhiko Umehara, Deputy Director of the MITI Feasibility Study) is a striking illustration of how far science has advanced. No doubt, this complex of basic and applied research is likely even in the near future to produce a broad range of practical benefits, such as novel means of treating dangerous diseases, the development of new kinds of crops, improved "man-machine" relations, etc. Advanced robots, for example, can be of invaluable assistance to man in the exploration of the planets of the solar system.

Although the Human Frontier Scientific Programme presupposes broad international cooperation, some major industrialised countries declined to participate in it on the grounds of a lack of funds, even though they had willingly accepted the invitation to join the SDI programme. Already during their first acquaintance with the Japanese-sponsored programme, Western companies and foundations found the high proportion of basic research in it that was not typical of Japan's technological policy, worrisome. According to Sir Walter Bodmer, Director of Research at Britain's Imperial Cancer Research Fund, "... it is most unlikely that within the United Kingdom we would find a large amount of extra money, if any extra money, to support such a programme".[2]

[1]David Swinbanks, *Japanese Frontiers Programme Fillip to Research, Nature*, Vol. 326, March 5, 1987, p. 8.
[2]*Ibid.*

Bodmer's colleague, Thomas Blundell, professor of molecular biology at London University, was even more forthright when he said: "Given equal opportunities of access to basic research, Japanese industry will use them more profitably".[1]

Of course, there is no denying that in their handling of this issue both the British scientists and the Japanese sponsors of the Human Frontier Scientific Programme are being guided by their own good reasons. Often it is not their fault, but rather a source of difficulties for them, that scientific ideas measuring up to the demands of the 21st century have to be implemented against the background of a specific political situation of the 20th century, with all of its lingering stereotypes of outdated political thinking.

Specifically, this explains why, judging by media reports, the directors of Human Frontier are exclusively oriented towards collaboration with scientists in the capitalist world, ignoring the opportunities for work with scientific institutions in socialist countries.

Undoubtedly, both the West and the socialist countries have sufficient scientific capacities to solve eventually the task of creating an "android", in addition to the other projects set up under the Human Frontier Scientific Programme.

The point, however, is that the significance of this programme lies not so much in its direct scientific value as in its social orientation as a factor facilitating mankind's consolidation around a "common cause" without distinction of race, nationality or class. This is how the Russian cosmists envisioned it.

Fyodorov's concept of scientific and technological change has therefore lost none of its topicality in our day. His idea of a "common cause" as an alternative to wars and destruction fits into the pattern of the new political thinking perfectly. Fyodorov appealed that "... the outcome of the tremendous might and variety of explosives that have been accumulated in

[1]Bob Johnstone, *Europe Spurns Japan's Human Frontier, New Scientist,* February 5, 1987, p. 25.

the world must be truly fraternal rather than be used for what all this was designed for, i.e., war".[1]

At the same time, in his article *Disarmament. The Way to Make the Tools of Destruction Work for Survival* Fyodorov foresaw and refuted the vicious Western concept of "nuclear deterrence" as a guarantee of international stability, and exposed the fallacy of this concept from the point of view that it creates only illusory security. "The infernal technology," he wrote, "that produces tools of destruction needs to justify its existence by viewing the tremendous destructiveness of its weapons as the best guarantee against war, that is, it wants everyone to believe this, while forgetting or ignoring the fact that the state of being armed and the constant threat of war is much the same as, if not worse, than being at war".[2]

The cosmic philosophy of Konstantin Tsiolkovsky, Vladimir Vernadsky, Alexander Chizhevsky and Nikolai Fyodorov represents a real contribution to world science, one that measures up to the significance of manned space flights.

Modern man has advanced very far in developing the technosphere. At every step, he has had to admit that, to his own surprise, he has not become happier. Today's world is not just the "golden age" of science, but also a world of man-devised self-destruction, social contrasts, hunger and diseases affecting millions of people.

As he develops modern bio-computers, man begins to realise that, as remarkable as it may seem, he may be able to build a human being in his own likeness in a couple of decades. But he is unable to answer one short and importunate question: what for?

Russian cosmism gives a clear and exact answer to this question: so as to jointly enable the creation here on Earth of the magic planet of *Krsnaloka*, believed by ancient Indians to be free of death, diseases and old age.

[1] *The Philosophy of Common Cause. Articles, Ideas and Letters By Nikolai Fyodorov*, edited By V. Kozhevnikov and N. Peterson, Vol. 1, Verny, 1906, p. 663. (Russ. ed.).
[2] *Ibid.* p. 665.

CHAPTER TWELVE

Rescue

The feedback between man's practical activity and his ethical and aesthetic realisation of the surrounding world manifests itself most directly in cosmonautics. This phenomenon was intuitively noted much earlier, particularly by Oriental philosophers. In Western philosophy it was pinpointed by Immanuel Kant, who wrote the following: "Two things fill the mind with ever new and increasing admiration and awe, the oftener and the more steadily we reflect on them: *the starry heavens above and the moral law within*".[1]

So, today, in paying tribute to man's heroic exploits here on Earth, we notice that because of the special social import of the cosmos the most prosaic operations performed on board a spaceship assume a far greater social significance. Cosmonautics seems to revive and repersonify the traditional human virtues that have been squashed by the conditions of conveyor-belt production.

The broad social impact of cosmonautics appears as a particularly important factor, for it gives cosmonautics a special political flavour, since according to Lenin, "... politics begins where millions of men and women are; where are not thousands, but millions, that is where serious politics begins..."[2]

This explains why Yuri Gagarin, the first man in space, immediately became the messenger of the new political thinking. Inspired by all that he had seen, he kept reiterating to millions upon millions of people in various countries: "Our

[1]Immanuel Kant, *Critique of Practical Reason, Conclusion,* in *Great Books of the Western World*, Vol. 42, *Encyclopaedia Britannica*, Inc. Chicago, 1952, p. 360.
[2]Lenin, *Coll. Works*, Vol. 27, p. 100.

planet is beautiful, but too small for fighting, so we must all live in peace."[1]

Cosmonautics provides millions of people with bright examples of international cooperation, such as the handshakes exchanged in space by the Soviet cosmonauts and US astronauts who participated in the Soyuz-Apollo Test Project. The joint experiment was seen by the world as a vivid manifestation of detente, as a real act of peaceful coexistence of two powers with different social systems.

"Cosmonautics is like the arts", Soviet cosmonaut Alexei Leonov once said, commenting on the interrelationship of his profession and public consciousness. "Why? Because it is done in front of millions of people. This is especially vital today, given the global nature of communication and human contacts... Our multilingual orbital 'arcs' help people to visualise a model of true cooperation, mutual respect and understanding, of gravitation towards progress".[2]

The social instinct inherent in man, the realisation of oneself as part of humanity acquires tangible meaning with every new step taken in the exploration of outer space. This involves not only those who have had a chance to participate in space ventures, but also all those who think about the future of mankind as well as their own future.

New political thinking is impossible without stronger spiritual bonds between nations and mutual cultural enrichment. The use of outer space for direct international television broadcasting, which is accomplished according to the Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting adopted by the 37th Session of the UN General Assembly, offers broad opportunities for cultural exchange worldwide, and promotes better mutual understanding and greater knowledge of one another's national cultures. The TV space links held via satellite in 1985-1986 enabling Soviet and US public representatives to engage in a direct exchange of views

[1] V. Safonov, *A Word on War and Peace, Moscow, Pravda*, October 11, 1986 (Russ. ed.).
[2] *Pravda*, January 2, 1987 (Russ. ed.).

served as a good example of how television can help in moulding the new political thinking.

A space-link dialogue held between the legislators of the two countries — the Deputies to the Supreme Soviet of the USSR and members of the US Congress — was held on September 23, 1987 at 7.30 a.m. Moscow time and 11.30 p.m. Washington time, through a joint effort of Gosteleradio of the USSR and the US television company ABC, with assistance from the Internews company. The Soviet participants in the space link included Marshal of the Soviet Union Sergei Akhromeyev, Chief of USSR's Armed Forces General Staff; Academician Yevgeni Velikhov, Vice-Chairman of the USSR's Academy of Sciences; Georgi Kornienko, First Deputy Head of the Foreign Relations Department of the CPSU Central Committee, and Lev Tolkunov, Chairman of the Council of the Union of the USSR's Supreme Soviet. The US team was made up of Sam Nunn, Chairman of the Senate Committee on Armed Services; Les Aspin, Chairman of the House Armed Services Committee, and Trent Lott, Minority Leader.

It can be anticipated that news agencies and other bodies of the mass media will be making broader use of satellites coupled with relevant remote sensing techniques. In any event, this subject is causing some interest.[1]

Because of its social import, cosmonautics serves as a sort of a huge public screen displaying the monstrous contradiction of our times — between the omnipotence of science and the threat of nuclear self-destruction.

Viewed against the unlimited potential to use outer space for peaceful purposes, the plans for taking arms into space to wage Star Wars become particularly odious and absurd. The advocates of large-scale space-based ABM systems argue that these systems will stabilise the world's strategic situation, lessen the risk of nuclear war, and, if the latter cannot be avoided, will make it possible to confine the warfare to outer space, and thus save the Earth and its inhabitants from destruction.

For example, the book *The Battle for Space* by Curtis

[1]See: *A Spy Satellite for the Press? Science*, Vol. 238. No. 4833, December 4, 1987, p. 1346.

Peebles suggests an idyllic scenario of the initial stage of a global conflict between two antagonistic military blocs in the second half of the 1980s involving the wide use of space-strike weapons, satellite and laser warfare, etc. Meanwhile, says the writer, "down below on Earth's green acres, the final outcome is anxiously awaited".

This is a naive and, hence, a dangerous tale. In actuality, the creation of space-based ABM systems would sharply increase the probability of a thermonuclear catastrophe. When political decisions have to be taken instantly, a simple malfunction of an observation satellite mistaken for an enemy signal to start hostilities can instantaneously put the world on the brink of a global war.

As Rajiv Gandhi pointed out during the Stockholm Summit on January 24, 1988, the chimera of an impenetrable space shield must be abandoned, for technology is incapable of devising an ultimate defence. The search for technical answers thwarts the real search for durable peace. No technological solution to the problems of war and peace is possible. "It is in the human mind", he said, "that the defences for peace are built. Human destiny cannot be mortgaged to a machine".

This assessment by India's Prime Minister is consonant with the opinion of not only the majority of the world's politicians, but also of major aerospace professionals. Says Richard L. Garwin, a prominent US physicist and a member of the Union of Concerned Scientists: "I think this... leads to war in space, not as an alternative to war on Earth, but as a prelude to war on Earth".[1]

Convincing proof of Garwin's words was provided by the destruction of the American shuttle spaceship in early 1986. The Challenger tragedy could become a global tragedy if the efforts of scientists, astronauts, engineers, and technicians are directed towards creating and deploying space-strike weapons, which allegedly would be defensive, but which would in fact be capable of being used for delivering a first strike. Such systems would destabilise the strategic situation, and that could result in a tragedy, first in space and then on Earth. Suffice it to say that electronic failures accompanied virtually every flight or

[1] *International Herald Tribune*, March 28, 1983, p. 4.

pre-launch test of the shuttle spacecraft. And compared to Challenger, a space-based anti-missile defence system will naturally involve hundreds of times more computers, which means that the system will be hundreds of times less predictable. The future of mankind will be mortgaged to automatic devices, which apropos, failed to prevent the tragedy in the sky off the shores of Florida.

The Soviet Union is fully aware of the dangers posed by the strategic chaos that will be brought about by the militarisation of space. It was not by chance that it was Moscow which gave a warning in connection with this aspect of the tragic events off Cape Canaveral. In his answers to questions put by *L'Humanité* in the wake of the Challenger accident, Mikhail Gorbachev stressed: "Despite assertions by Star Wars advocates, there will simply not be enough time for nuclear weapons to become 'obsolete'. On the contrary, they will be perfected. As a result, they might become so sophisticated that the whole process of decision-making will have to be handed over to computers, to automatic control systems. Human civilisation would thus become hostage to machines, and thus, to technical breakdowns and errors. The extent of this danger was demonstrated by the recent tragedy of the American spacecraft Challenger, which was reliable and repeatedly tested within the scope currently possible".[1]

Should the ambitious militaristic plans for building a "space shield" be realised, they would not guarantee complete invulnerability to either of the parties involved in the conflict. The destructive power of modern strategic weapons is so great that a hundredth part of it would be enough to cause losses and casualties which even in military language could not be termed "acceptable". According to US Congressional statistics, the strategic arsenals of both the USA and the USSR as of 1985 were estimated at 22,000 warheads, with a total yield of 13,500 megatons of TNT.[2] A thousandth part of this monstrous potential would be enough to detonate 700 explosions of a yield

[1] *Mikhail Gorbachev's Answers to Questions Put by L'Humanité*, Novosti Press Agency Publishing House, Moscow, 1986, p. 19.

[2] *Effects of Nuclear War. F.A.S. Public Interest Report, Journal of the Federation of American Scientists (FAS)*, Vol. 34, No. 2, February 1981, p.5.

comparable to those which pulverised Hiroshima and Nagasaki. These figures convincingly show that the only guarantee against offensive strategic armaments is not a strategic defence, but the elimination of all kinds of nuclear weapons.

Quite effective arguments against SDI are being put forward by those US science analysts who question not so much the feasibility of X-ray lasers, but rather their strategic expediency. Scientists say that these lasers would be useless against the next generation of Soviet missiles, because their energy will be insufficient to hit the high-speed projectiles.

According to Theodore Postol, a former science adviser to the Pentagon, X-ray lasers are only dangerous because they "would be best suited to an offensive system".[1]

The implementation of SDI will obviously undermine the entire system of international treaties and agreements governing the use of outer space. In particular, these treaties put an unqualified ban on the launching of space objects carrying nuclear weapons. It is now common knowledge that lasers powered by nuclear explosions are to be an important element of SDI. The recent upsurge of public protest has somewhat cooled the ardour of the advocates of this version of SDI. The accent now has been shifted to the use of powerful chemical lasers, not that this means that the idea of using nuclear lasers has been completely discarded. Moreover, it has come to the knowledge of US scientists who are opposed to the entire concept of Star Wars, that a laboratory in New Mexico is working intensively on developing a compact laser whose power source will be a pulsating nuclear reactor.

"The nuclear power source," wrote the British magazine *New Scientist*, "is attractive to SDI planners because it would be much smaller and lighter than non-nuclear sources, and thus easier to put into satellite battle stations".[2] It is this type of laser, which is being developed under the FALCON programme, that is more attractive to the Pentagon than the "too heavy" chemical lasers.

[1]Ian Anderson, *New Scientist*, October 29, 1987, p. 25.
[2]*Nuclear Lasers for Star Wars, New Scientist*, Vol. 116, No. 1589, December 3, 1987, p. 40.

So it can be seen that all the strategic "advantages" cited by the proponents of space-based ABM defence systems turn out to be, at best, questionable and often will, in fact, have the opposite effect to that intended. Moreover, in view of the enormous costs of space weapons programmes, the militarisation of outer space is fraught with the danger of plunging the world into a state of armed barbarity.

The cost of orbiting an effective load by means of shuttle spacecraft—1,500 dollars per kilogramme—has been taken by specialists as a reference point for estimating the cost of spacestrike weapons systems. According to this criterion, putting a satellite weighing 100 tons into a geostationary orbit would cost about 1.5 billion dollars. As to the number of satellites required to set up a large-scale ABM defense system with space-based components, specialists have difficulty in determining this since any number may prove insufficient in view of certain vulnerability.[1]

On the basis of the occasional publication devoted to the costs of the deployment in outer space of a multilayered ABM system, even in view of the discrepancies between the various expert estimates of the cost of its separate elements, it can be concluded that the total amount of funds needed is bound to become extremely burdensome. While the cost of setting up a battle-station system is estimated at 100 billion to 500 billion dollars, the cost of a multilayered anti-missile system with several space-based components is as high as 2 trillion dollars, which according to the Stockholm International Peace Research Institute is three times the world's annual military budget.

These figures clearly indicate that the use of outer space solely for peaceful purposes is not only a possibility, but is also an absolute necessity within the framework of the new political thinking.

The realisation of this is leading to a growing consensus in the world community that the militarisation of outer space is inadmissible. According to I.S. Rajan, India's representative in

[1] *Kampfentfernung 40 00 Kilometer. Der amerikanische Physiker und Rüstungexperte Richard Garwin über den "Krieg im Weltraum", Der Spiegel,* No. 2, January 9, 1984, S. 118.

the Committee on the Peaceful Uses of Outer Space, such a development would cause the unprecedented growth of military expenditures, which would both put a heavy burden on the space powers and have a negative impact on other countries.

* * *

In late 1986 the debris of Challenger were buried in two abandoned missile silos on the grounds of the US Air Force base on Cape Canaveral.

David Whitehouse, a scientist and writer, suggested that in addition a few pieces of Challenger should be displayed at aerospace museums in various countries "as a humble reminder that we are not yet masters of space technology".[1]

While this is a very good suggestion, burying the pieces of the spacecraft in two abandoned ballistic missile silos also has symbolic meaning. But perhaps the best way to express the interrelationship between cosmonautics and new political thinking would be to display the fragment of the Challenger on which is written the word RESCUE next to the sculpture by Vuchetich *They shall beat their swords into ploughshares*... in the esplanade by the UN building in New York.

There is only one way of rescuing the spaceship Earth from the emergency it is facing—the peaceful coexistence of all nations, disarmament and the creation of a comprehensive system of international security.

Even the most perfect technology, though it can help in achieving these goals, cannot replace the necessity that there be a political will for peace. This political will is taking shape before our eyes in response to the truly wonderful prospects being opened up by the scientific and technological revolution.

We believe that once the light of Reason has been lit it will not be put out, but will illuminate the infinite vastness of the cosmos. But it would be a disastrous mistake to assume that the light of Reason glows on its own. It would be apt here to echo

[1] David Whitehouse, *A Piece of Challenger, New Scientist*, January 29, 1987, p. 69.

the words of Bertolt Brecht, a great humanist of our time, who put the following words into the mouth of the great astronomer and experimenter, Galileo Galilei: "As much of the truth will prevail as we make prevail. The victory of reason can only be the victory of reasonable people".[1]

[1] Bertolt Brecht, *The Life of Galileo*, Translated by Howard Brenton, Eyre Methuen, London, 1980, p. 51.

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