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## Scientific and Technological Progress Analysis of Space Technologies

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### Abstract

The study of the issues on use and exploration of outer space, which were made possible thanks to the development of new means of technology, required concerted action by different states. International cooperation in space exploration is also promoted by the high cost of research and the economic feasibility of joint projects. Despite the long history of international cooperation in space exploration, today in connection with the rapid development of space research, the involvement of an increasing number of states in space activity, and the emergence of new subjects of international space law, the forms and nature of international cooperation are evolving. In the age of the Internet, of the fourth scientific revolution and the unstable political situation of law and order in the world, it is important for modern society to find diplomatic ways for international communication of states in space exploration.

In the proposed paper, the authors consider the history of the main directions of international cooperation in the field of space exploration, their dynamics and features are studied. We study the corresponding doctrine, the scientific literature, and international sources of outer space law dedicated to the raised issues. The authors analyse the history, concept, legal nature of international space law, the evolution of forms of international cooperation, the international regulatory framework for international cooperation in space. The paper presents the historical trends of the international interaction of states in space exploration, analysis of not only the legal, but also the technological component of the problem, the study of the specifics of the interaction between international scientific cooperation and the emergence of outer space law, the results of studying the main trends and forms of the dynamics of international space law.

In conclusion, the authors draw their own opinion aimed at solving the analysed topic.

### Keywords

*International Space Law, International Cooperation of States, Sources of International Space Law, United Nations, International Organizations, Scientific and Technological Progress.*

### Introduction

The history of international cooperation in the exploration and use of outer space has long origins and various reasons. Space scientists have long felt the need for interaction among themselves since the subject of research is so vast that it is almost impossible for people of science in one country to achieve high results without communicating with each other. In addition, the reason for the development of scientific and technical cooperation in space exploration is that the interaction of technical, scientific and material resources of states allows us to quickly solve the most complex problems that arise in people in the process of space exploration, while avoiding unnecessary repetition and waste of economic funds and human strength.

These reasons focus states towards the creation of coordinated or common space programs, as well as joint efforts and the expansion of international cooperation.

Despite numerous studies in the field of international cooperation, at the moment there is no single approach to the legal nature of international cooperation in the field of space exploration, there are no sources devoted to the interaction between the history of space law and international cooperation in the scientific field. As a result, the evolution of international cooperation forms in space exploration causes interest and debate, as before.

### Methods

The work uses general and special methods of scientific knowledge. The key research methods are analysis and synthesis. Also, such methods as the historical, systemic, comparative-legal and formal logical methods are widely used in the work.

### Results and Discussion

Astronomy is the science of celestial bodies and one of the oldest sciences. It provides us with the earliest examples of international cooperation of researchers in the study of outer space. Already at the beginning of the 18th century, international astronomical expeditions were organized, and since the middle of the 18th century, joint observations of the passage of Venus along the solar disk (1761 and 1769) were carried out, which gave rise to the successful practice of interstate coordinated observations of the most interesting cosmic phenomena.

At the beginning of the 20th century, in 1904, the International Union for the Cooperation and Research of the Sun was established as one of the first international associations of scientists. Today there is the International Astronomical Union, which was created in 1919 in Brussels (Belgium). Over a thousand astronomers from around the world and more than a dozen national scientific institutions take part in its work.

It should also be said that in addition to international associations of scientists studying outer space, there are other sciences where international relations have long been established - these are Earth sciences: geology, geography, geophysics and geodesy.

By the XIX century, numerous countries involved in geographic discoveries and exploring the Earth had accumulated sufficient knowledge about our planet, which required exchange and systematization. The first international geographic congress was held in Antwerp in 1871, and the first international geological congress was held in Paris in 1878.

The International Geophysical Congress of 1957-1958 remains significant. At this congress, scientists from 66 countries came together to comprehensively study our planet. A number of programs have been created aimed at exploring the world around us. So, all the world observatories organized constant observation of the Sun, about 70 ships conducted oceanographic research, and special expeditionary missions were sent to the Antarctic and the Arctic.

Among other things, the international geophysical year went down in the history of world science due to the fact that it was during its organization that the Soviet Union launched the first artificial Earth satellite (codenamed "Simplest Satellite - 1") on October 4, 1957. That flight opened the way for humanity to space.

With the advent of rocket and space technology, the sciences of the Universe and the Earth received a new charge for their development. New prospects and goals that arose after the advent of space technology, and the very history of the development of fundamental science, required the strengthening of international interaction and cooperation of researchers from different countries. The question of international uniting in the space particularly acutely confronted developing countries, which saw this as a path for their further development and overcoming their economic backwardness. So, it was noted in the literature that space research and their practical component can assist developing countries in addressing pressing problems for them: the development and the study of natural resources, the eradication of illiteracy, improving weather forecasts, and so on. [1].

One of the first areas of international cooperation in space research is cooperation in the field of optical observations of artificial Earth satellites. Socialist countries concluded first bilateral and then multilateral agreements in this sphere through a system of scientific institutions. A large number of bilateral agreements on the deployment of satellite observation stations of foreign countries were concluded by the United States.

Actual common work in space has been formed since the mid-60s, when, through the joint efforts of states, various institutions were created to solve economic and scientific problems. To solve these problems, the states of Western Europe in 1964 created the European Launcher Development Organization (ELDO) and the European Organization of Space Researchers (ESRO). In 1967, the nine socialist states organized and signed the program for multilateral cooperation Intercosmos. At the same time, an agreement on cooperation was also signed between the USSR and France. The United States launched the Intelsat program, an international consortium for the use of communications satellites for commercial purposes; also, a number of bilateral agreements on joint experiments in space were concluded.

Scientists note that the picture of international cooperation in outer space by the end of the 60s of the XX century could be represented as follows: three world centres of cooperation with certain relationships between them - the United States of America, Western Europe, and the Soviet Union. The difficulties between the USA and Western Europe were expressed in the dependence of European programs on the provision of US launch vehicles [2]. It became clear that international cooperation in space research was a very effective way of establishing relations between states. A French scientist J.-P. Couse has noted that: "It is obvious that scientific research has found the most favourable environment for its development, since there were fewer obstacles than in other areas, and also because there is a long tradition of international cooperation in science" [3].

Considering the issue of the history of international cooperation between states, I would also like to say about the role of law in the development of international cooperation. In general, space law is a symbiosis of cooperation between states and scientific and technological progress. It acts as a significant means of developing international scientific and technical cooperation. Scientists note that the influence of the space law on scientific and technical cooperation is expressed, firstly, in the formation of a general legal regime of outer space, and, secondly, in the consolidation and regulation of specific rights and obligations of states in the implementation of space activities [4].

Note that one of the first works published at the beginning of the XXth century, which speaks of the possible emergence of a branch of international space law that is distinct from air law, is the work of the Belgian lawyer E. Lod [5]. Then, in 1932, the first work of the Czech lawyer W. Mandl has appeared: "Space Law, the Problem of Outer Space" [6] which was also devoted to the problems of international space law and its definition.

At the initial stage of the space law emergence, scientists regularly conducted a comparison between the principles of freedom in space and the free high sea. In this regard, the following can be noted. The high sea freedom principle has been formed for centuries, and the principle of freedom of space was established immediately without the ardent resistance of any state. First, through the tacit consent of states, then in the form of resolutions of the UN General Assembly and, in the end, through the conclusion of a multilateral international treaty.

However, the recognition of the principle of freedom of exploration and use of outer space has given rise to several other important issues.

Firstly, the acute question arose of where the airspace ends and outer space, access to which is free for all states, begins. Note that today a norm of customary international law has been formed that defines the border of air and space at an altitude of 100-110 km above the sea level. We believe that the task of states today is to include this rule in the Chicago

Convention of 1944 and permanently stop the historical discussion about the division of air and outer space. The argument for the speedy official separation of outer space and national space is the attempt of some equatorial countries to establish their sovereignty over those parts of the orbit that pass over their territory [7].

The second important question that arose before scientists were whether the rules of international law in outer space generally apply.

Some Western lawyers expressed the view that outer space is a “legal vacuum” that denies any influence of the law to it [8]. However, Soviet doctrine went a different way [9]. Scientists believed that, despite the fact that the sovereign power of a state does not extend to outer space, the general principles of international law, binding on everyone, are in force in space. The ideas of scientists on the extension of international law to outer space were first enshrined in resolution 1721 (XIV) unanimously adopted by the UN General Assembly on December 20, 1961.

In this regard, we would like to note the opinion of one of the space law science founders in the Soviet Union, V.S. Vereshchetin: “For centuries, the legal regime of the high seas has been developed, for decades - the regime of airspace. The history of space law, like the history of space research, is calculated only for years”. [10]

The defining year for the development of international space law was 1967. Then, after a series of lengthy discussions, an Agreement on the Principles of the Activities of States for the Exploration and Use of Outer Space, including the Moon and other celestial bodies (hereinafter referred to as the Outer Space Treaty), was adopted on the initiative of the Soviet Union. It entered into force on October 10, 1967 [11]. Note that as of 2018, the number of States parties to the Treaty amounted to 107 states [12]. The Outer Space Treaty is considered to be the main of the 5 existing outer space treaties, as it contains the fundamental principles for the implementation of space activities [13].

An analysis of the Outer Space Treaty and other international space law sources shows that states in many articles of these agreements indicate a desire to maximize the comprehensive development of international cooperation in outer space.

### Summary

International space law was born on the basis of international cooperation of states in the field of science and technology. It was at the sites of international organizations involved in the problems of astronomy, geology and geography that they first spoke about the problems of space research. These sites became the precursors of creating new institutions involved in space exploration. In addition, cooperation in science has overcome many obstacles and barriers encountered in creating a new industry. Contacts between scientists have contributed to many of the challenges facing the young industry.

The role of scientific and technological progress, which is the cornerstone of the creation of international space law, is also important. Human flights into space and the creation of rockets made it possible to study those phenomena and objects that were previously not available for ground-based surveillance. Astronomers, geophysicists, and geologists have received new technologies that allow them to study the world around us in more detail, and make it more accessible. The development of space technologies has allowed us to find a new impetus for further deepening international cooperation between scientists from different countries. In the literature, it is noted that by the time the first artificial Earth satellite was launched, it became obvious that legal norms are indispensable if the international community wants to avoid confusion and undesirable practices in the use and exploration of outer space [14]. In this regard, one should agree with Yu.M. Kolosov: “the close interweaving of technological and legal components in the process of international cooperation is becoming increasingly visible and will obviously be the main one in the development of international law in the 21st century” [15].

It should also be said about the role of the general principles of international law, which have become a catalyst for the systematization of norms on international space law. The principle of the full and exclusive sovereignty of states over their air territory, the principle of freedom to explore the high seas, the spread of the principles of international law on airspace and the high seas have led to the creation of a special legal regime for outer space, which has its own characteristics and rules.

### Conclusions

The process of the emergence of a new field of law, namely, international space law, was far from smooth and not without the resistance of certain positions of scientists or states. Law, technology, politics, science, cooperation and the struggle of ideologies on the world stage here represent a single system. That is why years of long preparation and heated debate took to develop norms that sometimes seemed quite obvious. However, the history of the international space law emergence is a history of the peaceful coexistence of many states and an example of international cooperation. In comparison with many branches of international public law, international space has developed peacefully and on the sidelines of international organizations. In this area, it did not take much time to understand the importance of creating special international regulatory acts on space exploration. Just 10 years from the launch of the first artificial Earth satellite and the creation of the Outer Space Treaty, it took preparation and discussion of the creation of a new branch of law. In a short time, the path was passed from the theory of “legal vacuum” to the creation of a specialized system of norms that regulate relations between states in space exploration and establish the legal regime of celestial bodies.

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