History of Rocketry and Astronautics

Proceedings of the Eighteenth and Nineteenth History Symposia of the International Academy of Astronautics

Lausanne, Switzerland, 1984

Stockholm, Sweden, 1985

Tom D. Crouch and Alex M. Spencer, Volume Editors

R. Cargill Hall, Series Editor

AAS History Series, Volume 14

A Supplement to Advances in the Astronautical Sciences

IAA History Symposia, Volume 8

AAS Publications Office
P.O. Box 28130
San Diego, California 92198

Affiliated with the American Association for the Advancement of Science
Member of the International Astronautical Federation

First Printing 1993

ISSN 0730-3564

ISBN 0-87703-374-9 (Hard Cover)
ISBN 0-87703-375-7 (Soft Cover)

Published for the American Astronautical Society
by Univelt, Incorporated, P.O. Box 28130, San Diego, California 92198

Printed and Bound in the U.S.A.

Chapter 18

ANATOLE ARKADIEVICH BLAGONRAVOV AND SOVIET COSMONAUTICS*

K. V. Frolov and A. A. Parkhomenko†

Anatole Arkadievich Blagonravov (1874-1975), the eminent Soviet scientist and science activity organizer, is widely known throughout the Soviet Union and the world. He was twice conferred with the title of Hero of Socialist Labor and of the Lenin and State prizes laureate of the U.S.S.R. For more than thirty years he was a member of the U.S.S.R. Academy of Science and of the Presidium of the Academy. He served as secretary-academician of the Engineering Sciences Department of the Academy and for more than twenty years as the Director of the Scientific and Research Institute for Machine Engineering.

Blagonravov was a prominent expert in the general theories of space machines and mechanisms, machine automation and automatic transfer lines, problem of machine strength, as well as an expert in the field of automatic weapons and small arms. A. A. Blagonravov became world famed for his work in the 1950s through 1970s as a participant, organizer and manager of a number of the major scientific programs associated with the development of rocketry for the exploration and mastering of space.

Blagonravov became involved in the problems of rocket research during the late 1940s and early 1950s, when vast programs were initiated in this area of scientific development. Being a broad minded scientist of great learning, Blagonravov was among those eminent representatives of the scientific community who believed that rocket engineering could be successfully employed to serve peaceful purposes for the sake of science and practice, a daring idea for those times. Blagonravov suggested utilizing rockets for the purposes of studying complex physical phenomena in near-Earth space.

As an expert in the area of ballistics, and closely acquainted with rocket engineering, Blagonravov was entrusted to administer the joint activities related to the employment of vertically launched rockets for the purpose of scientific research. The presidium of the U.S.S.R. Academy of Science established a commission for

* Presented at the Eighteenth History Symposium of the International Academy of Astronautics, Lausanne, Switerland, 1984.

† National Committee for the History of Science and Technology, U.S.S.R. Academy of Sciences, Moscow, U.S.S.R.

the exploration of the upper atmosphere and nominated Blagonravov to chair the commission.

Proceeding from his belief that the success of exploration efforts were largely dependent upon the quality and engineering perfection of the rockets, Blagonravov, with a group of experts, detailed the specifications for the design and manufacture of a variety of rocket types required for high altitude exploration. Owing to fruitful support from S. I. Vavilov, President of the U.S.S.R. Academy of Science, and the dramatic efforts made by these scientists and design engineers headed by S. P. Korolev, various modifications of the high altitude rockets were produced for atmospheric exploration. These rockets were known as "academic" rockets since they were based on the specifications placed by the Academy of Science.

The commission, headed by Blagonravov, was concerned with creating the programs and techniques for various types of exploration, and they guided the development of the rocket's scientific instrumentation. The initial experiments studied air composition, density, pressure, temperature, direction and velocity in the upper atmosphere, as well as investigating cosmic rays.

Concurrently, they prepared other programs for manned space flight. The academic rockets were adapted for accommodating animals. Such provisions ensured the possibility of studying the impact of a high altitude flight upon a living organism. The first launch of a geophysical rocket carrying research instrumentation and two animals came in 1951, six years prior to the start of the first manned satellite. Blagonravov, S. P. Korolev and V. I. Vazdovsky administered the preparation and execution of this major scientific experiment. The rocket climbed to an altitude of 101 km which at that time was a very high altitude. Blagonravov later published his impressions of this very interesting event in the history of space exploration [1].

Following the successful launching of the geophysical rocket with animals on board, the exploration of the upper atmosphere was expanded. Enriched with the experience gained, scientists and experts started to pose new tasks in the course of the launch preparation periods, expanding the program of explorations, followed by the improvement of rockets and research instrumentation. Data on the composition and density of air, pressure, temperature and the speed of winds obtained in the course of firing the first geophysical and meteorological rockets was used for various scientific and practical purposes by the institutes of the Academy of Science, the Central Aerological Observatory and the U.S.S.R. Center for Hydrometeorology. A large body of important data was obtained on the composition and primary flow as well as the variations of intensity of cosmic radiation.

As years passed, the academic rockets ascended to ever increasing altitudes. Their initial ceiling of 200 km was soon increased to 475 km and finally reached the altitude of 500 km. The program of research work directed by Blagonravov's commission was continuously expanding. New data was obtained on the structure of the ionosphere, density of meteorite flows and the intensity of solar radiation. During the period 1951-1957, the physiological condition of living organisms on these flights (research was primarily conducted on dogs) was rigorously investigated. The scientists discovered that time spent in the upper atmosphere did not result in any

appreciable changes in the behavior of the animals or in the state of their major functions. With these results there was no doubt that safe space flight could be ensured. The observations and conclusions from these launches were utilized to prepare for the voyage of a manned space flight [2].

Blagonravov's commission carried out a number of significant experiments from 1957 to 1959 during the International Geophysical Year (IGY) and the Year of International Cooperation in Geophysics (ICG). During this period, research was carried out with the aid of high altitude rockets and the first man-made Earth satellite. All in all, 175 high altitude rockets were fired in the course of the IGY-ICG programs in the U.S.S.R. Launchings were made from Franz Josef Land, in the medium latitudes of the U.S.S.R., from aboard ships near the South Pole Observatory, Mirny, in the equatorial latitudes and in the north waters of the Pacific. A vast amount of data was gathered on the stratification of temperature and density of the atmosphere, their variation over time and latitude, temperature fields in the stratosphere, the brightness of the sky at various heights and similar information. Long term rocket flights at altitudes up to 450 km and higher enabled a number of biological investigations to be carried out: estimating the influence of atmospheric conditions on the rocket flight as well as the effect of upper atmospheric conditions on the vital functions of living organisms [3].

The accomplishments of the high altitude geophysical, meteorological and biological research program enabled the U.S.S.R. by the early 1960s (prior to the commencement of the mass launching of manned satellites) to obtain not only rich and versatile information, but also to arrive at a number of novel scientific conclusions. We should emphasize the peaceful orientation of these high altitude research studies. The cosmic program in the U.S.S.R. during the 1960s and 1970s was built on the earlier work of the designs of the carrier rocket program and the extensive research obtained on the upper atmosphere by high altitude rockets.

The major contributions made by academician A. A. Blagonravov to the development of high altitude atmospheric research won him well deserved recognition. In 1960, he was conferred with the highest Soviet award in science—the Lenin Prize. For his services in the exploration of space, Blagonravov won membership in the International Academy of Astronautics in 1964.

Having accomplished its goals, the Commission completed its activity. High altitude rockets became a well mastered tool in scientific research. Their experimental mission was gradually taken over by commercial weather forecasting. The Institutes of the Academy of Science became concerned with the preparation and execution of space research, of the deployment of artificial Earth satellites and automatic interplanetary space stations.

Bearing in mind the wide expansion of space exploration with the aid of MMS and AISS, which took place in the early 1960s, the Presidium of the Academy of Science established in 1962 a special purpose commission on research and utilization of space. A. A. Blagonravov became Chairman of the commission. From that time on, this "cosmic" research became the most important part of his work for almost fifteen years.

The spread of scientific experiments to the study of interplanetary space and the necessity of international cooperation, resulted in the establishment of the International Council of Scientific Unions of the Special Committee on Space Research—COSPAR. When COSPAR was founded in 1958, A. A. Blagonravov became the Soviet Union's representative, and a member of the executive committee, of this international organization. He later became Vice President of COSPAR in 1959.

Investigations carried out by artificial Earth satellites and automated interplanetary space stations have provided significant results in the fields of geo and solar physics, meteorology, communications and the like. Of no less importance were experiments relating to the preparation of manned space flight. The data and research obtained were regularly presented to the sessions of COSPAR, as well as to various international symposia of which Blagonravov was a permanent participant as head of multiple Soviet delegations.

Speaking before a session of the U.S.S.R. Academy of Science with the report "Preparation of the Flight of Man into Space," Blagonravov gave a detailed analysis of all of the preparatory activities, the most important of which concerned the safety of space voyages. He analyzed the preparation, execution and results of launchings made in 1960-1961 of the first Soviet heavy satellite vehicles and automated interplanetary space stations [5]. He paid particular attention to the difficulties, problems and tasks associated with correcting the problems of trajectories of artificial satellites, maneuvering, retardation of orbit and landing. These problems were solved in the preparation and launching of the *Vostok 1* and *Vostok 2* which carried the first Soviet cosmonauts, Yu. A. Gagarin, H. S. Titov, A. G. Nikolaev and P. R. Popovich.

The next historical plateau in mastering space was the creation of multiple satellite ships. Soyuz was intended for long term flight maneuvering and docking in orbit. Blagonravov considered a comprehensive scientific investigation performed with the aid of the program, as well as the requirements which enabled future Soyuz long term manned space stations.

For his active involvement in international studies in the mastery of space, Blagonravov was appointed in 1960 as the deputy representative for the Soviet Union on the Committee on Peaceful Space Utilization under UNO. Concurrently, he served as the Soviet representative on the Scientific Engineering Subcommittee. As a participant in their sessions, he was concerned with solving the multiple problems in science and technology relating to various countries' mastery of space. These problems increasingly concerned the scientific community. Several agreements signed between the U.S.S.R. and the United States on the use of Earth satellite vehicles for peaceful purposes were put into effect by Blagonravov's active participation [7].

In 1962, during the first meeting between scientists from the U.S.S.R. Academy of Science and NASA in Geneva, Blagonravov participated in, and headed, a number of Soviet delegations. He contributed to the development and expansion of joint research projects carried out by scientists of the two countries. Blagonravov

stated in 1964, "We should consider as rather positive those steps taken by the scientists of the two countries, expressing satisfaction with the exchange of information now in progress and hoping that further strengthening of contacts in the field of science will contribute to more efficient and faster mastering of the mysteries of space" [8].

The Soviet-American talks resulted in the signing of a treaty on the preparation of a joint scientific study, "Fundamentals of Space Biology and Medicine." This three volume publication, which involved a great number of experts, was completed in 1975 after several years of research. Two identical publications, in Russian and English, were issued in the two countries. This study was "Dedicated to the cherished memory of A. A. Blagonravov and Hugh L. Dryden, who have laid the foundation of the cooperation in the field of space exploration" [9].

Soviet-American cooperation in the 1960s and 1970s resulted in the coordination of various scientific space research programs, regular exchange of meteorological, geophysical and other information in the field of science and technology; stabilization of the operation of a permanent Moscow-Washington communication line; compilation and publication of several joint papers; preparation and accomplishment of the Apollo-Soyuz mission.

Blagonravov's multiple publications on the investigation and mastering of space are also worth mentioning. Starting from the firing of the first Soviet ESV, until the last days of his life, he was a tireless and consistent organizer and proponent of space development. A number of Blagonravov's papers, press interviews, speeches and articles on space rocketry, upper atmosphere research, lunar exploration, planets and solar space have been published in the most reputable Soviet and foreign scientific editions, popular scientific books and collections, newspapers and magazines.

A recognized authority, A. A. Blagonravov became the Chief Editor of *Space Exploration Progress in the U.S.S.R.: the First Space Decade 1957-1967* published in 1968. He served again as the Chief Editor of a similar work on the second decade of space exploration. However, Blagonravov died before this edition was completed. The second volume was then completed under the direction of S. N. Vernov [10].

Blagonravov studied the creative heritage of K. E. Tsiolkovsky. He wrote several articles and studies on Tsiolkovsky and served as the editor of *From the History of Rocket Engineering*. During the 1960s and 1970s, Blagonravov took an active part in scientific readings dedicated to Tsiolkovsky and the problems of mastering space. He edited the collected papers and served on the editorial board which published the proceedings of these readings.

Over many years, Blagonravov was a member of the Academy's Committee of the Soviet National Society of Historians of Natural Science and Engineering. He participated in the committee's sessions and headed the section on the History of Aviation and Cosmonautics. This committee coordinated all the activity in the U.S.S.R. connected with the history of aviation, rockets, space science and engineering. He took an active part in the work of the 13th International Congress on

the History of Science, which took place in Moscow in August 1971. Blagonravov was elected a member of the presidium of the Congress. As a participant in the working sessions and symposia, he and Victor N. Sokolsky, a historian of aviation and space engineering, submitted to the congress a report on historical and technological investigations in this field [11].

One of Blagonravov's last publications on the history and future of mastering space was an article, "Cosmos and Man" written in May 1974, prior to the opening of the 17th session of COSPAR. Although this was a short article, it contained a number of ideas of interest. This optimistic article was characteristic of the 80 year old scientist. "Space exploration nowadays," wrote Blagonravov, "is of truly global significance. Within a comparatively short period of time, satellites, spacecraft and automatic interplanetary space stations have yielded unique scientific materials, which would take many years of persistent labor, if one attempted to gather them through the old techniques, and many of them could not be conceived at all . . . Many fundamental problems of space exploration have been solved, and a reliable foundation has been laid for further developments. And with each year it is becoming clearer that the capabilities uncovered by space exploration are really unlimited . . . ." [12].

I conclude with the words of academician A. A. Blagonravov, taken from "Cosmos to Man": "Really great achievements have a remarkable distinction—the more they become a thing of the past, the more clear is the appearance of what has been achieved, and their impact on the fortunes of mankind is seen more completely." The tremendous achievements in mastering space, the enormous creative activity of Anatole Arkadievich Blagonravov will never be forgotten.

REFERENCES

1. Blagonravov, A. A., Memorable milestones, - *Voenno-istorichesky zhurnal* (Military historical magazine), 1974, No.6, pp.56-63.
2. Blagonravov, A. A., Sounding of the upper atmosphere with the aid of high-altitude rockets, - *Vestnik AN SSSR* (Herald of the U.S.S.R. Academy of Science), 1957, No.6, pp.25-32.
3. Blagonravov, A. A., Kroshkin, M. G., Geophysical research with the aid of rockets and artificial satellites, *Vestnik AN SSSR* (Herald of the U.S.S.R. Academy of Science), 1960, No.7, pp.7-20.
4. Blagonravov, A. A., Preparation of a flight of man into space, - *Vestnik AN SSSR* (Herald of the U.S.S.R. Academy of Science), 1961, No.6, pp.19-30.
5. Blagonravov, A. A., Sounding of space and the upper atmosphere, - *Vestnik AN SSSR* (Herald of the U.S.S.R. Academy of Science), 1963, No.9, pp.9-16
6. Blagonravov, A. A., Zaitsev, Yu., Progress in science and cosmonautics, - *Aviatsia i kosmonavtika* (Aviation and cosmonautics), 1968, No.3, pp.7-10; Blagonravov, A. A., Exploration of space, - *Vestnik AN SSSR* (Herald of the U.S.S.R. Academy of Science), 1970, No.9, pp.86-92.
7. Frolov, K. V., Parkhomenko, A. A., Uskov, M. K., Anatole Arkadievich Blagonravov, M.: Nauka Publishers, 1982, pp.90-91, p.181.
8. Blagonravov, A. A., Cooperation between the U.S.S.R. and the U.S.A. in space exploration, - *Vestnik AN SSSR* (Herald of the U.S.S.R. Academy of Science), 1964, No.10, p.34.

9. Fundamentals of space biology and medicine, V. I. Space as a dwelling medium, M.: Nauka Publishers, 1975, p.1.

10. Space exploration progress in the U.S.S.R. (Second space decade, 1967-1977), M.: Nauka Publishers, 1978.

11. Blagonravov, A. A., Sokolsky, V. N., Major trends in research in the field of aviation and cosmonautics history, - In: From the history of aviation and cosmonautics (Materials of the 13th International Conference on the history of science), M.: Nauka Publishers, 1972, pp.5-16.

12. Blagonravov, A. A., Cosmos to man, - *Nedelya* (Week), 1974, No.22, p.5.