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Chapter 6

A HISTORY OF THE ORGANIZATION AND ACTIVITY OF THE JET PROPULSION RESEARCH INSTITUTE (RNII), 1933-1944*

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The rapid progress of space exploration, initiated in our country 15 years ago with the launching of an artificial Earth satellite, might at first seem a result of successes in rocket engineering achieved immediately after World War II. Attentive study of the history of rocket engineering and cosmonautics in our country, however, convinces us that these successes were to a considerable extent made possible by the work conducted at the Jet Propulsion Research Institute (RNII) in the prewar period of its existence.

Although numerous studies are now available on the development of rocket engineering in RNII, the process of RNII's formation, organization, and initial activity has been barely elucidated. This report attempts to fill an existing gap in the history of Soviet rocket engineering in the 1930s and 1940s.

We should at the outset describe briefly the state of rocket engineering on the eve of creation of the first scientific research center. Organized in 1921, the first rocket laboratory, the Gas Dynamics Laboratory (GDL), successfully conducted experimental studies and tests of solid-propellant rocket engines composed of smokeless powder, and intended for use as artillery projectiles and the jet-assisted takeoff of aircraft. In 1929 GDL began constructing and testing liquid-propellant rocket engines, which established Soviet priority in these areas of rocket engineering.

The second rocket laboratory, the Group for the Study of Jet Propulsion (GIRD), was organized ten years later than the first one. It rapidly expanded research and in 1933 constructed and launched two liquid-propellant rockets, which marked considerable success for the laboratory and the beginning of Soviet missile construction. Simultaneously, in many cities, others actively worked on the principles of the GIRD, which helped train young specialists in this new area of science and technology.

In spite of the successes achieved in both laboratories, however, a shortage of experience was evident. Parallel work was observed, there remained an insufficient

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number of trained specialists, and the production base was weak. Therefore, the two laboratory heads, B.P. Petropavlovskiy (GDL) and S.P. Korolev (GIRD), considered it necessary to merge the two groups into an integrated scientific research organization to pursue a thorough and coordinated study of the problems of reactive motion, both theoretical and experimental. This action, they believed, would make it possible to improve the level of effort and more rapidly obtain reliable and highly efficient rocket engines for rocket vehicles. Both men repeatedly wrote M.N. Tukhachevskiy, who was an avid supporter of the idea of one primary scientific research center of jet propulsion technology. During May 1932, Tukhachevskiy submitted a report to the government urging the organization of a jet propulsion research institute based on GDL and GIRD. It would, he wrote, afford the quickest and most complete resolution of the problem of jet propulsion as regards its practical application . . . ." More-over, he continued, researchers had already made advances in the "development and construction of jet engines that indicate great possibilities of their use as new, powerful implements in different areas of our technology . . . ."[1]

After a detailed study of a number of organizational questions, the proposal obtained government approval. On 21 September 1933, the Revolutionary Military Council issued an order that formed the Jet Propulsion Research Institute (RNII). Then, with a resolution of the council of Trud and Oborony on 31 October 1933, the organization of RNII was assigned to the People's Commissariat of Heavy Industry.

The Jet Propulsion Research Institute became the USSR's first rocket center, and formed the scientific base for further development and practical implementation of the ideas of K.E. Tsiolkovsky and other founders of rocket engineering. From the very beginning, RNII established contact with Tsiolkovsky, who willingly supported the organization and submitted letters and scientific articles for publication in the collected works of RNII. Tsiolkovsky wrote to RNII during February 1934, describing a program of research, consisting of 18 areas, which compressed and enumerated investigations in rocket engineering and cosmonautics.[2] In turn, the RNII collective elected Konstantine Eduardovich Tsiolkovsky an honorary member of the scientific and technical council of the institute.[3]

Most of the research program proposed by Tsiolkovsky was systematically pursued in RNII, except areas 7-9, which involved inventions solicited from other organizations. The investigations proposed in areas 15-18 involved developing life-support systems for space flight in hermetically sealed cabins; these were assigned for research at a later period.

Specifically, the task of RNII involved the "theoretical and practical development reactive motion for the purpose of using rockets in different areas of military technology and the national economy. In particular, the institute:

1. Develops and tests jet engines using solid, liquid, and gaseous propellants.
2. Develops and tests experimental models of rocket and jet systems for terrestrial artillery and for the armament of aircraft.
3. Develops and tests experimental models of flight vehicles equipped with jet engines.

4. Studies projects and inventions involving gas dynamics, which are submitted to the institute from another organization. . . ."[4]

With this assignment, the newly organized institute addressed crucial research tasks on solid-propellant missiles, solid-propellant rockets for jet-assisted takeoff of aircraft, on the development of liquid-propellant rocket engines and air-breathing engines, on ballistic and winged rockets, and on boost-glide vehicles. The program of research of the associated tasks helped to identify experimental design and scientific research of important defense value. This placed great responsibility on the young institute, especially because, at that time, in many of these areas there was little experience, and the institute itself possessed neither a production nor test base. It was first necessary to structure the scientific departments, which would make it possible to successfully solve the assigned missions, and then construct the laboratory and organize production.

In the beginning, the institute was organized in four scientific departments. The first and second departments designed and built solid- and liquid-propellant rocket engines for rocket vehicles. The third department developed rocket units for the jet- assisted takeoff of aircraft and controlled cruise missiles. The fourth department investigated solid-propellants.

Soon the structure of these scientific departments began to change and by 1940 the institute was organized as follows: first department--solid propellant rockets; second department--liquid-propellant rockets; third department--aviation (jet assisted takeoff and cruise missiles); fourth department--liquid-propellant research. In addition, a fifth department investigated liquid propellant rocket engines of two types: nitric acid and kerosene, and oxygen-alcohol. Hence it followed that the research gave special importance to the creation of reliable and highly efficient rocket engines.

The RNII laboratories, design bureaus, and scientific departments occupied facilities with a common effective area of 300 square meters. In these facilities were 104 technical-engineering workers, among them four candidates in technical sciences and 40 engineers. Five experimental stations and six special test stands were constructed for conducting experimental investigations on rocket engines, each equipped with its own workshops. Five of the workshops of the institute had available an effective area of 1300 square meters and a staff of approximately 160 workers. Thus, in 1940, RNII occupied 1600 square meters of effective work area and employed more than 260 people.

Leadership of RNII was accomplished through a scientific and technical council of the institute (NTR), which included all branch chiefs and a number of leading colleagues. At the NTR meetings, council members discussed the current and long-range plans of research, and the coordination of activity of the subdivisions of the institute. Frequently, well-known scholars occupied with related research were invited to attend the NTS meetings. Among them numbered Professors B.S. Stechkin, V.P. Vetchinkin, and D.A. Venttsel, et al. Furthermore, the scientific and technical council examined plans to publish the theoretical works of institute members in special collections. As a result, in ten years, 19 collections of "Jet Propulsion" and

"Rocket Engineering" monographs were printed in 12 works, besides several hundred scientific reports on specific investigations and experiments, all publications whose value has withstood the test of time.[5]

Having examined the internal activity of RNII, one should also recognize that between 1933-1944 the staff of the institute made substantial contributions to the development of rocket science and technology and the defense of the Soviet Union.

1. Between 1934 and 1938 RNII finished the designs of two sizes of solid-propellant rocket projectiles for aviation armament, both "air-to-air" and "air-to-surface," with launchers appropriate for them. Soviet aircraft armed with these rocket weapons were successfully tested for the first time in 1939, under field conditions, in the area of the Khalkhin-Gol river. the United States of America and England adopted rockets for aircraft armament in 1942, while Germany adopted them only in 1943.[6]

2. Between 1938 and 1941 RNII designed, constructed, and provided for Soviet armament multicharged "mortars" -- launchers on trucks, called "Katyusha rocket launchers." The "Katyusha rocket launchers" sharply raised the effectiveness of barrage rocket weapons and they became the basis of rocket artillery in the war of 1941-1945. These Soviet multicharged, self-propelled launchers are widely acknowledged to be the best fielded during the Second World War. The use of such barrage rocket installations was borrowed in the course of war, first by the German, and then by the American and English armies.[7]

3. In 1933-1934 RNII completed tests on jet-assisted takeoff of heavy aircraft, rocket units which were subsequently introduced into the Air Force with corresponding climb-assisting units, all of them based on solid-propellant rocket engines. These advances were first introduced in the USSR.

4. RNII developed several experimental liquid-propellant rocket engines of the ORM type, which burned nitric acid and kerosene, and also several ZhRD types which worked on oxygen-alcohol. The RNII liquid-propellant rocket engines developed between 1934 and 1940 significantly advanced Soviet rocket engine construction, which made it possible to construct ZhRD engines for ballistic missiles, and then for the boost-glide vehicle and rocket aircraft.

5. RNII constructed and tested several experimental and ballistic missiles of the "07" type for the "All-Union Aviation Scientific, Engineering, and Technical Society (1932-1941)," and the 521 and 604 (the latter with a range up to 20 km), and also several experimental aircraft cruise missiles with gyro-rudder controls, which RNII supplied with automatic takeoff and flight controls. The construction of ballistic missiles and gyro systems for control, which RNII built for the cruise missiles, provided the experience needed for further development of Soviet rockets of the ZUR type.

6. RNII built the boost-glide vehicle RP-318, powered by a liquid-propellant rocket engine designed by S.P. Korolev, a ZhRD type that burned nitric acid-kerosene. In this vehicle, on 28 February 1940, the pilot V.P. Fedorov completed the USSR's first flight of a boost-glide vehicle, reaching an altitude of 2600 m., in this case speed increased from 80 to 120 km/h over a distance of 300 meters.

7. RNII built a special aircraft, BI-I, designed by V.F. Bolkhovitinov, that featured a ZhRD rocket engine. The BI-I pilot, G. Ya. Bakhchivvandzhi, on 15 May 1942, conducted the USSR's first flight of a rocket-powered aircraft with normal takeoff from the ground, and attained a maximum speed of about 800 km/h.

8. RNII constructed and equipped a laboratory-experimental base for the testing of rocket engines and engine installations, and developed procedures for their testing.

9. RNII trained cadres of qualified rocket specialists; namely, mechanics and testers, engineers and designers, scientists and experimenters, and, finally, leading specialists, those who headed and organized projects, whose efforts led the way and set the direction of contemporary rocket and space technology in our country.

Unquestionably, the Soviet rocket organizations of the 1920s and 1930s helped pave the way to the opening of the Space Age in 1957, and left an indelible stamp on the course of the development of rocket engineering and cosmonautics. But the research pursued at the Jet Propulsion Research Institute led the development of rocket science and technology in the 1930s and the 1940s, and made possible the swift advances that transpired in the 1950s.

Considering RNII's important contributions to Soviet missile construction, the USSR Academy of Sciences named a chain of craters on the reverse side of the Moon, with a length of 540 km, "RNII."

REFERENCES

1. TsGASA. f. 33988, pub. 3, No 232, 1. 129-131.
2. Archive of AN USSR, f. 555, pub. 1, d. 95.
3. Archive of AN USSR, f. 555 pub. 3, d. 108, 1.3.
4. Indentation is borrowed from the TsGASA and appears in book, the *First Launching*, by Yu. A. Pobedonostsev and K.M. Kuznetsov, a publication of SOSAAF (All-Union Voluntary Society for Assistance to the Army, Air Force, and Navy), 1972, p 25.
5. Ye. S. Shchetinkov. *Main Scientific-Technical Trends of RNII During the Period from 1933-1942*. Report of 1968, p. 2.
6. Yu. A. Pobedonostsev and K.M. Kuznetsov. *From the History of the Development of Soviet Combat Solid-propellant Rockets*. Manuscript of 1967, p. 68.
7. Yu. A. Pobedonostsev and K.M. Kuznetsov. *From the History of the Development of Soviet combat Solid-propellant Rockets*. Manuscript of 1967, pp. 109-110.