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## **Chapter 9**

# **The Industrial Space Organization in the USSR from 1946 to 1991<sup>\*</sup>**

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### **Introduction**

The space sector in the USSR was a part of the military-industrial complex (OPK). In 1933, the first institute on rockets, the RNII, belonged to the heavy industry ministry (NKTP). In 1936, this ministry included a glavka (main directorate) for defense industry (guns, tanks, weapons, and optics), for ammunitions (cartridges, shell, powder, and explosives), for the aircraft industry (airplanes, engines, et cetera) and for the chemical industry. On 22 August 1937, the NKTP gave birth to the machines ministry (NK Mach), which, on 5 February 1939, was divided into Heavy machines (NKTM), Middle machines (NKSM), and General machines (NKOM). On 11 September 1941, the Tanks ministry was formed from elements of NKTM and NKSM, and NKOM became the Mortars ministry (Katyusha) on 26 November of that year.

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<sup>†</sup> Air & Cosmos, Paris, France. I would like to thank my friends, Jacob Terweij and Victor Nikolaiev, for their help.



**Figure 9–1:** Heroes of socialist work in 1961: first row, F.R. Kozlov, Khrouchtchev, Keldysh, Brejnev. Second row, Oustinov, Roudnev, Geogradze, Kalmykov. Credit: courtesy of the author.

## Defense Industry

The defense industry got its own ministry (NKOP) on 8 December 1936. It was headed first by M.D. Roukhimovitch, then M.M. Kaganovitch. On 11 January 1939, it gave birth to four ministries: weapons (NKV), ammunitions (NKB), the aircraft industry (NKAP), and the ship industry (NKSP). Their respective ministers were B.L. Vannikov (followed by D.F. Oustinov from 1941–1957), I.P. Sergueiev (followed by P.N. Goremykine from 1941–1942, and B.L. Vannikov from 1942–1946), M.M. Kaganovitch (then A.I. Chakhourine from 1940–1946, then M.V. Khrounitchev from 1946–1953), and I.F. Tevossian (then I.I. Nossenکو from 1940–1946, then A.A. Goregliad from 1946–1950). During World War II, Katyusha missiles were produced in great series by the mortars and ammunitions ministries (ministers P.I. Parchine and P.N. Goremykine). The rockets were produced by the Electromechanic Plant named for Vladimir Ilitch of Moscow (factory No. 70) and the launch systems by the Kompessor Plant of Moscow (evacuated in Tcheliabinsk in 1941). Beginning in May 1945, engineering teams from all the ministries were sent to Germany to study the trophies of war (nuclear, rockets, aircraft, radars, guidance systems, et cetera).

## **The 13 May 1946 Decree**

This decree set the basis of the rocket industry in the USSR. It included liquid rockets as part of the weapons ministry, solid propellant rockets as part of the agricultural machines ministry (formerly the ammunitions ministry), and the winged missiles became part of the aircraft industry. Liquid propellant were provided by the chemical industry, solid propellant and detonators by the agricultural machines industry, launch systems by the machines and instrumentation ministry (formerly the mortars ministry), guidance systems by the electric industry ministry, gyroscopes by the ship industry ministry, and liquid engines, aerodynamic studies, and flight by the aircraft industry ministry.

At Gosplan, Section No. 2 for rockets, headed by G.N. Pachkov, was linked to vice president P.I. Kirpichnikov. At the defense ministry, rockets were entrusted to the fourth directory of GAU and to a new directory created inside the weapons directory of the Navy. The GAU created the NII-4 in Bolchevo (part of the Artillery Sciences Academy from 1946 to 1953). The Navy created the NII-4 on 1 December 1948 in Leningrad (which became the NII-28 in 1965). The brigade BON was formed from a Katyusha unit and the launching polygon was established in Kapustin Yar.

Other glavkas were formed in the Weapons Ministry (seventh glavka), the Agricultural Machines, and the Communications Means industry, whereas simple directories were created in the Ship Industry Ministry, the Machines and Instrumentation Ministry, and the Chemical Industry Ministry.

On 18 October 1947, during the first launch of a V-2 in Kapustin Yar, deputy ministers in charge of rockets were S.I. Vetochnik at MOP, S.N. Chichkine at MAP, N.I. Vorontsov at the Communications Means Industry, V.P. Terentiev at the Ship Industry, N.I. Kotchnov at the Machines and Instrumentation Ministry, and M.K. Soukhov of the glavka for the Oxygen Industry. The industrial organizations were NII-88 (S.P. Korolev), OKB-456 (V.P. Glouchko), NII-885 (M.S. Riazansky and N.A. Piliougine), NII-10 (V.I. Kouznetsov), NII-20 (G.I. Degtiarenko), GSKB (V.P. Barmine), NII-627 (A.G. Iossifian), NII-686 (V.A. Okounev), NII-137 (M.I. Likhetsky), et cetera.

## **Special Committee No. 1**

To develop the atomic bomb, a special committee was created on 20 August 1945 in the State Committee for defense (GKO), which was later dissolved on 4 September 1945. It was headed by L.P. Beria, deputy of the ministry council (CM), and included G.M. Malenkov (deputy of CM), N.A. Voznessensky (presi-

dent of Gosplan), A.P. Zaveniagine (interior ministry), V.A. Makhnev (deputy of Beria), B.L. Vannikov (ammunitions ministry), M.G. Pervoukhine (chemical industry ministry), as well as scientists, such as I.V. Kourtchakov (LIPAN) and P.L. Kapitza (IFPAN). This committee No. 1 had a glavka in the CM (PGU), which was headed by B.L. Vannikov. A.P. Zaveniagine was the first deputy. Deputies were N.A. Borissov (deputy of Gosplan), P.Ya. Mechik (head of security), P.Ya. Antropov (non iron metallurgy), and A.G. Kassatkine (deputy of chemical industry). On 30 August, V.S. Emelianov (deputy of metallurgy industry ministry), E.P. Slavsky (deputy of the non iron metallurgy ministry), and A.N. Komarovsky (chief of GlavPromStroi of NKVD) were added in the PGU.

On 27 December 1949, a second glavka (VGU) was formed to take care of the supply of uranium and plutonium. It was headed by P.Ya. Antropov who, during the integration of VGU into the new ministry of middle machines (MSM) in June 1953, became the geology minister until 1962.



**Figure 9–2:** Delivery of medals for the flight of Gagarin on 24 June 1961. In center, Korolev, Brejnev, Oustinov, and Geogradze. Credit: courtesy of the author.

## Special Committee No. 2

On 13 May 1946, the special committee on rockets was created in the CM. It was headed by G.M. Malenkov (deputy of CM), and included D.F. Oustinov (weapons ministry), I.G. Zoubovitch (first deputy of ElektroProm ministry), N.D. Yakovlev (chief of GAU of Defense ministry), P.I. Kirpichnikov (deputy president of Gosplan), A.I. Berg (deputy of the radars council), P.N. Goremykine (agricultural machines ministry), I.A. Serov (deputy interior ministry) and N.E. Nossovsky (chief of the first glavka of the weapons ministry).



**Figure 9-3:** First row: V.P. Finogenov, unknown, K.N. Roudnev, V.P. Glouchko, V.I. Kouznetsov, D.F. Outinov, L.I. Brějnev, M.K. Yangel, M.P. Geogradze, N.A. Piliougine, unknown. Second row: S.A. Zverev, V.N. Tretiakov, G.N. Pachkov, G.A. Tiouline, unknown, unknown, unknown, L.V. Smirnov, unknown, unknown. Third row: M.I. Galas, A.G. Mrykine, G.P. Kazansky, A.I. Chokine, A.I. Semenov, unknown, B.E. Boutoma, unknown, E.N. Rabinovitch, V.M. Riabikov, I.D. Serbine, V.D. Kalmykov. Credit: courtesy of the author.

On 10 March 1947, decree No. 1454-388ss changed the special committee into committee No. 2, headed by N.A. Boulganine, deputy of CM and Defense ministry. On 15 May 1949 committee No. 2 was closed and the management of rocket activity was made by the defense industry ministry D.F. Oustinov.

On 26 June 1953, the middle machines ministry was created with the GlavSpetzMach, headed by V.M. Riabikov (then S.M. Vladimirsky in 1954/55), in charge of ground-to-air missiles, cruise missiles, and long range missiles.

In February 1955, Boulganine took direction of CM. On 14 April 1955, decree No. 720-435 created a special committee for the armament of the Army and Navy. This committee, headed by V.M. Riabikov, included the GlavSpetzMach, GlavSpetzMontaj and the TransMach directorate. The staff included G.A. Titov (first deputy), A.K. Repine, A.N. Choukine (scientific and technical committee), G.N. Pachkov, V.V. Iliouviev, P.I. Kalinouchkine, and B.A. Kiassov. The committee was in charge of the R-7 (Korolev), Bouria (Lavotchkine), Bourane (Miassichtchev), K-20 (Mikoyan), S-25 Berkout (Raspletine and La-

votchkine), S-50, and S-75 (Raspletine and Grouchine). Decree No. 378 in February 1957 included radar as part of the committee's functions.

The same decree created a first deputy for rockets in four ministries: S.I. Vetotchkine in the defense industry, S.M. Lechenko in the aviation industry, D.G. Diatlov in general machines, and S.M. Vladimirsky in the radio industry. Vetotchkine had been chief of the seventh glavka from 1946–1949, deputy minister from 1949–1951, the first deputy of the TGU from 1951–1953, then deputy chief of GlavSpetzMach from 1953–1955. He served as first deputy for rockets until 1958, and then as first deputy of the VPK from 1958–1966. Lechenko, on his part, had been director of Plants No. 23 (ZIKh) and 82 (TMZ) from 1946–1954, then chief of the sixth glavka in the aviation industry ministry. He served as deputy for rockets until 1957, then as first deputy of the ministry from 1957–1963, and followed that as chief of the Aeronautical Technology Institute (NIAT) from 1964–1974. D.G. Diatlov served as chief of NII-1 from 1947–1950, chief of the sixth glavka of the Agricultural Machines Ministry from 1952–1953, chief of the technical directorate of the Defense Industry Ministry from 1953–1954, and chief of NII-24 from 1954–1955. He was the first deputy until 1956, and then the director of NII-642 from 1956–1957. Finally, Vladimirsky served as director of Plant No. 703 (radars), director of NII-108 from 1946–1947, chief of the sixth glavka of the Communications Means Industry from 1947–1949, deputy minister from 1949–1952, assistant to Beria in the Special Committee from 1952–1953, main engineer, then chief of KB-1 from 1953–1954, and chief of GlavSpetzMach from 1954–1955. He was first deputy until 1957, then the deputy of the Radio Industry Ministry until 1968.

### **Special Committee No. 3**

In June 1946, Special Committee No. 3 on radars was created in the CM. It was formed on the basis of the radars council of the GKO, which had been created on 4 July 1943. This council, headed by G.M. Malenkov, included A.I. Berg (deputy), A.A. Tourtchaline (secretary), You.B. Kobzarev (science), A.I. Chokine (industry), G.A. Ouger (military), and V.M. Kalinine (information). At the same time, the NII-108 (TsNIRTI) and NII-160 (Istok), as well as the PKB-170 under N.L. Popov, were created. Moreover, A.N. Choukine took the direction of the scientific and technical committee (NTK). The council had been in Germany to recover German technology on radars in 1945–1946. In June 1946, Committee No. 3 was headed by M.Z. Sabourov. His deputies were A.I. Chokine and A.N. Choukine. Committee No. 3 became a State Committee from May 1947 to 12 October 1949.



On 9 August 1950, the decree about the S-25 Berkout anti-aircraft missile program was entrusted to the PGU, headed at that time by B.L. Vannikov. But the PGU did not succeed in parallel nuclear and radar activities. So, on 3 February 1951, the third glavka (TGU), headed by V.M. Riabikov, was created in the CM. The staff included S.I. Vetotchkine (first deputy), V.D. Kalmykov (main engineer), and A.N. Choukine (scientific director).

On 26 June 1953, the Middle Machines Ministry was created on the basis of PGU, VGU (nuclear), and TGU, which became GlavSpetzMach. The minister was V.A. Malychev and the first deputy B.L. Vannikov. Others deputies were A.P. Zaveniagine for nuclear and V.M. Riabikov for ground-to-air missiles, cruise missiles, and long range missiles.

In March 1954, V.M. Riabikov took over as head of GlavSpetzMontaj, which deployed the Berkout system around Moscow (it was declared operational in May 1955). The GlavSpetzMach was then entrusted to S.M. Vladimirsky.

In February 1955, Malenkov took many others with him in his disgrace (in particular, Malychev). Radar activities were then transferred to the Defense Industry Ministry (MOP) and then to the Aircraft Industry Ministry (MAP) from 1958–1959. Finally, the Radio Industry Ministry (MRP) took over in 1960. Deputy minister V.A. Charchavine, in charge of anti-aircraft defense, passed through all of these ministries.



Группа сотрудников первого специального космического управления ГКОТ, переведенных в Третье главное управление Минобщеша. Слева направо: сидят – И.П. Румянцев, Е.В. Богомолов, А.И. Базарный, В.Л. Цыбин, Н.А. Гаврилин; стоят – А.В. Матвеев, Ю.Г. Милов, В.А. Анфилов, В.Н. Ходаков, Л.Н. Чарушников, В.И. Козырев

**Figure 9–4:** Third Glavka MGOT. Credit: courtesy of the author.

## **The Military–Industrial Committee (VPK) of CM**

In 1957, the USSR launched the first ICBM on 15 May, the first artificial satellite of Earth, *Sputnik 1*, on 4 October and the first animal in space, Laika, on 3 November. The state commission was headed by V.M. Riabikov.

Then, on 6 December, the special committee for the armament of the Army and Navy was transformed into the VPK, headed by then-deputy president of the CM, D.F. Oustinov.

The VPK coordinated the works of nine ministries linked to defense industry. It included the ministries of the defense industry (MV, MOP, GKOT), created in 1936; the aircraft industry (MAP, GKAT), created in 1939, the ship industry (MSP), also in 1939; the Machines Ministry (MM), which existed from 1937–1939, 1953–1954, from 1956–1957, and from 1968–1989; the Communications Means Industry (MPSS), which existed from 1946–1953, then from 1974–1989; the Middle Machines (MSM,) created in 1953; the Radio Industry (MRP, GKRE), created in 1954; the Electronics Industry (MEP), created in 1961; and General Machines (MOM), created in 1965.

The space sector was first given to MOP. The minister was K.N. Roudnev, then L.V. Smirnov, then S.A. Zverev. The first deputy was G.A. Tiouline from 1963–1965. The space deputies were L.A. Grichine from 1958–1960, S.A. Zverev from 1960–1961, G.A. Tiouline from 1961–1963, B.A. Komissarov from 1963–1965, and G.R. Oudarov from 1958–1965. The concerned directorates were the fourth (satellites), seventh (rockets), and ninth glavka (ground infrastructures). The fourth glavka was headed by I.P. Roumiantsev from 1959–1961, then by A.I. Yakounine from 1961–1965. The deputy was A.A. Evteiev. The sector chiefs were V.A. Anfilatov (No. 3), V.A. Popov (No. 4), You.M. Verein (No. 5), A.V. Gantevitch (No. 6), N.A. Gavriline (No. 7), et cetera. The glavka's engineers were A.I. Bazarny, E.N. Bogomolov, V.I. Kossitsyne, A.V. Matveiev, M.Ya. Martov, You.G. Milov, You.V. Novikov, V.N. Khodakov, V.L. Tsybine, et cetera. The seventh glavka was headed by E.N. Rabinovitch from 1957–1961, B.A. Komissarov from 1961–1963, G.M. Tabakov from 1963–1965. The sector chiefs were N.B. Guerassimov (No. 3), A.A. Nemtchenko (No. 4), V.M. Mechkov (No. 5), et cetera. The ninth glavka was headed by N.A. Krivochein.



**Figure 9–5:** MOM (General Machines Industry) personnel, 1970. Credit: courtesy of the author.

## The General Machines Ministry

On 2 March 1965, MOM was formed to manage rocket and space activities. It was successively headed by Ministers S.A. Afanaseiev from 1965–1983, O.D. Baklanov from 1983–1988, V.Kh. Dogoujiev from 1988–1989, and O.N. Chichkine from 1989–1991. It then became the RKA in 1992, Rosaviacosmos in 1999, and FKA-Roscosmos in 2004. These were all headed by You.N. Koptev from 1992–2004, then by A.N. Perminov.

The first deputies of the Ministry were G.A. Tiouline from 1965–1976, B.V. Balmont from 1976–1980, O.D. Baklanov from 1981–1983, V.N. Konovalov from 1983–1987, V.Kh. Dogoujiev from 1987–1988, O.N. Chichkine from 1988–1989, R.R. Kiriouchine from 1989–1991, V.V. Alaverdov from 1992–2002, then N.F. Moisseiev starting in 2002.

The deputies were N.D. Khokhlov from 1965–1983, A.S. Matrenine from 1984–1991 (ICBM and launchers), G.M. Tabakov from 1965–1981, V.N. Konovalov from 1981–1983, V.Kh. Dogoujiev from 1983–1987 (engines and SLBM); V.Ya. Litvinov from 1965–1973, You.N. Koptev from 1988–1991 (space program); G.R. Oudarov from 1965–1979, S.S. Vanine from 1979–1991 (ground infrastructures); L.I. Goussev from March to December 1965, M.A. Brejnev from 1965–1973, B.V. Balmont from 1973–1976, O.D. Baklanov from 1976–1981, O.N. Chichkine from 1981–1988, E.A. Jelonov from 1988–1989, V.E. Sokolov from 1989–1991 (radio systems, onboard instrumentation and gyroscopes); E.V. Mazour from 1965–1982, V.N. Sochine from 1982–1991 (construction); V.V.

Lobanov (administration); A.I. Dounaiev from 1985–1991 (Glavcosmos); A.E. Chestakov (technical direction); and G.F. Grigorenko (security).

The first glavka, in charge of ICBM and launchers, was headed by P.A. Sysoiev (the former director of KrasMach), then by S.F. Sigaiev, V.N. Konovalov, V.D. Krioutchkov, E.A. Verbine, V.N. Ivanov, and V.A. Andreiev. The deputies were E.N. Rabinovitch, A.V. Matveiev, L.E. Makarov, et cetera. The second glavka, in charge of engines and SLBM, was headed by I.I. Abramov, V.N. Konovalov, N.B. Guerassimov, and then S.F. Sigaiev. Later on, engines were separated out to become the twelfth glavka, headed by P.A. Gortchakov. The third glavka, in charge of the space program, was headed by K.A. Kerimov from 1965–1974, by V.D. Vatchnadze from 1974–1977, by You.N. Koptev from 1977–1988, and then by V.D. Ostroumov from 1989–1991. The fourth glavka, in charge of ground infrastructure (cosmodromes), was headed by P.P. Kotcherov, V.F. Matiachine, A.M. Mokine, and then by You.A. Fomine. The fifth glavka, in charge of guidance systems, was headed by A.P. Zoubov for twenty-five years. The sixth glavka, in charge of gyroscopes, was headed by B.V. Balmont, V.A. Frolov, and then V.V. Bezroutchenkov. The seventh glavka, in charge of ICBM maintenance, was headed by A.S. Matrenine, A.V. Oussenkov, and then V.A. Chouliakovsky. The eighth glavka, responsible for research and development and planning, was headed by K.P. Kolobenzov, B.V. Balmont, A.K. Vanitsky, I.P. Roumiantsev, A.I. Dounaiev, and then by V.F. Gribanov. The ninth glavka, responsible for SLBM maintenance, was headed by S.S. Vanine, then by V.I. Mikerine. The tenth glavka, in charge of radio systems and onboard instrumentation, was headed by O.F. Antoufiev. The eleventh glavka, in charge of Energya-Bourane from 1976 to 1991, was headed by P.N. Potekhine (V.N. Khodakov was in charge for manned and international flights, whereas M.V. Sinelchikov was responsible for Energya-Bourane). The twelfth glavka, in charge of conversion, was headed by S.A. Choumakov. It became glavka No. 11 after the end of Energya-Bourane program, and was then headed by S.I. Younochev. Finally, the thirteenth glavka, for export and commercialization, formed in 1985 (Glavcosmos), was headed by A.I. Dounaiev.

## **The Companies of the Defense Industry**

On 13 May 1946, MOP had created, on the basis of Plant No. 8 in Podlipki, the NII-88. At this time, the plant was headed by A.D. Kallistratov and the design office (OKB) by P.I. Kostine. To study the German trophies, an SKB was formed on 30 November 1945. The main designer was P.I. Kostine, the deputy was Emelianov, who came from NII-13 of MOP. Then, on 9 August 1946, L.R.

Gonor was nominated chief of the institute. The main engineer was You.A. Pobedonostsev, and the SKB chief was K.I. Tritko. The SKB included sections No. 3 (S.P. Korolev, V-2), No. 4 (E.V. Sinelchikov, Wasserfal), No. 5 (S.E. Rachkov, Schmetterling), No. 6 (P.I. Kostine, Taifun) and No. 8 (N.L. Oumansky, engines). On 24 May 1948, A.M. Isaiev took the head of section No. 9 (engines). On 26 April 1950, section No. 3 became the OKB-1 of Korolev and the other sections went into the OKB-2 of Tritko. In June 1951, the activities linked to ground-to-air missiles (SAM) were transferred to MAP. On 20 March 1952, sections No. 6 and No. 9 merged to form the OKB-2 of Isaiev, whereas section No. 8 became the OKB-3 of D.D. Sevrouk. On 13 August 1956, the OKB-1 became autonomous. On 16 January 1959, the OKB-2 became also autonomous. The NII-88 had also an OKB working for artillery: AKB. In August 1949, it was transformed to KB-10 headed by E.V. Tcharnko. In February 1951, he was responsible for experimental installations of the institute, and went on to develop the technology of underwater launches for SLBM in 1955/58. In 1958, the KBTO and KB-10 merged to become the OKB NII.



**Figure 9-6:** Designers and general staff of RVSN at PCUS Congress in 1966: from left to right, first row, third from left V.P. Barmine, fifth from left A.G. Iossifian, seventh from left M.K. Yangel, ninth from left V.I. Kouznetsov, fourth from right V.P. Michine, third from right N.A. Piliougine. Credit: courtesy of the author.

Subsidiary No. 1 of NII-88 at Ostachov (Gorodomlia), which specialized in the building of gyroscopes, was attached to the NII-944 of V.I. Kouznetsov on 2 July 1958. Subsidiary No. 2 at Zagorsk (now Serguei-Possad), where the engine test benches were located, became autonomous on 13 August 1956 (NII-229, then NII KhimMach). The OKB-2 created a subsidiary in SKB-385 in Zlatousk

on 19 November 1956. In 1957, Sevrouk had refused to go in Dniepropetrovsk to open a subsidiary in OKB-586. Therefore, OKB-3 merged with OKB-2 in December 1958. Sevrouk then worked on electronuclear propulsion in OKB-456. On 2 June 1962, his team formed, on the basis of the engine institute of the Academy of Sciences headed by B.S. Stetchkine, the OKB Zarya that he would lead until 1965.

On 16 December 1947, a subsidiary of OKB-1 was created in Zlatousk (Plant No. 66 plus Plant No. 385) for the serial production of rockets, but many difficulties made this production impossible. The main designer of SKB-385 was A.Ya. Cherbakov. In 1955, V.P. Makeiev took his place. He began the development of missiles, such as the R-11, R-11M, R-11FM, et cetera. In 1958, the production of the R-17 missile was transferred to Plant No. 235 in Votkinsk.

On 10 May 1951, Plant No. 586 of Dniepropetrovsk (Ukraine) was selected for the serial production of Korolev's R-1 missile. V.S. Boudnik was named main designer of the plant. The plant also produced the R-2 and the R-5. On 10 April 1954, OKB-586 was created and entrusted to M.K. Yangel (Boudnik was his deputy). He championed the R-12, which flew on 22 June 1957.

On 1 April 1959, it was decided that serial production of the R-7A should be in the Plant No. 1001 in Krasnoïarsk. Shortly thereafter, however, it was decided that this plant would produce the R-9A instead of the R-7A. On 4 June 1959, a group of forty OKB-1 engineers, headed by M.F. Rechetnev, arrived in Krasnoïarsk (Subsidiary No. 2 of OKB-1). But the production of R-9A was cancelled. At the end of 1960, Yangel entrusted to them the production of the R-14. On 23 July 1961, the subsidiary was transformed into OKB-10. They worked together with Subsidiary No. 5 of OKB-456 and the SKB of Plant No. 1001 (now KrasMach). In 1969, the production of the R-14 was transferred to Plant No. 166 in Omsk (now PO Poliot). OKB-10 (now NPO of applied mechanic) has produced more than 1,000 telecommunications satellites.

On 23 July 1959, Sector No. 25 of the OKB-1 of Korolev, headed by D.I. Kozlov, left to go to Plant No. 1 of Kouybishev to produce R-7s. It became Subsidiary No. 3 of OKB-1 from 1960–1967, then the subsidiary of TsKBEM from 1967–1974, and then of TsSKB in 1974. It has produced more than 1,700 Semioroka and about 1,000 Earth observation satellites.

In NII-88, sector No. 20 (measurement techniques) opened its subsidiary at Plant No. 50 in Penza on 28 July 1960 (now NIIFI). On 28 July 1966, it became the NII IT (and then the NPO in 1978). In February 1969, the sector opened a subsidiary in Kharkhov (now NII of radio measurements, headed by G.A. Baranovsky, then A.P. Verechak). In 1976, it opened the Izmeritel Plant in Novopolotsk (directed by V.Ya. Grichounine, then by M.V. Tchourillov).

On 22 May 1973, the Subsidiary Agat was created from Sector No. 7 (headed by A.G. Mrykine from 1965–1973) along with the computing center of MOM. It became autonomous in 1992. It was headed by V.M. Tchebanenko; A.K. Vanitsky from 1976–2002; and then V.V. Alaverdov.

On 20 January 1975, Sector No. 3 became the Institute of Materials (TsNIIMV), which was renamed the NPO Kompozit in 1987. It was headed by N.V. Chiganov, by G.G. Konradi, by You.G. Bouchouiev, by V.N. Kirillov, and finally by S.P. Polovnikov. In 1968, a laboratory of NII TechnoMach was created in Perm. It became the Oural Subsidiary of TsNIIMV from 1975–1995. Then, it became the Oural NII of Composite Materials (UNIIKM). It was headed by V.P. Perminov, then by I.I. Cheglov, and finally by V.N. Konoplev.

The Institute of Machines Technology (NITI-40, NIITM in 1967, now TekhnoMach) of Moscow, created in 1940, started working on rockets in 1946. It was headed by V.K. Tcharsky, V.I. Lazarev, A.I. Milekhine, Ya.V. Koloupaiev, V.A. Issatchenko, and finally V.V. Boulavkine.

The optical instruments are also created and produced by MOP. The institutes concerned are the Vavilov State Optical Institute (GOI), the Optico-Mechanic Society of Leningrad (LOMO), the Zverev Plant in Krasnogorsk, near Moscow (NPO Zenit), the PO Arsenal in Kiev, the BeLOMO in Minsk, the TsKB-589/NPO Geophysica in Moscow, the NPO Astrophysica in Touchino, and others.

The warhead's fuses were developed by the NII-137 in Leningrad and the NII-504 in Moscow. The NII-137, created in 1947, became the NII TotchMach. It was headed by V.A. Kostrov, by V.N. Petrov, then by You.V. Antonov starting in 1993. The NII-504 became the NPP Impulse.

## **The Companies of the Aircraft Industry**

MAP took over the Reaction Institute on 18 February 1944. This institute had been, successively, the RNII of NKTP starting in October 1933; the NII-3 of MOP starting 2 January 1937; the NII-3 of the Ammunitions Ministry starting in January 1939; the GIRT of Kostikov in 1942; the NII RA (jet aviation) of MAP on 18 February 1944; NII-1 on 22 May 1944; the NII of Heat Technics of MOM in March 1965; and finally the Keldysh center in 1992. Subsidiary No. 1 was the OKB-293 of V.F. Bolkhovitinov and became the OKB of M.R. Bisnovat on 7 June 1946.

At NII-1, Sector No. 1 included V.P. Glouchko, A.M. Isaiev, and L.S. Douchkine (all three working on rocket engines), whereas Sector No. 2 included

A.M. Lioulka (turbojets), M.M. Bondariouk (ramjets), and S.G. Rozental (pulso-jets).



**Figure 9–7:** The heads of ministries, design offices, factories, and institutes at the celebration of twenty-five years of KB Youjnoe in April 1979. First row, from left to right, V.G. Sergueiev, unknown, A.G. Iossifian, B.N. Petrov, You.B. Khariton, V.P. Glouchko, V.F. Outkine, N.A. Piliougine, unknown, A.M. Makarov, G.S. Titov, unknown. Credit: courtesy of the author.

In July 1944, the Glouchko group (including Korolev), working in Kazan Charaga, was liberated and entrusted to NII-1. It became, successively, the OKB-456 of MAP on 3 July 1946, of MOP on 7 December 1950, of MOM on 2 March 1965, the KB EnergoMach on 1 January 1967, a subsidiary of NPO Energya on 22 May 1974, and then an autonomous NPO on 19 January 1990. Subsidiary No. 1 was installed in Plant No. 586 of Dnepropetrovsk. Since 1958, other subsidiaries were opened in three aircraft engine Plants (No. 24 in Kouybichev, No. 29 in Omsk, and No. 19 in Perm) and one artillery Plant (No. 1001 in Krasnoïarsk). Finally, the Leningrad Subsidiary was specialized into exotic propellant engines (Fluor, et cetera).

The Isaiev group became Section No. 9 of the SKB of NII-88 on 24 May 1948, then OKB-2 of NII-88 on 26 April 1950; it became autonomous on 16 January 1959, then KB KhimMach in 1974.

The Douchkine group became OKB-1 of MAP on 20 March 1952. At that time it produced rocket engines for aircraft. In 1954, Douchkine's group refused to go in Voronej to open a new OKB for rocket engines, so S.A. Kosberg agreed



to take this task. From 1957–1959, the Douchkine OKB was linked to the OKB-165 under A.M. Lioulka. Then it became autonomous again and developed engines for ground-to-air missiles. In 1967, it was merged with OKB-670 under M.M. Bondariouk (MKB Krasnaya Zvezda in 1973).

The Lioulka group, which created the S-18 turbo-engine, was transferred to Plant No. 165 in March 1946 (it is now the NPO Saturne).

The Bondariouk group became OKB-670 on 1 October 50. In 1967, it merged with the Douchkine group and became the OKB Krasnaya Zvezda. In 1973, this new group merged with a part of OKB-300 and the OKB Zarya to become the MKB Krasnaya Zvezda of MSM. A part of Krasnaya Zvezda went into the MKB Soyouz of Touraievo to continue their work on ramjets.

The Rozental group was quickly closed because, on 19 September 1944, the OKB-51 of V.N. Tchelomei began to develop a copy of the German V-1 called the 10X missile.

To manage rocket propulsion work, MAP created the Eighteenth Glavka on 30 October 1944. It was headed by the first deputy of Minister P.V. Dementiev. But, at the end 1945, MAP asked the NII-1 specialists in Germany to stop their work on the V-2, because they wanted to concentrate on jet airplanes. On 7 June 1946, Plant No. 456 was transferred to Special Glavka No. 14 of the MAP (production of rocket engines).

The NII-1 was a subsidiary of TsIAM from 1948 to 1952. It also gave birth to two other organizations. The first was MOKB Mars. It had been created from laboratories No. 11 and No. 12 (astronavigation system of Bouria missile), which had moved to Plant No. 914 to become a Subsidiary of NII-1 on 9 June 1955. The main designer was R.G. Tchatchikian in 1955/59. Then it became a section of NII-923, a subsidiary of the Electromechanic and Automatic Institute of Moscow (MIEA), then OKB Mars in 1979. The director and main designer was V.L. Moratchevsky from 1960–1974 and from 1979–1983, but in 1974–1979, the director was N.P. Nikitine and the main designer E.P. Popov. A. S. Syrov has been the boss since 1984. The second organization was NII Mach, created in 1958 in Nijny-Selda (Oural). It produced small rocket engines and disposed of big test benches. This NII-1 Subsidiary became autonomous in 1981. It was headed by M.G. Mironiuk, then B.A. Nekrassov starting in 1988. The main designer was E.G. Larine.

MAP was in charge of developing and producing liquid propellant rocket engines. Thus, a design office was opened in Plant No. 154 of Voronej in 1954. This OKB-154 was headed by S.A. Kosberg from 1941–1965, A.D. Konopatov from 1965–1993, then V.S. Ratchouk. Then, in 1960, at the request of Khrouchtchev, other OKBs of aircraft engines began to develop rocket engines.

Thus, the OKB-117 of V.Ya. Klimov, then S.P. Izotov, in Leningrad, developed engines for the second stage of the UR-100 and A-350 rockets. Plant No. 466, Krasnyia Oktiabr of Leningrad, made a serial production of engines for ground-to-air missiles. The OKB was headed by A.S. Mevius. The OKB-165 of A.M. Lioulka (NPO Saturne) in Moscow developed a cryotechnic engine, 11D57, for the N-1 moon rocket. The OKB-276 of N.D. Kouznetsov (NPO Troud) in Kouy-bichev developed engines for the N-1. Those last engines were produced by Plant No. 24. The OKB-300 of A.A. Mikouline, then S.K. Toumansky (AMNTK Soyouz), developed engines for missiles and satellites. Its subsidiary in Touraievo (TMKB Soyouz), headed by V.G. Stepanov, D.D. Guilkevitch, and then G.V. Komissarov, developed ramjets and orientation engines.

In 1960, Khrouchtchev requested the transfer of activities from aviation to space technic. Thus, the OKB-52 of Tchelomei, where Khrouchtchev's son was working, began to work in the space sector. On 19 September 1944, Tchelomei was named main designer of OKB-51 to develop a Russian copy of the V-1, the 10X missile. He produced a series of missiles equipped with pulsojet engines until February 1953. But the OKB was taken over by A.I. Mikoyan, who had developed the Kometa missile with Beria's son. In June 1954, the Tchelomei group opened an SKB in Plant No. 500 of Touchino. There, they developed the naval missile P-5. On 20 August 1955, Tchelomei became the main designer of the OKB-52 of Reoutov (which became TsKBM in 1966, then NPO Mach in 1983). On 6 November 1957, it absorbed the NII-642 of Semenovka, which included four OKB: M.V. Orlov (sea-to-sea missiles), D.V. Svetcharnik (air-to-air missiles), E.N. Kacherininov (ground-to-air missiles), and A.D. Nadiradze (air-to-ground missiles). In 1958, A.D. Nadiradze left the NII-642 to go to NII-1 (MIT) where he became director in 1961. On 3 October 1960, Tchelomei absorbed the OKB-23 (V.M. Miassichtchev had left the OKB to become the chief of TsAGI), the OKB-256 of P.V. Tsybine in Doubna (the last to go to work in Korolev's OKB), and the Khrounitchev Plant, which became Subsidiary No. 1. In 1961, G.I. Arkhangelsky's group moved to NII-642 to develop ground infrastructures for Tchelomei's rockets. On 15 January 1963, it became Subsidiary No. 2 of OKB-52 (then OKB Vympel in 1991), headed by V.M. Barychev from 1963–1985, O.S. Baskakov from 1985–1995, then D.K. Dragoun. The NII-642 Plant became the MMZ Vympel. On 9 June 1960, when S.A. Lavotchkine died, M.M. Pachinine succeeded him as the head of OKB-301 in Khimki. But at this time, the Dal and Bouria programs were stopped, and Tchemolei absorbed the company in December 1962. It became Subsidiary No. 3 of OKB-52 headed by A.I. Eidis. It produced naval missiles until March 1965. Then OKB-301 became an autonomous company of MOM headed by G.N. Babakine. Korolev entrusted to

him the development of interplanetary probes (Moon, Venus, Mars). Plants No. 256 of Droubna and No. 292 of Saratov made serial production of Tchelomei's missiles. After the dismissal of Khrouchtchev, in October 1964, the backlog of Tchelomei was overhauled and reduced, and his empire was dismantled.

Besides that, other companies of MAP were working in the space sector. For example, the SOKB KT of NII AO in Joukovsky made control panels for manned spacecraft. This institute was created in 1983 from a department of LII named Gromov. It was headed by B.M. Abramov starting in 1990. The main designer of SOKB KT was S.G. Darevsky from 1958–1975, then S.A. Borodine. Scaphanders were produced by Plant No. 918 (now Zvezda) of Tomilino, headed by S.M. Alexeiev from 1952–1964, then G.I. Severine. Starting in 1956, the life support systems were done by Plant No. 124 (now NPO Nauka), which was headed by G.I. Voronine from 1939–1985, I.V. Tichine, A.A. Sinitsa, E.S. Neïmark, and then V.A. Chapovalov.

Parachutes were produced by the NII PDS (now NII Parachutostroenie), which was headed by G.M. Voronine from 1946–1950, S.A. Pavlov from 1950–1955, F.D. Tkatchev from 1955–1967, N.A. Lobanov from 1967–1978, O.V. Ryssev, then V.V. Lialine.

## **The Companies of Solid Propellant Rockets**

The solid propellant rockets were under the Ammunitions Ministry from 1942–1946 (headed by B.L. Vannikov), the Agricultural Machines Ministry from January 1946 to March 1953 (headed by P.N. Goremykine from 1951–1953, fired by Stalin; G.M. Popov; and then S.A. Stepanov); the Machines Ministry from March to August 1953 (headed by M.Z. Sabourov); the Defense Industry Ministry from August 1953 to April 1955 (headed by D.F. Oustinov, and his deputy Goremykine); MOM from April 1955 to June 1957 (headed by Goremykine, who was fired by Khrouchtchev in 1957); MOP from June 1957 to 1968 (headed by Oustinov, Roudnev, Smirnov, and Zverev), back under the Machines Ministry from 1968–1989 (headed by V.V. Bakhirev), then again under the Defense Industry Ministry.

In 1945, the Weapons and Ammunitions Ministries worked together on a plan to take charge of captured German rockets. In November, the Weapons Ministry wanted to create the GNII-70 with Glouchko as the main designer, whereas the Ammunitions Ministry wanted to create the NII-88 with Kostine as the main designer. The latter plan prevailed, with the difference being that Korolev was named main designer in August 1946.

In July 1944, Section No. 5 of NII-1, headed by You.A. Pobedonostsev, took over Plant No. 482 in Vladykino, which had just been vacated by V.M. Miassichtchev. It became the Reaction Weapon Institute (NII RV), Subsidiary No. 2 of NII-1, on 27 December 1944. This plant was not used for production, but rather to provide design space. In March 1945, the idea was to create the GSKB-1 in Subsidiary No. 2 of NII-1 for rockets from 20 to 30 km of range (which became NII-1/MIT); the GSKB-2 in Plant No. 67 for missiles up to 100 km of range (which became NII-642/GNPP Vympel); and the GSKB-3 in Plant No. 70, which would receive the V-2 and other German rockets (instead of NII-88). In July 1945, the ministry created the NII-147 in Toula (which became NII Totch-Mach, then GNPP Splav) for the development of MLRS (the successor of Katyusha).

On 13 May 1946, the GSKB-1 and Subsidiary No. 2 of NII-1 became the NII PRS of the Agricultural Machines Ministry, then NII-1 on 1 April 1947, then the Institute of Heat Technic (MIT) in March 1966. It was headed by A.V. Sakhanitsky from 1946–1951, S.Ya. Bodrov from 1951–1961, A.D. Nadiradze from 1961–1987, B.N. Lagoutine in 1987–1997, and then by You.S. Solomonov.

The GSKB-2 moved to Plant No.67, Mastriajart (subway station Semenovka). There, D.L. Tomachevitch, the main designer from 1947–1949, started to work on the air-to-ground antiship German missile Hs-293A. M.V. Orlov, the main designer from 1949–1957, developed the air-to-ground missiles RAMT-1400 Chouka-A and B from 1949–1952. This was the basis for the first missile fired from a ship, the KSCh Chouka (SSN-1 Scrubber), developed in 1953, tested in 1958–1959 and operational in 1959.

In 1948, A.D. Nadiradze's group, which since 1948 had headed the OKB of the Reaction Weapon faculty at the Mechanical Institute of Moscow of the Ammunition Ministry (which became MIFI in 1953) was transferred to KB-2. This group flight tested the German missile RS-1400 Fritz-X in 1950–1951. The group then developed the UB-2000F "Tchaïka," UB-5000F "Condor," UBV-5 and URB-100 guided bombs; the Strij rocket (Taïfun with powder), the MR-1 meteorological rocket, and others, through 1958. The KB-2 merged with Plant No. 67 to become SNII-642 on 15 December 1951, and was later absorbed by OKB-52 of Tchelomei on 6 November 1957. The new main designer was A.I. Eidis.

At the beginning, the other organizations involved in the ministry were the NII-6 in Moscow (now TsNII of Chemistry and Mechanical Engineering), the NII-125 in Liouberetsky (which became NIKhTI, then NPO Soyouz), the NII-137 in Leningrad (now NII TotchMecanik), the NII-504 in Moscow, and Plants No. 15 in Tchapaiev and No. 253 in Mourom.

The NII-6, created in 1894, was headed by I.I. Vernidoub from 1962–1970, by N.N. Afonsky from 1970–1977, by You.I. Krasnochekov from 1977–1999, and then by S.S. Fokine.

The NII-125, created in October 1947, moved to the grounds of Plant No. 512. It was headed by S.G. Frankfurt from 1947–1951, by B.P. Joukov from 1951–1953, by L.A. Smirnov from 1953–1955, by B.P. Joukov from 1955–1988, by Z.P. Pak from 1988–1996, and then by You.I. Milekhine.

In 1959, the NII-9 was created in Brisk (Altaï) for the production of solid propellant. It was headed by T.G. Kornikov in 1959, Ya.F. Savtchenko from 1959–1984, G.V. Sakovitch from 1984–1997, then A.S. Jarkov. This Plant became the NPO Altaï, which produced butylcaoutchouc, used on the RT-2 rocket in 1968.

During the 1960s, the development of ICBMs and SLBMs with solid propellant began in Korolev and Yangel's OKB. For that, Korolev had absorbed the TsNII-58 of V.G. Grabine in Podlipki and asked for the use of TsKB-7 at Plant No. 7 of Leningrad (PO Arsenal) and at the OKB-172 (KB Mach) of Perm to develop rocket stages. The PO Arsenal had been headed by S.V. Kouprianov from 1949–1957, by V.N. Semenov from 1957–1969, by E.K. Ivanov from 1969–1979, by V.G. Petrov from 1979–1997, then by B.I. Poletaiev. The main designer of TsKB-7 was N.P. Antonov from 1949–1953, P.A. Tiourine from 1953–1981, You.F. Valov from 1981–1995, then B.I. Poletaiev. At Perm, the main designer of OKB-172 was M.You. Tsyroulnikov from 1955–1968, L.N. Lavrov from 1968–1994, then M.I. Sokolovsky. The production was assured by the Arsenal and Machinostritel (ex-PZKhO) Plants of Perm. Also in Perm, there were Plants No. 98 (now NPO Kirov) and NII-130 (now the Polymers Materials Institute).

Yangel opened a Youjnoe Subsidiary at the Pavlograd (Ukraine) chemical combinat. For missile boosters, the KB-2 of Plant No. 81 was created in Moscow in 1946 (now MKB Iskra). It was headed by I.I. Kartoukov from 1946–1986, by You.K. Koulikov from 1986–1992, then by M.D. Gramenitsky. Boosters were also developed by the OKB-16 of Kazan starting in 1960. The OKB-16 was headed by P.F. Zoubets from 1954–1983, by I.Kh. Fakhroutdinov from 1983–1996, then by R.Rh. Raimov. Plastic and graphite elements of missiles are produced by TsNII SpetzMach of Khotkovo (near Moscow). Created in 1970, it was headed first by V.D. Protassov, then by V.A. Barynine. In 1947, the Mechanization Institute (KNIIM) of Krasnoarmeïsk near Moscow was created as a test polygon.

## **The Industry of Radiotechnics Means and Guidance Systems**

The organizations of this ministry were the NII-20 (now NIEMI), the NII-885 (now the Space Instrumentation Institute, or RNIKP), the NII-648 (now the Precision Instrumentation Institute, or NIITP), the SKB-567 (which existed only from 1952–1963), the OKB-692 in Kharkov (which became the NPO Elektropribor, then Khartron), the NII-626 of Sverdlovsk (now the NPO Automatika), the NII-695 (now the MNII of radio communications), the NII-33 (now RIVR), the VNII-380 (now VNII Television), and others.

The NII-20 was created in 1946 on the grounds of TsKB-20, associated with Plant No. 465. Sector No. 24 of the institute gave birth to the SB-1 of S.L. Beria on 29 August 1947. The NII-20 was transferred to Kounstevo in 1950 and, in 1958, began developing ground-to-air missiles. It was renamed the Electromechanic Institute (NIEMI) in 1966, and then the NPO Anteï in 1983.

The NII-885 was created on 13 May 1946 on the grounds of Plant No. 192, based on workers from NII-20, which had studied German trophies. The director was N.D. Maximov from 1946–1949, P.V. Kozlov from 1949–1954, G.S. Savelev from 1954–1955, M.S. Riazansky from 1955–1965, L.I. Goussev from 1965–2001, and finally You.M. Ourlichitch. The main designer for radiotechnic systems was M.S. Riazansky, whereas the main designer for guidance systems was N.A. Piliouguine. The radioguidance system was developed by B.M. Konoplev's group in NII-20 from 1946–1950. Then this group was transferred to NII-885 in 1950. In 1955, Konoplev went to NII-695 and was replaced by E.Ya. Bogouslavsky. In April 1963, Piliouguine's team left the institute to form the Automatism and Instrumentation Institute (NII AP). The NII-885 became the Instrumentation Institute (NIIP), then NPO Radiopribor in 1978.

The NII AP developed the majority of guidance systems for rockets and satellites. It was headed by N.A. Piliouguine from 1963–1982, by V.L. Lapyguine from 1982–1998 (You.T. Mironiuk was the general director from 1982–1984), by You.V. Trounov from 1998–2001, and by E.L. Mejiritsky in 2001. In 1961, OKB-2 of Plant No. 118, headed by N.P. Nikitine, which specialized in autopilots for air-to-air missiles, became a subsidiary of NII AP at Plant No. 23. It made guidance systems for the Proton rocket, moon probes, the Block-D stage, and the Angara rocket. It was headed by V.L. Lapyguine from 1978–1982, by V.K. Stoupine from 1982–1999, and then by O.M. Nevsky. Another Subsidiary, created in 1982, became the apparatus factory of Sosensk in the Kalouga region.

On 4 April 1952, Sector No. 4 became the NII-648. It was headed by P.Z. Stas from 1953–1955, by N.I. Belov from 1955–1961, by A.S. Mnatsakanian from 1961–1977, by O.N. Chichkine from 1977–1981, by A.N. Tchourkine from

1981–1987, by N.A. Gorkovoï from 1987–1994, and finally by A.V. Chichanov. In 1955, the sector was associated with Plant No. 830 and absorbed N.A. Viktorov's group of NII-20. The NII-648 developed the Igla rendezvous system for the Soyuz spaceship. The main designers of Igla were E.V. Kandaourov from 1962–1970, A.S. Morgoulev from 1970–1988, then V.V. Souslennikov.

Sector No. 12 became SKB-567 in 1952. It was headed by E.S. Goubenko from 1952–1959, A.V. Beloussov from 1959–1963. After 1963, it return into the RNII KP. It created the deep space communications station (TsDKS) at Evpatoria in the Crimea (NIP-16).

The NII-885 has also gave birth to other organizations: the subsidiary of Krasnoznamensk (Golitsyno-2), created in 1984, became the GNPP Orion in 1992; the Space Instrumentation Institute was created in 1985 (headed by You.N. Korolev); the Institute for Precision Instrument Engineering (NII PP) was created in 1986 (headed by L.F. Pliev), among others.

For guidance systems, a back-up of NII-885 was created at Plant No. 626 in Sverdlovsk on 4 April 1952. Here the guidance systems of R-17 (Scud) were created, as well as Makeiev's SLBM, Temp-S, et cetera. On 14 August 1958, the SKB and the factory merged to become the NII-592. On 6 March 1966, it became the NII Automatika, then an NPO in 1977 (including NII, a factory and a subsidiary in Krasnoïarsk). The company was headed by N.M. Komlev from 1949–1969, by I.T. Skripnitchenko from 1969–1973, by You.T. Mironiuk from 1973–1982, I.I. Velitchko from 1982–1985, by V.V. Tchebotarev from 1985–1996, and then by L.N. Chalimov. The OKB was headed by N.A. Semikhatov from 1952–1992, and then by D.F. Deriougine.

In Ukraine, several companies started production of guidance systems for rockets and satellites. In Kharkov, there were four companies. The OKB-692 (which became KB Elektropribor, then NPO Khartron) was created by B.M. Konolev in April 1959. There, the guidance system of the R-16 rocket was produced, which exploded in October 1960 in Baïkonour and killed Konoplev. He was replaced by V.G. Sergueiev, who headed the company from 1960–1986, then by A.G. Andriouchenko from 1986–1990, and by Ya.E. Aïzenberg from 1990–2002. Today, the president of Khartron is N.I. Vakhno, and the general designer is You.M. Zlatkine. The second company was Plant No. 897 (now PO Kommunar), which began to produce guidance systems for missiles in September 1951 (R-1, R-2, R-5, R-11, and R-7). The director was V.N. Koulikov from 1952–1964, V.E. Sokolov, et cetera. The current general director is A.A. Asmolov. The main designer of SKB-897 (now SKB Polisvit) was A.M. Ginzbourg from 1952–1959 (the R-12 guidance system). The chief of SKB was L.L. Balachov starting in May 1964, then A.G. Andriouchenko from 1983–1986, then

V.M. Svich. The third company is Plant No. 285 (which became the T.G. Chevtchenko instrumentation Plant, then PO Monolit). It started production of R-7 guidance systems in 1957. The director was S.I. Ovrakh, then V.P. Lyssov, then O.D. Baklanov from 1972–1976, You.I. Zagorovsky, A.P. Chpeïer, et cetera. The current general director is V.N. Gritzenko, and the main engineer is N.N. Gora. The OKB was headed by K.K. Zykov, G.A. Baranovsky, B.N. Balzamor, et cetera. The last company is Plant “ElektroApparat” (KhZEA), which was headed by I.S. Streletsky.

In Kiev, there were two companies. The first was the RadioPlant de Kiev (KRZ). Starting in 1958, it produced guidance systems for Yangel’s and Makeiev’s rockets, rendezvous system Kours for the spaceship Soyuz-TM, et cetera. It was headed by V.F. Slavgorodsky from 1958–1961, B.P. Yastrebov from 1961–1970, D.G. Toptchii from 1970–1996, et cetera. The current general director is A.V. Ossadtchii. The OKB was headed by A.N. Poulemetov, I.V. Bortovoï, A.I. Goudimenko from 1967–1988, then by P.I. Podoplelov. The Kiev Pri-bor Plant produced control systems for manned and automatic spaceships. The directors were M.G. Nesterov, I.G. Miagkov, V.D. Tcherenkov, and then O.N. Lebedev.

For radiotechnic systems, the back-up of NII-885 was the OKB of the Energy Institute of Moscow (MEI), part of the High Education Ministry (minVUZ). This OKB, which was equipped with a big station at Lac des Ours near Moscow, was headed by V.A. Kotelnikov from 1947–1954, A.F. Bogomolov from 1954–1988, then by K.A. Pobedonostsev. Many communications systems were developed by NII-695 (MNIIRS). This institute, created in 1927, began specializing in space communications in 1957. It was headed by L.I. Goussev from 1959–1963, by You.S. Bykov from 1963–1970, by A.P. Bilenko from 1970–1990, by AV. Lissin from 1990–2001, then by E.I. Fedorov starting in 2001. This institute has in particular developed the communications system of Rechetnev’s Strela; Mol-nya sitcom transponders (Alpha and Beta of I.D. Bogatchev, Koround and Routcheï of M.R. Kaplanov, et cetera); as well as the payload for Cyclone navigation satellites (N.N. Nesvit, N.A. Potchtar, and I.Kh. Golchteïn).

The NII-108 (now TsNIIRTI), created in 1943, contributed to space programs. It was headed by A.I. Berg in 1943, P.Z. Stas from 1943–1947, A.I. Berg from 1947–1958, P.S. Plechakov from 1959–1964, N.P. Emokhonov from 1964–1968, You.N. Majorov from 1968–1985, You.A. Spiridonov from 1985–1986, and then A.N. Choulounov. Payloads for electronic intelligence (elint) satellites were developed by A.V. Zagoriansky, A.G. Rapoport, M.E. Zaslavsky, V.L. Gretchka, S.F. Rakitine, A.A. Lebed, et cetera. The institute created a subsidiary



in Kalouga in 1957 (KNIRTI), which developed radiogoniometers for Navy elint satellites (US-P).

The TsNII Kometa had taken over as the prime contractor for Poliot/IS anti-satellite satellites and Navy elint satellites US-A and US-P from the Tchelomei OKB in 1964. It then developed early warning satellites (US-KMO) with NPO Lavotchkine. At the beginning, the TsNII was the OKB-41 of NPO Almaz, headed by A.I. Savine starting on 12 October 1960. In 1968, the OKB became a part of MKB Strela, headed by B.V. Boukine (then TsKB Almaz in 1971). In 1973, the TsNII was formed from OKB-41, SKB-39, and Plant Mos-Pribor. It became an NPO in 1979 and in 1985, a TsNPO. The ASATs were stopped in 1982; the satellites US were produced by the Arsenal Plant in Leningrad; and the US-KMO by Lavotchkine. The director and general designer has been V.P. Misnik since 1999. The main designers were K.A. Vlasko-Vlassov, V.G. Khlibko, Ts.G. Litovtchenko, et cetera.

The NII Micropribor of Zelenograd (NPO Elas, then NPP OPTEKS) produced space electronics (telecommunications, onboard computers, et cetera). It was headed by I.N. Boukreiev from 1962–1967, G.Ya. Gouskov from 1967–192002, and lately by V.I. Karaseiev.

The NII-33 of Leningrad, created in 1957, provided time synchronization and radionavigation apparatus (LNIRTI in 1960, then RIRV in 1991). It was headed by N.A. Begoun from 1957–1969, P.P. Dmitriev from 1969–1984, You.G. Goujvoï from 1984–1998, then S.B. Pissarev.

The OKB of the Kalinine Polytechnic Institute of the Ministry of High education in Leningrad, created in December 1961, created automatic control systems for space programs (which became NPO Impulse in 1987). It was headed by T.N. Sokolov from 1961–1979, then B.G. Mikhailov.

The MotoPlant of Ijevsk, created in 1933, produced electronic equipment for space programs starting in 1949. Now the Aksion Company, it was headed by I.S. Stytsenko, V.P. Grodetsky from 1990–1996, then G.I. Koudriavtsev. The RadioPlant of Ijevsk, created in 1958, produced radiotelemetry systems. It was headed by A.I. Urban, then I.N. Valiakhmetov. The RadioPlant of Krasnoïarsk (NPO Radiosviaz) produced the payload for NPO PM Strela satellites. It was headed by A.T. Taranenko. Finally, the Radio Apparatus Plant of Smela, headed by You.A. Bannikov, produced equipment for MOM.

## **The Gyroscope Industry**

Gyroscopes for space programs were developed by the naval industry. The deputy minister in charge of this activity was V.P. Terentiev, then V.N. Tretiakov

from 1958–1962. In 1965, gyroscope work was transferred to MOM (sixth glavka). On 13 May 1946, this work had been entrusted to the SKB-10 of NII-10 (NPO Altaïr) of Leningrad. On 15 September 1955, it became autonomous (NII-944, NII of applied mechanics in 1966, NPO Rotor in 1991, then NII PM Kouznetsov). The OKB was headed by V.I. Kouznetsov from 1946–1989, by I.N. Sapojnikov from 1989–2001, then by A.P. Mezentsev. The NII-10 continued the development of guidance systems for missiles (main designer, M.P. Peteline).

The NPO Granit was created like the OTB on 18 July 1921 in Leningrad. From 1937–1939, it was a subsidiary of NII-20, then it became the NII-49 in 1939. In August 1946, it developed gyroscopes for R-1, R-2, and R-3 rockets. The main designers were S.E. Frolov, V.P. Arefiev, and You.A. Cherbakov. After that, it developed gyroscopes for naval rockets, the R-11FM, R-13, R-21, et cetera, as well as guidance systems for Tchelomei naval missiles. In 1967, it became the Institute of Command Apparatus (NII KP), which was a part of the TsNII of Automatic Apparatus (which became NPO Granit in 1971). This NPO was headed by V.I. Bekaouri from 1921–1937, N.A. Tcharine from 1946–1963, V.V. Pavlov from 1965–1985, I.You. Krivtsov from 1985–1992, then V.P. Nikoltsev. V.P. Arefiev has been the director and main designer of NIIKP since 1967 (he is the creator of the R-3 gyroscopic platform, the R-14 Koround gyroscope, et cetera).

The PO Zvezda of Ostachov was a subsidiary of NII-88 from 1946–1956, where Germans were located from October 1946 to 1953; it then became the NII of autonomous apparatus in 1956, then PO Zvezda. It was headed by B.B. Mokrouchev.

The Plant No. 205 of Saratov (now PO Korpus) has produced gyroscopes since 1948. It was headed by A.K. Vannitsky, You.V. Berestovsky, and then V.V. Bezroutchenko.

The Metallist Plant of Serpoukhov, created in 1943, built gyrolasers and quartz accelerometers for MIEA. It was headed by E.A. Jelonov, then P.V. Jdanov. The chief of the SKB is G.G. Morozov.

The Electromechanic Institute of Miass, created in 1959, was headed by You.A. Bouïniakov, then V.A. Lokotkov. The Electromechanic Plant of Omsk, created in 1959, became Sibérie Systems & Apparatus in 1992, headed by V.I. Zaïtsev, and then by G.K. Ereimeiev since 1996. The Electromechanic Plant of Berdsk, created in 1959, was headed by M.I. Valentinovitch, then R.R. Kiriouchine. The Electromechanic Apparatus Plant of Moscow was headed by V.V. Lapchine. The Apparatus Plant of Tomsk, which produces astrocorrection gyroscopes for naval missiles, is headed by R.R. Kiriouchine.

## Ground Infrastructure Companies

The mortars ministry, which was in charge of Katyusha during World War II, became the Min Mach & Pribor from 1946–1953, the Min Mach from 1953–1954, again the Min Mach & Pribor from 1954–1956, and again the Min Mach from 1956–1957. The minister in charge was P.I. Parchine, and the deputy for ground infrastructures to launch rockets was G.R. Oudarov. This activity was then transferred to MOP from 1958–1965. After 1965 it became a part of MOM.

On 13 May 1946, the GSKB SpetzMach (previously the OKB of Plant No. 733 Kompressor, which designed Katyusha during the war) began the development of launch platforms (R-1, R-2, R-5, R-7, et cetera). In 1967, it became KBOM. It was headed by V.P. Barmine from 1941–1993, then by I.V. Barmine (his son).

The GSKB DorMach began ground infrastructure activity in 1948, developing launch platforms for missiles and rockets. It became the KBTM, which was headed by A.Ya. Gourevitch from 1948–1951, by V.P. Petrov from 1951–1963, by V.N. Soloviev from 1963–1991, then by G.P. Birioukov.

The SPKB of antire equipment, created in 1943, provided a certain amount of equipment for ground infrastructure. It became the KB TKhM. It was headed by D.S. Sokolov, N.A. Alexeiev, S.A. Preobrajensky, L.A. Sirotkine, and N.G. Alexeiev from 1949–1960, V.K. Filippov from 1960–1978, I.V. Brilev from 1978–1990, and then by M.I. Stepanov.

The TsKB TiajMach began as the Podiennik Plant, where a group began to work on space programs on 7 May 1947. This group became an SKB on 26 August 1948, then a TsKB on 25 March 1953, which became autonomous on 7 August 1958. It was headed by L. Semenov from 1947–1948, by N. Leikine from 1948–1953, by N.A. Krivochein from 1954–1976, by B.P. Aksioutine from 1977–1988, and finally by A.A. Leontenkov.

Plant No. 232 in Leningrad (Bolchevik, then Oboukhov) developed launch installations for naval and ground missiles starting in 1945. The directors were V.I. Privalov from 1951–1966, V.M. Velitchko from 1971–1975, A.S. Spitsyne from 1975–1988, then A.F. Vachenko. There, the MATsKB of I.I. Ivanov was divided into four KBs: the main designers were E.G. Roudiak (KB-1), D.E. Brill, B.S. Korobov and A.A. Florensky (KB-4). The MATsKB became the TsKB-34 in 1948, then the KB of special machines KB (KBSM) in 1967. It was headed by A.M. Chakhov, then N.A. Trofimov starting in 1997. The KB-1 was headed by E.G. Roudiak from 1944–1970, then V.S. Stepanov. The KB-4 was headed by A.A. Florensky from 1945–1959, by B.G. Botchkov from 1959–1970, then by A.F. Outkine from 1970–1990. The main designer today is V.G. Dolbenkov.

Plant No. 75 of Yourga was created in 1943 during the evacuation of four factories in the Ourals (the Metallurgic Plant and Bolchevik Plant of Léningrad, the Barricade Plant of Volgograd and the Machines Plant of Novo-Kramatorsk). It produced elements for launch complexes. It was headed by V.N. Esaoulov, then by B.M. Efremenkov since 1997.

The KB Armatur of Kovrov was first the OKB-2 of Plant No. 575, headed by V.A. Degtiarev. It began producing subsystems for space in 1960 (umbilical mast, et cetera). The OKB-575 became the KB Armatur in 1965. It was headed by O.S. Roussakov, A.M. Nikiforenko, and then You.L. Arzoumanov since 1988. Today it is a subsidiary of the Khrounitchev Center.

The NII KhimStroïtelMach (NII KhSM) of Zagorsk was created in 1960. It was headed by M.V. Soukhopalko, G.I. Matysiak, and since 2000 by V.A. Lebiga.

The SOKB of Moscow, created in 1961, became KB Motor. It was headed by V.A. Rojdoov from 1961–1965, by E.F. Stepanov from 1965–1990, and then by A.V. Titov.

The SKB of Wagons Plant, in Kalinine, was created in 1956. It became an OKB in 1966, then the TsKB TranMach of Min TiajMach in 1976. It was headed by L.D. Novikov starting in 1962. The OKB of Novo-Kramatorsk Plant (NKMZ), was headed by V.I. Kapoutinsky. The wagons Plant of the Ourals, in Nijni-Tagil, also provided equipment for space programs, as well as the PKB-12 MontajSpetzStroï ministry, the VNII StroïDorMach, the VNII HidroMach, the VNII KholodMach, et cetera.

## **The Electrotechnic Industry Companies**

The company of A.G. Iossifian, main designer of meteorological and remote sensing satellites, was a part of the Automatization and Machine Building Ministry. Iossifian was named director of Plant No. 627 of Moscow on 24 September 1941. This plant had merged with factory No. 689 on 14 July 1942. Then, on 1 May 1944, Plant No. 627 became NII-627, whereas Plant No. 689 became Experimental Factory No. 1. On 17 August 1959, NII-627 was renamed VNII Electromechanic (VNIIEM). It was headed by A.G. Iossifian from 1940–1974, by N.N. Cheremetievsky from 1974–1991, by V.I. Adasko from 1991–1993, and then by S.A. Stoma.

This institute opened its first subsidiary in Erevan in June 1956. It became the VNII of electric equipment complexes (VNNKE) in 1965. The second subsidiary was opened in Plant No. 690 of Tomsk in September–October 1951 as backup for defense developments. It was headed by V.F. Vorobiev from 1951–

1953, by N.A. Bykov, then by V.I. Nellina. In 1968, the subsidiary became autonomous as the NII Polius of Tomsk (now NPO). The general director is P.V. Goloubev. The third subsidiary was opened on the grounds of a laboratory at the Elektrosila Plant of Leningrad in 1956. The subsidiary of Plessetsk was created in 1968. It was headed by L.M. Poliak from 1968–1969, by V.E. Alksoufiev from 1969–1972, by A.M. Pogorelyi from 1972–1985, then by V.P. Kachpourov. It became the NII Novator in 1972. The subsidiary of Istra (NIIEM), near Moscow, was created in December 1959. In 1960, it began working on electric propulsion for satellites. Then in 1961, Yangel used it to make Omega satellites. Later, five Meteor satellites were developed here, which were launched from 1964–1966. The serial production of Meteor-1 was entrusted to Plant No. 586 of Dnepropetrovsk (twenty-five satellites). But for Meteor-2, the subsidiary took charge of production in 1973. It was headed by K.N. Mkrtchan, V.I. Adasko, S.You. Samarsky, and then A.E. Khokhlovitch.

A certain amount of electric equipment for space programs were provided by Plant No. 686 (now PO Projektor). It was headed by A.M. Goltsman, then V.A. Okounev until 1991.

The VNII handling current sources for the electrotechnic industry ministry (now NPO Kvant of Moscow) provided solar panels for satellites. It was headed by N.S. Lidorenko, You.V. Skokov, A.B. Sloutsky, and finally V.P. Nadorov since 1994. Chemical batteries were provided by the NII of Accumulators (now NPO Istotchnik of Leningrad). It was headed by V.N. Leonov, and You.A. Podalinsky since 2001.

Finally, the NPO Energia of Voronej of the Electrotechnic Industry Ministry provided highly precise electromechanic equipment. It was headed by E.A. .Lodotchnikov, then V.N. Popov.

### **Companies of the Chemical Industry Ministry**

The liquid propellants were studied and qualified by the Applied Chemistry Institute (renamed the NPO GIPKh in 1985). It was headed by V.S. Chpak from 1952–1977, by B.V. Gidasov from 1978–1989, and by G.F. Terechenko since 1989. The cryogenic propellants (liquid oxygen and hydrogen) were provided by the OKB of VNII KiMach (now NPO KriogenMach). This institute was established in Plant No. 120 of Balachikh in 1949. It was headed by V.P. Beliaikov from 1972–1986, then V.E. Kourtachine in 1986. The NII-94 and the Oil Institute worked on propellants for space programs.



**Figure 9–8:** The sector of defense of CC PCUS in 1989: First row, V.A. Efimov, V.A. Kataiev, N.A. Chakov, N.M. Loujine, O.D. Baklanov, O.S. Beliakov, V.V. Kozlov, A.D. Skourikhine, A.G. Makarov, V.L. Zelenkov. Second row, N.K. Lebedev, A.P. Smirnov, V.P. Gavrilov, G.V. Savasteiev, L.N. Chakhov, L.P. Vassiliev, M.K. Redkine, V.F. Lazarev, I.N. Kolokolov, A.S. Ivanov, I.A. Agachkov, You.P. Grigoriev, V.K. Mikhailov, V.I. Drojdine, E.V. Mikhailov, V.I. Evstratov, L.K. Nedelko. Credit: courtesy of the author.

### **Companies of the Middle Machines Ministry**

The fifth glavka, in charge of nuclear weapons was headed by P.M. Zernov from 1953–1955, N.I. Pavlov from 1955–1964, V.I. Alferov from 1964–1965, G.A. Tsyrvkov from 1965–1996, N.P. Volochine from 1996–2004. Warheads were developed by six organizations. The KB-11 (now VNII of experimental physics) was created in Plant No. 550 of Arzamas near Gorky in 1946. It was headed by P.M. Zernov from 1946–1951, A.S. Alexandrov from 1951–1955, B.G. Mourzoukov from 1955–1978, E.A. Negine from 1978–1987, V.A. Belougine from 1987–1998, and finally by R.I. Ilkaiev. The scientific director was You. B. Khariton from 1946–1993. The main designers were E.A. Negine, S.G. Kotchariantz, G.N. Dmitriev, S.N. Voronine, et cetera. The NII-1011 (which became the VNII of instrumentation, then the VNII of technical physics) was created in Snezhinsk, near Tcheliabinsk, in 1955. It was headed by D.E. Vassiliev from 1955–1961, B.N. Lebedev from 1961–1964, G.P. Lominsky from 1964–1988, V.Z. Netchaï from 1988–1996, and E.N. Avrorine since 1996. The scientific director was K.I. Chelkine from 1955–1960, E.I. Zababakhine from 1960–

1984, et cetera. The main designers were A.D. Zakharenkov, B.V. Litvinov, L.F. Klopov, O.N. Tikhane, et cetera. Finally, the KB-25 (now VNII of Automatic) was created in Plant No. 25 in Moscow in May 1954. At first it was Subsidiary No. 1 of KB-11. It was headed by N.L. Doukhov from 1954–1964, N.I. Pavlov from 1964–1987, and since then by You.N. Barmakov. The main designers were N.L. Doukhov, V.A. Zouievsky, A.A. Brisch, et cetera. The three other organizations are NII-50 of Moscow, created in 1962 (now NIIT); the OKB-20 of Mytichi, created in 1963 (now KB ATO); and the KTB of measuring apparatus of Gorky, created in 1966 (now NIIS).

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