REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
9 Jan 97

3. REPORT TYPE AND DATES COVERED

4. TITLE AND SUBTITLE
The Missile Design Bureaux and Soviet Manned Space Policy: 1953-1970

5. FUNDING NUMBERS

6. AUTHOR(S)
William P. Barry

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Merton College

8. PERFORMING ORGANIZATION REPORT NUMBER
96-40D

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
DEPARTMENT OF THE AIR FORCE
AFIT/CIA
2950 P STREET
WPAFB OH 45433-7765

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT
Unlimited

DISTRIBUTION STATEMENT A
Approved for public release
Distribution Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

19970116 019

DTIC QUALITY INSPECTED 2

14. SUBJECT TERMS

15. NUMBER OF PAGES
407

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT

18. SECURITY CLASSIFICATION OF THIS PAGE

19. SECURITY CLASSIFICATION OF ABSTRACT

20. LIMITATION OF ABSTRACT

UNIVERSITY OF OXFORD

THIS is to certify that it appears by the Register of the Ancient House of Congregation of Doctors and Regent Masters of the University of Oxford that

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Merton College

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The Missile Design Bureaux and Soviet
Manned Space Policy 1953-1970

and having satisfied all the conditions prescribed in that respect by the Statutes of the University, was on the twenty-seventh *day of* July 1996 *duly admitted to the degree of*

DOCTOR OF PHILOSOPHY

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The Missile Design Bureaux and Soviet Manned Space Policy: 1953-1970

William P. Barry
Merton College

Thesis submitted in partial fulfilment of the requirements for the degree of D.Phil. in Politics in the Faculty of Social Studies at the University of Oxford
Hilary Term 1996

Abstract

The Soviet manned space programme is one of the most impressive and mysterious legacies of the Soviet Union. Evidence that has come to light since 1989 throws considerable doubt on earlier Western understanding of the Soviet space effort. One of the more puzzling aspects of the new data is the claim that the Chief Designers of several missile design bureaux played a pivotal role in the making of Soviet manned space policy. This claim contradicts much of what was thought to be known about the Soviet space programme, their research and development system, and Soviet politics generally.

This dissertation is an empirical study that seeks to answer four interrelated questions. 1. What major manned space projects did the Soviet Union engage in during the 1960s, and how were these projects authorised? 2. Did the Chief Designers play an influential role in the promotion, selection, approval, and implementation of these projects? 3. What were the overall objectives and purposes of the Soviet manned space programme? 4. What does the example of Soviet space policy tell us about the Soviet political system?

The examination of institutions, individuals, and the policymaking process has led to the following conclusions. The Soviet manned space programme was an extremely limited state undertaking until 1964. Prior to Khrushchev's ouster, the Soviet Union began several manned lunar space programmes designed to upstage the US Apollo moon landing effort. When all of these efforts failed by 1969, Soviet manned space policy was re-directed toward orbital space stations. One Chief Designer, Sergei Pavlovich Korolev, played a central role in establishing the Soviet manned space programme. However, the ability Chief Designers to influence space policy was systematically restricted after 1960. The manned space programme was essentially a political programme. Throughout the 1960s, it was effectively controlled by a handful of top party leaders to achieve their domestic and international political objectives.

The Missile Design Bureaux

and

Soviet Manned Space Policy

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The Missile Design Bureaux and Soviet Manned Space Policy 1953-1970

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Acknowledgements

This dissertation reflects the efforts, influences and help of so many people that to list them all would be impossible. However, I would be remiss if I did not acknowledge the special contributions of a number of people and institutions.

My fellow students, faculty and staff at Oxford University helped in countless ways. Many librarians throughout the University deserve thanks for their gracious and thoughtful assistance. Merton College was especially generous, both in daily support and in a travel grant that made my research in Moscow possible. Dr. Christopher Davis, who served as one of my supervisors for the first two years, was extremely helpful in getting my research off to a good start. Mr. James Sherr, who supervised all of my work at Oxford, deserves special note for his perseverance, patience, dedication to his students, and keen insight.

Research for this dissertation would have been impossible without the selfless and cheerful assistance of many people who have devoted themselves to the study of the Soviet space programme. Long before the many new sources of information became available, these people were ferreting out the truth behind the Soviet space programme. Particular thanks to: Phillip Clark, Rex Hall, Nick Johnson, and Asif Siddiqi.

Numerous people in Moscow and St. Petersburg were both helpful and hospitable. Thanks to the Council on International Educational Exchange, and everyone associated with their Summer Russian for Research Program in St. Petersburg. Particular thanks to Andy Aldrin, for making the introductions that made my trip to Moscow possible. The Institute for the History of Science and Technology of the Russian Academy of Sciences proved invaluable as an institutional "home" in Moscow. Viktor Nikolaevich Sokolskii, head of the Pioneers of Space Technology section of the Institute, was a cheerful and invaluable guide to the mysteries of doing research in Moscow. Thanks also, to: V. M. Karpii, editor of Vozdushnyi Transport; Mikhail I. Rudenko, the US Embassy Air Attache's office; and the people at the ANSER Corporation Moscow Office. I am eternally grateful for the warmth and hospitality of the many Russians that befriended me during my research visits.

The opportunity to pursue doctoral studies at Oxford was made possible by the support of the taxpayers of the United State of America and the help of numerous US Air Force personnel. Thank you for your confidence and assistance.

Finally, and most importantly, thanks to my family. To my parents and brothers, for many years of encouragement. To my son, Philip, for patience with his absentee father. Most of all, to Monica, who has gone so far above and beyond the call of duty that I could never fully express my gratitude and love. I humbly dedicate this work to you.

Notes for the Reader

Weights and Measures

For the sake of consistency and comparison, this dissertation uses metric weights and measures. The metric tonne can be particularly confusing. In this work a tonne is 1,000 kilograms, about 2,200 pounds. By way of comparison, the "ton" commonly used in Great Britain (also known as the long ton) is 2,240 pounds, while the "ton" used in the US and a number of Commonwealth countries (the short ton) is 2,000 pounds.

Transliteration

This dissertation uses the Library of Congress system of transliteration from the Russian language. The Library of Congress system has been the standard of transliteration at the Bodleian Library of Oxford University since 1988. As a result, some words and names in this dissertation are different from their more common Western forms. For example, the spacecraft commonly transliterated as "Soyuz" appears here as "Soiuz," and the missile designer "Yangel" is known here as "Iangel'". Quotations and bibliographical citations previously transliterated under a different system have not been changed. Hence, the head of the MVD appears as "Beriia" in the text, but as "Beria" in some footnote citations.

Chapter 1: Introduction

"Poekhali! (We're off!)"

Iurii Gagarin, as his rocket lifted off
on the first manned spaceflight,
12 April 1961

Soviet Space Policy: A Curious Case

The Soviet space programme was one of the most impressive and lasting legacies of the USSR. Not only was the Soviet Union the first country to place an artificial satellite in orbit, but the USSR and its successors have conducted the most active space effort in the world.[1] The manned programme has proven especially robust and effective. The Soviet Union set all of the early records for human spaceflight[2] and Russia now holds unchallenged pre-eminence in long-duration missions.[3] The manned space programme not only survived the collapse of the Soviet Union, but remains an important priority of the Russian leadership. After being invited to join a consortium of Western countries, the Russian Federation has become one of the leading participants in the construction of the international space station.[4]

The Soviet Union was a space superpower. In fact, the space programme was one of the key elements in establishing the Soviet Union as a superpower in the first place. Sputnik, the world's first artificial satellite, resulted in a monumental change in international perceptions.

> "Backward Russia, home of the abacus, seemed to have 'overtaken and surpassed' the world's leading scientific power. Many people around the world, including in the United States, viewed Sputnik as symbolizing a major turning point in the tide of world history..."[5]

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[1]Even after the disintegration of the Soviet Union, the Russian space programme continues to set the pace in the number of successful launches to orbit with 49 in 1994. Despite a forty percent decline since 1990, the Russian Federation still conducts more space launches than all other countries combined.

[2]The first man in space, the first woman in space, the first multi-person crew, the first space "walk," the first exchange of crewmen between spacecraft.

[3]On 22 March 1995 Russian cosmonaut Valerii Poliakov returned from space after spending 438 days in orbit. This mission broke the earlier record of 365 days, set by the Soviet Union in 1988. Both of these missions were conducted on the Mir space station, a facility that has been continuously manned for all but four months since its launch in February 1987.

[4]The Russian Federation is slated to launch the first component of the space station in 1997. They will also provide a substantial part of the remaining hardware for the station.

[5]Morton Schwartz, The Foreign Policy of the USSR: Domestic Factors, Encino, California: Dickenson Publishing Co., Inc., 1975, p. 42.

After Sputnik in 1957, the Soviet Union gained momentum in the competition with the West. A significant factor in this was their uncanny ability to upstage the United States with a seemingly endless stream of space "firsts," especially manned missions. Following Iurii Gagarin's historic first flight in April 1961, the Soviet space programme focused on manned flights of astounding audacity and ingenuity.

Even though the pace of manned flights appeared to diminish after Khrushchev's ouster in 1964, the Soviet Union still touted its space achievements as one of the premier examples of the success of its ideology and leadership. Soviet manned space achievements in the late 1960s were limited, but the Soviet-American space docking mission in the mid-1970s seemed to confirm superpower parity in the heavens as well as on Earth.[6] The highly successful later series of flights by "guest cosmonauts" to Soviet space stations, especially when compared to the US Space Shuttle Challenger accident, further underlined the apparent wisdom and expertise of the Soviet approach to manned spaceflight.[7] The Soviets appeared to be the successful space tortoise, compared to the flashy and imprudent US hare. The successes of their manned space programme helped to secure the reputation of the Soviet Union as a technologically advanced country that could surpass the West.

Although the manned space programme was the centrepiece of a very successful propaganda campaign, little about the programme was actually revealed by the Soviet Union, especially during its first decade. There were endless tributes to the stream of successes, to the cosmonauts themselves, and to the top political leaders who closely associated themselves with the programme. Yet, virtually all other aspects were successfully protected state secrets. In the 1960s, the Soviet press was full of utopian proclamations about the goals of the space programme, but there were no announcements of formal space plans, or any indication of what major space projects were being pursued. There was certainly no real mention about how such projects were chosen by the political leadership or developed. The objectives and purposes of Soviet space missions were

[6]This mission was known as the Apollo-Soiuz Test Project. In Russian the acronym is "EPAS".
[7]Due to a failure in one of its solid rocket boosters the shuttle Challenger, and its crew of seven, were destroyed in an explosion seventy three seconds after launch on 28 January 1986. The Soviet Union launched the Mir space station the month after this accident.

touted as peaceful scientific exploration, but specific details were only mentioned retrospectively.

Leadership pronouncements on the objectives and purposes of the Soviet manned space programme were especially rare in the 1960s. Khrushchev closely associated himself with the manned space programme, and frequently cited it as an example of Soviet power.[8] He simultaneously held that the manned space programme was a scientific effort with no connection to international politics, but he did not go any further in explaining its objectives. Initially, his successors were even more reticent about the purposes of the space programme. Once again, the head of the party, Brezhnev, was the leader most publicly connected with the space programme, but he said little about its purposes until 1969. Late that year he announced that the aim of the manned space programme was long-term exploration of space, and that the first step in that process was gaining experience with space stations in Earth orbit.

One of the few consistent themes of Soviet space propaganda and leadership statements was that their manned space programme was <u>not</u> a race with the US. Khrushchev hotly contradicted suggestions that the Soviet Union was engaged in a space race with the United States and categorically denied the existence of a Soviet manned lunar programme in 1962. Although there were hints to the contrary, the post-Khrushchev leadership continued to suggest that the manned space race was a Western delusion. In fact, while the United States landed a dozen men on the moon between 1969 and 1972, the Soviet Union dismissed the "moon race" as a dangerous, one-sided stunt. After Brezhnev's pronouncement on space stations in 1969, Soviet authorities retroactively explained the manned programme of the 1960s as a systematic, conscious effort to colonise space in the ways foreseen by visionary Soviet scientists.

The extraordinary limits on evidence have effectively precluded serious political analysis of such Soviet claims. There was long a substantial body of technical and anecdotal evidence to suggest that the first decade of the Soviet manned space programme was not a systematic, scientific drive to develop space stations. However, one could never

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[8]For example, in 1961 he regularly pointed out that manned missions had been launched on an ICBM, and that the space capsule could easily be replaced by a nuclear weapon. For Khrushchev, see Appendix 3.

be sure how much of the official propaganda was true. Programmes, projects, and even individual space launches were never announced until after they had begun, or succeeded. Virtually every announced space mission was declared to be a completely flawless success. Aside from references to the elusive "Chief Designers" and their "Council of Chief Designers," the technical leadership of the manned space programme was not publicly identified, except posthumously. In the 1960s, the only institutions publicly connected with the space programme were the Party, the Academy of Sciences, and a mysterious "State Commission."[9] Western analysts, even those with access to classified intelligence data, had little to go on.[10] There was only limited technical evidence from successful manned and unmanned Soviet space launches, information gleaned from the Soviet press, émigré reports and rumours.[11]

Earlier Western studies of the Soviet manned space programme have come to wildly varying conclusions based on the available evidence. Some authors concluded that the programme was purely military; science was merely the stalking horse for Soviet plans to dominate the Earth from space.[12] A few took the opposite tack, largely accepting Soviet claims about the long-term scientific and colonisation aims of the programme.[13] Most analysts were more even-handed in their studies. However, on the question of the goals and purposes of the Soviet manned space programme in the 1960s, their conclusions

[9]During the US-Soviet space docking mission in the 1970s the Soviet Union took great pains to prove that the manned space programme was run by the USSR Academy of Sciences. The US did not publicly dispute this claim, but Americans involved with this project clearly believed that the Academy of Sciences "management" was an elaborate ruse. (e.g., see: L. M. Gray, Working Paper on A Case Study on the Transfer of Space Technology, (Defense Advanced Research Project Agency Report Order No. 2857), Columbus Ohio: Battelle Columbus Laboratories, 1 August 1975.)
[10]Recently declassified US National Intelligence Estimates (NIE) from the early 1960s suggest that the United States knew few details about the organisation and goals of the Soviet programme. See: US Central Intelligence Agency (CIA), National Intelligence Estimate 11-1-62: The Soviet Space Program, (classification obscured), Washington DC, 5 December 1962, as declassified April 1991. Events in the later 1960s suggest that US technical intelligence on the Soviet manned space effort was improved (probably through the use of reconnaissance satellites). However, it is not known when, or if, US government analysts understood the organisation and goals of the Soviet manned space programme.
[11]The Soviet Union never announced unsuccessful launch attempts. On critical questions of policymaking émigrés and defectors were often silent, and more frequently, contradictory. For example, compare: Oleg Penkovskiy, The Penkovskiy Papers, trans. Peter Deriabin, New York: Doubleday and Co. Inc., 1965; Grigorii A. Tokaty, "Foundations of Soviet Cosmonautics," Spaceflight, Vol. 10, No. 10, October 1968, pp. 335-346; Leonid Vladimirov, The Russian Space Bluff, New York: Dial Press, 1973; and Viktor Yevsikov, Re-Entry Technology and the Soviet Space Program, Falls Church, Virginia: Delphic Associates, Inc., 1982.
[12]Peter N. James, Soviet Conquest from Space, New Rochelle, New York: Arlington House, 1974.
[13]Peter L. Smolders, Soviets in Space, trans. by Marian Powell, New York: Taplinger Publishing Co., 1974.

cover a wide range of possibilities. One of the most thorough early studies stated that the Soviet Union was building lunar rockets and spacecraft, and may have tried to upstage the US lunar programme in 1969, but deferred its lunar plans for unknown reasons.[14] Other studies suggested that the Soviet Union had intended to have a manned lunar programme, but abandoned those plans in the mid-1960s.[15] By the 1980s, the continuing trickle of evidence had convinced most serious analysts that there had been some sort of "race to the Moon."[16] But even the most thorough and ingenious of the Soviet space watchers were cautious about reading too much into the limited evidence.[17]

Although they may have disagreed on many points, virtually all Western studies of the Soviet manned space programme have two critical assumptions in common. The first and most widely held Western assumption was that the Soviet space programme was, in fact, following a long-term plan and that these efforts were centrally directed by the political leadership. A second assumption was that the long-term plan was not driven primarily by scientific aims, but largely by defence and foreign policy considerations.

These assumptions were adopted by Western analysts at the beginning of the space age and have dominated discussions of Soviet space policy ever since. One of the only scholarly attempts at comparative analysis of space policy even took these points as its central premise. In the Pulitzer prize-winning _...the Heavens and the Earth,_ Walter McDougall claims that the United States succeeded with its moon landing programme only by adopting the "centralised technocratic state structure" of the Soviet Union.[18]

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[14]US Congress, Senate Committee on Aeronautical and Space Sciences, _Soviet Space Programs, 1966-1970,_ 92nd Congress, 1st session, 9 December 1971. (See pp. 391-2.) (This was the third in a series of reports by the US Congressional Research Service.)

[15]William H. Schauer, _The Politics of Space: A Comparison of the Soviet and American Space Programs,_ New York: Holmes & Meier, Publishers, 1976 (Schauer states that the Soviets abandoned their lunar ambitions "by 1967." (p. 172)); and Nicholas Daniloff, _The Kremlin and the Cosmos,_ New York: William Morrow & Co., 1972 (Daniloff suggests that manned lunar efforts were abandoned in 1966. (p. 165)).

[16]e.g., James E. Oberg, _Red Star in Orbit: The Inside Story of the Soviet Space Program,_ London: Harrap Ltd., 1981; Ronald D. Humble, _The Soviet Space Program_ , London: Routledge, 1988; and Brian Harvey, _Race into Space: The Soviet Space Programme_, Chichester: Ellis Horwood Ltd., 1988.

[17]Nicholas L. Johnson, _Handbook of Soviet Manned Space Flight,_ San Diego: Univelt Inc., 1988; and Phillip Clark, _The Soviet Manned Space Programme: An Illustrated History of the Men, the Missions and the Spacecraft_, London: Salamander Books, Ltd., 1988. (Clark was particularly methodical and ingenious in his use of available technical data.)

[18]Walter A. McDougall, _...The Heavens and the Earth_, New York: Basic Books, Inc., 1985.

Unlike the study of Soviet politics as a whole, Soviet space policy is still understood largely in terms of a totalitarian model of politics.

However, startling new revelations have undermined the totalitarian assumptions previously shared by Western analysts. In mid-1989, the walls of secrecy surrounding the Soviet manned space programme began to crack.[19] Suddenly, Soviet sources began to report that there had been a race to the moon.[20] Within months Western scientists were even shown the spacecraft that had been built for the lunar missions.[21]

It soon became clear that the Soviet Union had been so keen to upstage the US that it had run two manned lunar programmes simultaneously.[22] One programme was aimed at circumnavigation of the moon, and the other at landing a man on the surface. After the moon programme revelations, the flow of information continued to increase. Since April 1992, when President El'tsin declassified parts of the space programme, evidence about the history, organisation, and structure of the Soviet space industry has become more widely available.[23]

Many of the new Russian sources about the Soviet space programme suggest that three major ballistic missile design bureaux, the Korolev, Iangel', and Chelomei organisations, played an influential role in space policymaking. Memoirs and press reports, many by former senior officials, hold that the Soviet space programme was not planned, but chaotic. The chaos, they claim, was caused by uncontrolled competition between these three designers. For example, the chief designer of lunar equipment after 1966 says that it was the United States that had the advantage of a clearly defined, well-planned, high-priority lunar programme. Academician Vasilii Mishin goes on to say that

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[19]Under the policy of glasnost, there were a few unflattering articles about the space programme in the Soviet press but hardly a torrent of information. However, in mid-1989 the situation changed dramatically.
[20]The first Soviet press articles admitting the existence of a manned lunar programme appeared in July (Poisk) and August (Izvestiia) 1989.
[21]This first occurred in November 1989 when a team of aerospace engineers from the Massachusetts Institute of Technology and the California Institute of Technology were on a tour of the Moscow Aviation Institute.
[22]One of the better early analyses of the Soviet lunar programmes was: Rob R. Landis, "A Shadowy Trace of the Space Race," Griffith Observer, Vol. 57, No. 10, October 1993, pp. 3-20.
[23]The President's decree declassified "...30 categories of space research issues." "Space Research Secrecy Lifted," text from Ostankino television broadcast of 30April 1992, as recorded and translated in Foreign Broadcast Information Service (hereafter FBIS), Science and Technology Central Eurasia: Space, JPRS-USP-92-004, 10 June 1992, p. 71.

the competition between the major missile/space design bureaux was a major cause of the failure to beat the US to the moon.[24] Another space programme "insider" has stated that the manned lunar rocket programme was "hindered by the caprices of V. P. Glushko, the chief designer of rocket engines."[25]

Some Russian journalists go even further, claiming that the design bureaux dominated space policy. Iaroslav Golovanov, a prolific "official" journalist[26] of the Soviet spaceflight, now says that there was "not any sort of general-governmental plan" for the space programme.[27] He implies that this was the result of machinations by various interested parties, including chief designers. Leonard Nikishin, a science writer for Moskovskie Novosti, advances the most extreme view. He has written that the

> "... design bureaux themselves realised their own ideas. Until recent times they proposed to do one thing or another to 'the heights,' who nodded their heads from one side to the other."[28]

While blaming the party leadership for earlier failures may not be surprising in the post-Soviet period, the unexpected twist to these stories is the reason the leaders are blamed. The failures are generally not attributed to interference, incompetence or poor policy choices, but to the inability of the leadership to control the designers and design bureaux . These accounts suggest that Soviet manned space policy was often the unintended result of the competition between the three major missile design bureaux that developed the equipment for the space programme. This contradicts the commonly accepted Western explanation of Soviet space policymaking.

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[24] V. P. Mishin, "Pochemu My Ne Sletali Na Lunu?", Znanie: Kosmonavtika, Astronomiia, No. 12, December 1990, p. 41. (Interestingly, Mishin's work corroborates McDougall's proposition that the US adopted a centrally controlled system to succeed in the moon race. It also suggests that McDougall's assumption about the nature of the Soviet space programme was wrong.)

[25] V. Pikul, "How We Conceeded the Moon: a Look by One of the Participants of the N-1 Drama at the Reasons Behind It," Izobretatel' i Ratsionalizator, August 1990, pp. 20-21, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-91-002, 16 April 1991, p. 71.

[26] Golovanov was not only a senior journalist of the Soviet manned programme, but was one of the three selected for cosmonaut training in 1965. The Soviet reporter in space programme was later abandoned. (Gordon R. Hooper, The Soviet Cosmonaut Team, Volume 2: Cosmonaut Biographies, Lowestoft, Suffolk: GRH Publications, 1990, pp. 90-91.)

[27] Iaroslav Golovanov, "Kuda Zhe My Letim?", Izvestiia, 16 December 1991.

[28] Leonard Nikishin "Kommentarii," Moskovskie Novosti, No. 3, 17 January 1993.

Policymaking and Soviet Politics

A review of the literature on Soviet politics and policymaking offers a possible explanation for the reports about Soviet manned space policy in the 1960s, but taken as a whole the literature is contradictory. On the question of the role of state institutions and specialists in policymaking there are two major political models and several useful empirical studies. One of the political models fits the recent evidence. However, the empirical studies contradict each other, and none of them allow for a significant role in policymaking by technical advisors like chief designers. A discussion of the political models and the empirical studies will illustrate these points.

The question of whether chief designers and their bureaux were influential is ultimately about policymaking power. Who has it? How is this power used to influence or direct policy? In this regard modern Soviet political models fall into two major categories. I have chosen to call these the "modified totalitarian," and "pluralist" types. The terms are used here in a relative sense - as broad categories that encompass considerable variation.[29] Both of these categories are historically related to the totalitarian model. In order to understand the two current alternatives, it is necessary to review the original model.

The totalitarian model of Soviet politics was developed by a number of scholars in the early 1950s, but was epitomised by Friedrich and Brzezinski's Totalitarian Dictatorship and Autocracy.[30] In this work the authors identified seven key attributes of the totalitarian society: an official ideology, a single party, terroristic police control, a monopoly on the means of communication, a monopoly of the means of armed coercion, a centrally directed economy, and revolutionary expansionism. The totalitarian model posits that, as a result of the combination of these factors, the party, in the person of its leader, was able to control all aspects of society. Such centralisation of power was the key point. The totalitarian model emphasised that formal Soviet institutions did not enjoy the same type of rights, responsibilities, and powers as their Western counterparts.

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[29] If one were looking at something other than policymaking power the grouping and typology of these models might be quite different.

[30] Carl J. Friedrich and Zbigniew Brzezinski, Totalitarian Dictatorship and Autocracy, Cambridge: Harvard University Press, 1956.

As a result, the model predicted that policymaking in a totalitarian polity was significantly different from policymaking as it is understood in the West.[31] Policy was not the outcome of a struggle or bargaining between legitimate independent interests. Instead, policy was seen as the product of the deliberations of an ideologically anointed elite. As a result, totalitarian systems were capable of sudden, bold policy changes, unlike the incremental changes typical of pluralist polities. There was not likely to be any significant resistance to totalitarian policies because factionalism was discouraged by "democratic centralism," which was ruthlessly enforced.

The party was the locus of power and served as a means of control and verification. Later explanations suggested that the party was able to retain its dominant position within what appeared to be a pluralist institutional structure through the "circular flow of power."[32] Thus, all institutions outside the party were of little consequence to policymaking. Their function was not to represent interests, but to mobilise, control, and direct the population to serve the leader's ends.

The totalitarian model may have been useful at highlighting the differences between Stalinism and Western pluralism, but it had a serious weakness. It did not explain decisions made below the level of the political elite. The totalitarian model did not account for the bulk of mundane, but cumulatively significant, political activity that did not attract leadership attention. It left open the question of which issues would attract leadership attention and, especially, what happened in fields that did not.

The limitations of the totalitarian model became particularly evident after the death of Stalin. His successors made changes that undermined many of the seven key attributes in Friederich and Brzezinski's model. The most obvious change, the absence of a single powerful leader, was not even an attribute of their totalitarian model. But, among the changes that did undermine the model were: the end of terroristic police control, an initial softening of confrontational aspects of ideology, and a somewhat more open media.

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[31] There is an excellent discussion of the policy implications of the totalitarian model in Samuel P. Huntington and Zbigniew Brzezinski, Political Power: USA/USSR, New York: Viking Press, 1963, Chapter 4.

[32] See: Robert V. Daniels, "Soviet Politics Since Khrushchev," in John W. Strong, ed., The Soviet Union under Brezhnev and Kosygin, New York: Van Nostrand-Reinhold, 1971.

By the early 1960s the weaknesses of the totalitarian model spawned a number of alternative models. One school of thought retained the totalitarian model's central premise of the political monopoly of the party and sought new explanations within that framework. There were a number of such modified totalitarian approaches. The "conflict model" was one of the first of these.[33] In this model power was still centralised, but in a faction-riven elite. The implication was that policy was a product of personal conflict in the elite. "Directed society" models appeared in the middle of the 1960s.[34] Less concerned with struggles in the elite, the emphasis of this approach was on political control at a lower level; how "totalitarianism without terror" worked. There were numerous other variations on these themes including authoritarian, elite, oligarchic, and patronage models. In each case, they share the fundamental emphasis on the concentration of policymaking power in the Communist Party that characterised the totalitarian model.

These modified totalitarian models were a useful corrective to the weaknesses of the original, but they themselves came in for criticism on a number of fronts. For example, the conflict model was frequently criticised in later years for its assumption that conflict was a "critical and continuous fact of life."[35] However, the fundamental problem was simply the lack of firm evidence. At the time, all models were susceptible to criticism for the deductive use of evidence. This problem was especially evident in the conflict model and its "Kremlinology" variant. These approaches relied on deducing both the issues and the participants in leadership debates from the often minute shades of difference that were thought to be detectable in the Soviet media. The assumption that these esoteric "debates" were an accurate reflection of the real political process was

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[33]See: Robert Conquest, Power and Policy in the U.S.S.R.: The Study of Soviet Dynastics, London: Macmillan, 1962; Sidney Ploss, Conflict and Decision-Making in Soviet Russia: A Case Study of Agricultural Policy, 1953-1963, Princeton: Princeton University Press, 1965; and Carl A. Linden, Khrushchev and the Soviet Leadership, 1957-1964, Baltimore: Johns Hopkins Press, 1966.

[34]See the articles by T. H. Rigby and Allen Kassof in the July 1964 issue of World Politics. (T. H. Rigby, "Traditional, Market, and Organizational Societies and the USSR," pp. 539-557; and Allen Kassof, "The Administered Society: Totalitarianism Without Terror," pp. 558-575.)

[35]The quote is from Linden, Khrushchev and the Soviet Leadership, p. 3. For an interesting example of criticism of this assumption see: C. Grant Pendill, "'Bipartisanship' in Soviet Foreign Policy-Making," in Erik P. Hoffman and Frederick J. Fleron, eds., The Conduct of Soviet Foreign Policy, 2nd ed., New York: Aldine Publishing Co., 1980.

effectively criticised by numerous analysts. It was, of course, possible to posit logical explanations for the "differences" found in various pronouncements. Yet, it was impossible to prove or disprove any of them without substantially improved data.

The other school of Soviet political power models dismissed the totalitarian premise of the concentration of power in favour of a "pluralist" approach. This trend was spurred by increasing evidence that some aspects of Soviet politics were not so different from their Western counterparts, and the increasing use of "group" models in Western social science.[36] One of the earliest proponents of Soviet interest group models, H. Gordon Skilling, held that since Stalin's death there had not only been more leadership conflict, but also

> "...the increased activity of political interest groups...(and) a broadening of group participation in the crucial preliminary stages of policy deliberation and in the subsequent phase of implementation."[37]

Arising during the same period, the bureaucratic politics model was also transferred from Western to Soviet political studies.[38] A number of other variations of these models, like Jerry Hough's "institutional pluralism" were also proposed during this period.[39] More recently pluralist models have gained increasing currency.[40] In some cases, they have even challenged the notion that the totalitarian model applied to the Soviet Union at any time.[41]

From the perspective of this dissertation, the distinctive feature of the pluralist models is the assumption that policymaking power in the Soviet political system is

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[36]In the field of American politics see, for example: David B. Truman, The Governmental Process, New York: Knopf, 1951; and Robert A. Dahl, Who Governs?, New Haven: Yale University Press, 1961.

[37]H. Gordon Skilling, "Groups in Soviet Politics: Some Hypotheses," in H. Gordon Skilling and Franklyn Griffiths, eds., Interest Groups in Soviet Politics, Princeton: Princeton University Press, 1971, p. 19. (For an earlier statement of the interest group hypothesis see: H. Gordon Skilling, "Interest Groups and Communist Politics," World Politics, 18, April 1966, pp. 435-451.)

[38]Graham T. Allison, Essence of Decision: Explaining the Cuban Missile Crisis, Boston: Little, Brown and Co., 1971.

[39]Jerry F. Hough and Merle Fainsod, How the Soviet Union is Governed, Cambridge: Harvard University Press, 1979, p. 526.

[40]This has been especially true in the 1990s. The conventional wisdom is that the Soviet collapse was the result of a gradual loss of political power at the centre. The aim of many current models is to explain the weakening and collapse of the Soviet Union over the last several decades. I am not convinced that such a gradual, linear model applies in this case.

[41]e.g., J. Arch Getty, The Origins of the Great Purges: The Soviet Communist Party Reconsidered 1933-38, Cambridge: Cambridge University Press, 1985; and Sheila Fitzpatrick, The Russian Revolution 1928-1932, Oxford: Oxford University Press, 1984.

distributed rather than concentrated. Wider participation in policymaking after Stalin's death was assumed to have changed the process into one of conflict, bargaining, and compromise both within and outside the party. In some of these models the party was just one of the many interest groups, while in others the party was the central political prize that various interests tried to capture. In any case, policy was seen more as an outcome of uncontrollable events.

Advocates of "modified totalitarian" models criticised this approach, especially its assumptions about power. In terms of accounting for the post-Stalin political changes and sub-Politburo decisionmaking, the decrease in emphasis on distinctions between East and West may have been useful. However, pluralist models were criticised for going too far; for ignoring the differences in politics between East and West.[42] If the party could still limit debate and demand conformity with its decisions, what had changed? The critics held that even though the party may not choose to exercise it, there were still huge asymmetries of power between political institutions.

Another major criticism was that Soviet interest groups were not like their Western counterparts. Some analysts found that Soviet political conflict was not waged by Western-style interest groups, but by factions built on ties of patronage.[43] When they existed, Soviet interest lobbies were found to be "loose and transient coalitions of individuals who unite to promote or oppose a particular policy."[44] This even appeared to be true in the defence industry. Arthur Alexander found that the source of policy alternatives in weapons programmes often lay more in individuals than in formal groups or organisations.[45] Thus, there are important questions about whether Western pluralist models can be applied to the missile design bureaux.

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[42]See: William E. Odom, "A Dissenting View on the Group Approach to Soviet Politics," World Politics, Vol. 28, No. 4, July 1976, pp. 542-567.
[43]e.g., Zdenek Mlynar, Nightfrost in Prague, trans. by Paul Wilson, New York: Karz Publishers, 1980; John P. Willerton, Patronage and Politics in the USSR New York: Cambridge University Press, 1992.
[44]Karen Dawisha, "The Limits of the Bureaucratic Politics Model: Observations on the Soviet Case," Studies in Comparative Communism, Vol. XIII, No. 4, 1980, p. 317.
[45]Arthur J. Alexander, Decision Making in Soviet Weapons Procurement, Adelphi Paper No. 147/8, London: International Institute for Strategic Studies, Winter 1978/79, p. 40.

In terms of theory, there is little consensus on how policymaking worked in the Soviet Union. The modified totalitarian models suggests that lower political institutions like design bureaux could have played a significant role in policymaking only in two instances: such institutions could have been invited by the party leadership to participate, or may have taken advantages of "gaps" in leadership oversight to advance their agenda. Even though design bureaux might generate new proposals, the policy decision ultimately rested with the party elite. Once the decision was made, a design bureau would have little recourse but to implement it.

On the other hand, pluralist models suggest that a design bureau has, at least, the potential to be a significant and continuous participant in the policy process. Not only could they generate new proposals, but their expertise would give them leverage during decisionmaking. In addition, their central role in implementation of R&D projects would allow them to subvert leadership decisions. On the basis of recent Russian press reports it would appear that the pluralist model best fits the case of Soviet manned space policy in the 1960s.

However, the conclusions of a number of empirical studies on the role of extra-party institutions in Soviet policymaking appear to contradict this hypothesis. Three studies in particular highlight the problems with the pluralist theoretical approach.

The first of these empirical studies is Peter Solomon's book on criminal policy in the 1950s and 1960s.[46] Solomon found that criminal policy specialists did begin to play a wider and more influential role in policymaking beginning around 1956.[47] In the 1960s their role was institutionalised. Despite this, he found that their "share of political power did not change a great deal ... the leaders retained ...a virtual monopoly of decision-making authority."[48] Solomon's research also showed that when the political leadership was not

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[46]Peter H. Solomon, Jr., Soviet Criminologists and Criminal Policy, London: Macmillan, 1978.
[47]Solomon's definition of "influence" was "changing the probability of a given outcome." Although this definition has a fine pedigree, it is rather undemanding and difficult to measure with any degree of accuracy. (Solomon, Soviet Criminologists and Criminal Policy, p. 128.)
[48]Solomon, Soviet Criminologists and Criminal Policy, p. 161.

engaged in an issue, the specialists had more influence on policy. However, when the leadership took an interest in criminal policy, the specialists' role was less evident.[49]

In a major study of land and water policy in the late 1960s through the 1970s, Thane Gustafson found remarkably similar results.[50] He claimed that the reform of agriculture under Brezhnev had demonstrated that the party still retained its monopoly on negative power. As a result other participants in the policy process were not truly independent. In his view, the power of sub-leadership institutions was "on loan" from the centre. Ultimately, such power could be revoked by the party leadership.[51] Although major changes in policy were not as quick and easy as the totalitarian model suggested, he found that the political leadership was still fundamentally in control.[52] The

> "professionalization, institutionalization, and subsequent participation [of specialists] depend not only on the relative suspension of negative controls but also on active support and receptiveness from political figures."[53]

Furthermore, he states that

> "state agencies use their delegated powers (for a time) to obstruct and divert, but not to oppose official policy openly or impose an alternative (though they may propose one)."[54]

The third, and most recent, empirical study proposes an altogether different perspective on policymaking in the Soviet Union. Stephen Whitefield boldly claims that the "industrial ministries were the dominant players in the game of Soviet politics."[55] Whitefield's study, which focuses on the post-Khrushchev era, found that:

> "...industrial ministries were able to act in their own interests, undermine the control, and even dominate the agendas of other institutions, and function both directly and indirectly as the most powerful, hegemonic political forces in the Soviet system."[56]

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[49]Solomon, Soviet Criminologists and Criminal Policy, p. 135.
[50]Thane Gustafson, Reform and Power in Soviet Politics: Lessons of Recent Policies on Land and Water, Cambridge: Cambridge University Press, 1981.
[51]Gustafson, Reform and Power in Soviet Politics, pp. 93 & 158.
[52]For example, his research shows that it took Brezhnev fifteen years to change agricultural policy.
[53]Gustafson, Reform and Power in Soviet Politics, p. 93.
[54]Gustafson, Reform and Power in Soviet Politics, p. 158. (Parenthetical material is in the original.)
[55]Stephen Whitefield, Industrial Power and the Soviet State, Oxford: Oxford University Press, 1993, p. 15.
[56]Whitefield, Industrial Power and the Soviet State, p. 29.

This study suggests that chief designers, and their design bureaux, should have played little or no independent role in space policymaking because they were subordinate to the all-powerful industrial ministries.

There is at least one thing that all three of these empirical studies seem to agree on. This is that design bureaux and their designers may have participated in the policy process, but that their influence would have been limited. The idea that the political or ministerial leadership lost control of design bureau competition and that manned space policy was an accidental outcome, does not fit with these studies. Although the Soviet politics literature offers a model that appears to fit the new evidence, alternative models and empirical research raise considerable doubts about the applicability of a "pluralist" explanation. Theoretical and empirical research, to date, does not offer a clear explanation of the apparent role of design bureaux in manned space policymaking.

This dissertation is the first empirical study of the role of design bureaux in Soviet manned space policymaking. From a disciplinary perspective, one of the major objectives is to determine whether policymaking in this case fits into any of the existing theoretical frameworks. Of particular interest is the question of whether the Solomon and Gustafson findings, or Whitefield's findings, better explain Soviet manned space policymaking.

The Design Bureau

The general study of Soviet politics offers no clear explanation of the recent evidence about Soviet manned space policy in the 1960s, and neither does the conventional wisdom about design bureaux. Even before the collapse of the Soviet Union there was a reasonable amount of Western literature about design bureaux. These earlier works suggest that the design bureaux had an extremely limited capacity to influence policy, even in their field of expertise.

Specific information about the missile design bureaux was all but unavailable until recently. Much of what is known about weapons design bureaux comes from research into the Soviet aviation industry.[57] This earlier work reveals very little about specific bureaux and how they operated. The missile design bureaux that are the subject of this dissertation were among the most secretive of all. Except for vague hints that such organisations existed, all information about missile design bureaux was kept secret until the collapse of the Soviet Union. Nonetheless, we do know a fair amount about the origins and functions of other weapons design bureaux.

The design bureau (konstruktorskoe biuro or KB) has long been a feature of Soviet research and development (R&D). They existed in all industries in the Soviet Union, but were particularly noted for their prominent role in weapons R&D. The KB was introduced as a means to speed the introduction of new technologies into production. The first aviation design bureaux were formed as departments of the Central Aerohydrodynamic Institute (TsAGI). During the industrialisation drive of the 1930s they were spun-off into separate organisations.[58] By the end of the 1930s the unique Soviet R&D process had stabilised; it's distinguishing feature being its compartmentalisation into three institutions.[59] These institutional divisions remained substantially unchanged for the remainder of the Soviet period.

The first of these institutions is the "Nauchno-Issledovatel'skii Institut" (NII) or Scientific-Research Institute. NII is a generic title for organisations engaged in basic theoretical work. There were thousands of scientific-research institutes in the Soviet Union assigned to a variety of organisations, including the Academy of Sciences and the military. In the industrial ministries, NIIs were tailored for research in areas of use to the ministry. At times there was a "leading" NII that served as a ministerial repository for both scientific expertise and research equipment.[60] These leading NIIs often held and controlled access to specialised test equipment, and could dictate the specific technologies

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[57]Of particular note is the work of Arthur Alexander of the RAND Corporation. For example: Arthur Alexander, R&D in Soviet Aviation, Report No. R-589-PR, Santa Monica, California: RAND, November 1970.
[58]Alexander, R&D in Soviet Aviation, p. 5.
[59]See: Mikhail Tsypkin, The Origins of Soviet Military Research and Development System (1917-1941), Harvard University: Ph.D. dissertation, 1985.
[60]TsAGI, the Central Aerohydrodynamic Institute, served this function for the Ministry of Aviation Industry.

and materials that designers were allowed to use. In practical terms, the NII appears to have been less prestigious than the design bureau, for when new products were needed the resources and attention went to designers rather than the scientists at NIIs.[61] In the aviation industry at least, leading designers, whose names were attached to their aircraft, were much better known than most scientists who worked in the NIIs.

The design bureau served as the engineering bridge between science and production. Its task was to develop new designs or applications of technology in light of basic research information (from the NII), the limitations and capabilities of industry, and the needs of the "customer." Major KBs had the capability to produce experimental prototypes both for testing purposes and to prove the feasibility of production. Design bureaux generally did not have substantial production facilities of their own, although some were co-located with major factories.

Once a design had been proven and approved, it then moved on to the third and final institution, the industrial plant. At the plant the newly approved design was supposed to move into full-scale production. In theory the transfer of the design was smoothed by ad hoc connections between the KB and the plant. However, in most sectors of the Soviet economy the institutional divisions, combined with the incentives inherent in centrally planned economies, usually prevented such a smooth operation of this final step in the R&D process. As a result technological change in most Soviet industry was extremely low.[62] Special features of the defence R&D process were thought to mitigate these problems.[63] Although institutionally the plant was also less prestigious than the KB, successful plant directors tended to advance to much higher positions in government than designers.[64]

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[61] Peter Almquist, Red Forge: Soviet Military Industry since 1965, New York: Columbia University Press, 1990, p. 36.

[62] See: Joseph Berliner, The Innovation Decision in Soviet Industry, London: The MIT Press, 1976; and Ronald Amann and Julian Cooper, eds., Industrial Innovation in the Soviet Union, Yale University Press, London, 1982.

[63] See Chapter 3.

[64] There are numerous examples of this in the space and missile industry. One notable post-Soviet case is the current President of Ukraine, L. D. Kuchma. Kuchma was director of the largest missile plant in the world (the Southern or Iuzhnyi Machinebuilding Plant in Dnepropetrovsk) from 1986-1992.

The title "design bureau" encompasses a wide variety of organisations. Many of these bureaux were relatively minor ministerial organisations. The vast majority were involved in relatively moribund technology or served as subcontractors to the major design bureaux.[65] Due to changes in organisations and functions over time, it appears that some institutions that functioned as design bureaux were known as NIIs and vice versa. These accidents of history add confusion to the already obscure world of Soviet R&D.

One thing that was fairly consistent about design bureaux was the fact that the weapons R&D process was dominated by a few elite KBs. These institutions were generally distinguished by the title OKB: "Opytno-Konstruktorskoe Biuro." The three design bureaux that this dissertation is concerned with were all OKBs. The term OKB is usually translated as "experimental design bureau," but as Arthur Alexander points out the Russian word also suggests "'trying out' or 'proving' an idea in practice."[66] The word could also be translated as "experienced," thus suggesting that these organisations were special repositories of experience. OKBs had responsibility for major, technologically challenging, projects. They also had more substantial test facilities and shops for building prototypes than a typical KB.

OKBs were led by an individual who was perhaps the closest thing to an entrepreneur that existed in the Soviet Union - the chief designer. These larger-than-life figures gave their organisations a distinct personality. OKBs were often simply referred to by the chief or general designer's name.[67] The chief designer not only had to lead the development of new weapons, but had to succeed in "selling" new proposals. Failure on a project, or the inability to win new "contracts" could lead to dismissal of the chief designer and, in some cases, the elimination of his bureau. In at least some instances, the award of the title "chief designer" was controlled by the Communist Party leadership.[68]

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[65]Vladimir Kontorovich, "The Long-Run Decline of Soviet R&D Productivity", in Henry S. Rowen and Charles Wolf Jr., eds., The Impoverished Superpower, San Francisco: ICS Press, 1990, p. 265.

[66]Arthur J. Alexander, "Weapons Acquisition in the Soviet Union, the United States, and France," in Frank B. Horton III, Anthony G. Rogerson, and Edward L. Warner III, eds., Comparative Defense Policy, Baltimore: Johns Hopkins University Press, 1974, p. 428.

[67]In the aviation industry these include such famous organisations as the Tupolev and MiG (Mikoian and Gurevich) bureaux.

[68]This was the case in the appointment of M. K. Iangel' to be "chief" of a missile OKB in the 1950s. (Sergei N. Khrushchev, Nikita Khrushchev: Krizisy i Rakety, Vol. 1, Moscow: Novosti, 1994, p. 285.)

The distinction between the titles Chief Designer and General Designer has long been unclear.[69] Research for this dissertation confirms the finding of Julian Cooper that the title "General Designer" originated in the aviation design bureaux in the post-war era.[70] This title, which reflects the broader responsibilities and authority of the leader of the most important OKBs, was only used in the aviation industry for many years. Since most of the ballistic missile industry was outside the Ministry of Aviation Industry, the highest rank available to the majority of missile designers was "Chief Designer."[71] It appears that the title "General Designer" was only adopted throughout the missile and space industry in the mid-1970s. "Chief Designer" will be used as the generic term for the leader of a KB throughout this dissertation.

Western studies of Soviet weapons development have shown that the chief designer himself played a central role in overcoming the obstacles inherent in Soviet R&D.[72] He supplied the leadership and co-ordination necessary to overcome the institutional barriers in the R&D process.[73] To accomplish this the party and government granted the chief designer broad authority and a remarkable degree of internal managerial autonomy. The weapon designer's authority was usually based on a joint decree of the Central Committee (TsK) of the Communist Party of the Soviet Union (KPSS) and the USSR Council of Ministers (SM). Designers who were successful reaped tremendous rewards in the form of prizes and medals, more important projects, and occasionally promotion to party and government positions. The close scrutiny of high priority projects by the top leadership also gave some weapons designers special access to the policymaking elite.[74]

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[69] Almquist, Red Forge, p. 68.

[70] Julian Cooper, "The Elite of the Defence Industry Complex," in David S. Lane, ed., Elites and Political Power in the USSR, Aldershot: Edward Elgar, 1988, p. 175.

[71] The reasons for the separation of the missile and aviation industries will be clarified in the next few chapters.

[72] Apparently this was not so much the case outside of the defence industry. This is one of the factors that contributed to the relatively poorer performance of non-defence R&D in the Soviet Union. On the role of the chief designer in defence R&D see the works by Alexander; Almquist, Red Forge; David Holloway, "Innovation in the Defence Sector: battle tanks and ICBMs", in Amann and Cooper, Industrial Innovation in the Soviet Union; and US Central Intelligence Agency, The Soviet Weapons Industry: An Overview, (DI 86-10016), Washington DC: US Government Printing Office, September 1986, p. 19.

[73] Alexander, Decision Making in Soviet Weapons Procurement, p. 24.

[74] Bruce Parrott, Politics and Technology in the Soviet Union, Cambridge: MIT Press, 1983, pp. 70-71.

Despite the prestige and access, Western analysts have long believed that weapons designers had little real influence on larger military policy issues. Chief designers may have acted as entrepreneurs in proposing new projects, but apparently they were not able to drive policy. Peter Almquist concluded that designers rarely participated in the highest policy decisions, except in a limited, technical advisory role.[75] Other studies have stated that the level of participation depended on the stage of the decisionmaking process and the salience of the issue to the political leadership.[76] Arthur Alexander also discovered that, although designers in some ministries may be more influential than in others, on the whole the military industrial ministries effectively controlled their design bureaux.[77]

In fact, design bureaux were thought to be enmeshed in a web of supervision and constraints. At the highest level this involved personal supervision of weapons programmes by the political leadership. The Soviet leadership maintained special institutions like the Defence Council of the Politburo and the Military-Industrial Commission (VPK) of the USSR Council of Ministers to co-ordinate weapons programmes and insure the implementation of military policy decisions.[78] Another method of controlling designers was the party leadership's deliberate use of competition between bureaux. Although this approach is expensive and ideologically questionable, it is known to have been used with considerable effect in aircraft design both during and after the Second World War.[79] At the ministerial level, procedural checks in the research and development process were believed to be a significant constraint on designers.[80] Perhaps the most important aspect of this was the ministry's control over the allocation of R&D project assignments.[81]

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[75]Almquist, Red Forge, p. 91.
[76]Arthur Alexander, "Modeling Soviet Defense Decisionmaking;" in Jiri Valenta and William Potter, eds., Soviet Decisionmaking for National Security, London: George Allen & Unwin, 1984, pp. 1-22; and Stephen M. Meyer, "Economic Constraints in Soviet Military Decision-Making," in Rowen and Wolf, The Impoverished Superpower, p. 203.
[77]Alexander, Decision Making in Soviet Weapons Procurement, p. 23.
[78]David Holloway, "Innovation in the Defence Sector," in Amann and Cooper, Industrial Innovation in the Soviet Union, p. 303.
[79]In Marxist-Leninist ideology, competition is generally viewed as one of the wasteful aspects of capitalism. For evidence of deliberate competition in the aviation industry see: A. S. Iakovlev, Tsel' Zhizni: Zapiski Aviakonstruktora, Moscow: Izdatel'stvo Politicheskoi Literatury, 1966.
[80]The military R&D process is explained in greater detail in Chapter 3.
[81]CIA, The Soviet Weapons Industry: An Overview, p. 40.

There are a number of ways in which the post-1989 Soviet/Russian reports contradict the conventional wisdom about design bureaux. First, the new reports suggest that chief designers virtually dictated Soviet space policy during certain periods. During other periods space policy appears to have been driven by uncontrolled competition among designers. This is despite the fact that the manned space programme was apparently an issue of extremely high priority among political leaders. Second, as far as the space programme is concerned, there is virtually no mention of the role of the appropriate ministry in overseeing and controlling "space" OKBs. Finally, it is also apparent in these reports that the missile design bureaux were not subject to the "usual" sort of oversight on space projects. The lack of both party and ministry control over organisations that remained administratively assigned to the defence industry is perplexing. This raises the question of whether or not manned space policy was an anomaly.

Methodology

Conducting an empirical analysis of Soviet manned space policy in the 1960s is still not a simple task. The first problem is to narrow the extraordinarily wide field of unknowns down to a few central questions. The second problem is determining how to find the answers to those questions. Finally, the evidence needs to be arranged in a logical and intelligible way.

There are countless unanswered questions about the Soviet manned space programme in the 1960s. In order to assess the role of the chief designers, this dissertation will focus on four central questions. First: What major manned space projects did the Soviet Union engage in during the 1960s, and how were these projects authorised? Second: Did the chief designers play an influential role in the promotion, selection, approval, and implementation of these projects? Third: What were the overall objectives and purposes of the Soviet manned space programme? Fourth: What does the example of Soviet space policy tell us about the Soviet political system?

Answering these four questions will permit us to answer a range of related or subsidiary questions. Did the Soviet Union have a serious manned lunar programme? When and why was it cancelled? Which of the chief designers were most influential with regard to manned space policy? Was the Soviet manned space programme "military" or "civilian." Did the distribution of policymaking power change in the Soviet Union? Does space policy "fit" any previous empirical studies or is it an anomaly? By the end of Chapter 8, the answers to these questions should become clear through answering the four central questions of the dissertation. As always, the difficulty is finding systematic and reliable evidence to answer such questions.

In the latest volume of Khrushchev's memoirs distributed in the West, he is quoted as saying:

"The history of producing missiles is well documented in the archives."[82]

Such archives surely exist, but although many former Soviet archives now claim to be open for research, materials relating to the missile and space programmes are not available. Some Politburo documents have been quoted in the Russian press, but the documents themselves are held in the Archive of the President of the Russian Federation. This archive is still closed. Other archives either have no space programme materials, or refuse to allow access to their holdings. For example, the Russian Scientific-Research Centre for Space Documentation (RNITsKD), an archive of the Soviet space programme, advertises itself as open to international researchers, but this author was refused access to any materials.[83] It is absolutely clear that the Russian government considers the development and operation of the missile and space industry, even of thirty years ago, to be an extremely sensitive topic. A comprehensive, systematic examination of original documents is not yet possible, but there are numerous other sources of information that are now available.

[82]Nikita S. Khrushchev, Khrushchev Remembers: The Glasnost Tapes, ed. and trans. by Jerrold L. Schecter, London: Little, Brown and Company, 1990, p. 192. (It is worth noting that even this latest volume mentions nothing about the secret Soviet manned lunar programmes, which were begun under Khrushchev.)

[83]This happened despite a letter of introduction from the Russian Academy of Sciences. It is probable that my status as an officer in the US Air Force was a factor in refusing my requests.

These new sources of information fall into two general categories, neither of which are highly reliable as historical records. The first category is commercial promotional information published by various parts of the Russian missile and space industry. Following the collapse of the Soviet Union many of the research institutes, design bureaux, and factories published extraordinarily detailed reports about their earlier accomplishments in order to lure both domestic and international investment. Virtually all such reports are extremely one-sided and of dubious reliability, but they do reveal much about the history of various programmes and institutions.

The second category of new sources is the surprising number of memoirs, diaries, and oral histories that have come to light since mid-1989. Of particular note are the extraordinarily detailed memoirs of former high-level participants in the space programme, including Khrushchev's son, Sergei Nikitich Khrushchev.[84] Another noteworthy source is the voluminous diaries of Soviet Air Force General N. P. Kamanin. General Kamanin was the head of cosmonaut selection and training until 1971.[85] Excerpts of his diaries, published by his son, amounted to the first public admission of the Soviet manned lunar projects.[86] All such personal reports are subject to numerous historiographical problems. However, taken as a whole, the remarkable volume of such material now available allows for a reasonable degree of reliability.

Careful sifting of the commercial materials, personal histories, and the Russian press reports allows one to gain a fairly comprehensive understanding of the Soviet manned space programme. Added together, the sources allow for the identification of major programmes, approval and execution procedures, and the key individuals and institutions.[87] Since much of this information has not yet been assembled elsewhere, parts of it are summarised in the form of appendices attached to this dissertation. Ultimately, this reveals much about Soviet politics. However, there are serious limitations with this

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[84] Sergei N. Khrushchev, Nikita Khrushchev: Krizisy i Rakety, 2 vols., Moscow: Novosti, 1994.

[85] For Kamanin, see Appendix 3.

[86] Since 1989, the publication of various parts of Kamanin's diaries has become a virtual cottage industry in Russia.

[87] The task of finding and assessing these many sources would have been impossible without the enthusiastic willingness of fellow researchers in both Russia and the West to share their latest sources and findings. This dissertation would not have been possible without such co-operation.

approach. Until the archives are opened our conclusions must remain conditional and limited.

The Soviet manned space programme has deep historical roots. Many of the formative influences on the programme occurred long before the first Soviet space launch in 1957. Thus, the dissertation begins with a brief review of the origins of the Soviet space programme. Chapter 2 highlights the key individuals and ideas through the time of Stalin's death in 1953.

After this historical overview, Chapter 3 examines the central actors and procedures in the Soviet weapons R&D process. The Soviet space programme was an offshoot of ballistic missile R&D, so an understanding of how the weapons R&D process worked is an essential pre-requisite. Only by fitting the available evidence into the weapons R&D framework can we truly comprehend its meaning.

The fourth chapter is the first of the analytical chapters in the dissertation. It is a detailed examination of the political processes behind the decisions to launch the world's first satellite - Sputnik. This chapter covers the period from Stalin's death in 1953 until the launch of Sputnik in October 1957. Although not about the manned space programme, per se, Chapter 4 is critical to understanding the emergence and later development of the manned programme.

Chapters 5, 6, and 7 deal with the beginning and development of the Soviet manned space programme until 1970. These chapters are essentially "focused comparisons" of space policy during certain (seemingly) discrete policymaking periods.[88] Chapter 5 examines the origins of the manned programme and its connections to the ballistic missile programme, from Sputnik until the launch of the first manned spaceflight in 1961. Chapter 6 explains the extraordinary development of the Soviet manned space programme until the ouster of Khrushchev in October 1964. The ouster of Khrushchev is often considered an important political watershed in terms of Soviet policymaking, so

[88]The “focused comparison” methodology is explained by Alexander George in "Case Studies and Theory Development: The Method of Structured, Focused Comparison" in Paul Gordon, ed., Diplomacy: New Approaches in History, Theory, and Policy, New York: The Free Press, 1979, pp. 43-68. It has primarily been used to conduct comparative studies across issues or countries. Nonetheless it is equally applicable in one policy area across time.

Chapter 7 analyses manned space policymaking under his successors. Late 1969 was a major turning point in Soviet manned space policy, so the dissertation concludes at that point.[89]

The conclusion, Chapter 8, returns to the four central questions of the dissertation. The objective is to draw together the findings of the earlier chapters and present a reasonably coherent set of answers to the questions which prompted this dissertation. In particular, we will return to the theoretical questions about Soviet politics raised in this chapter.

The analytical chapters of this dissertation (Chapters 4 -7) are organised as a policy process study for the period in question. Each of these chapters begins with an overview of what was known, or thought to be known, about the Soviet space programme at the time. This is followed by a review of the major institutional actors of the period. The object of this section is to identify salient changes and trends in the party, government, and the design bureaux during the period. Frequently, seemingly peripheral issues and institutions had a significant influence on space policy. The third part of each chapter is an analysis of the major (manned) space programmes that were developed. Each chapter then concludes with a summary of implications and conclusions for the four central questions of the dissertation.

The analysis of the major space programmes (the third part of chapters 4-7) consists of a study of the policy process for specific programmes or other key decisions. This method involves the examination of the development of policy as it progresses through the necessary and predictable stages of initiation, persuasion, decision, and execution.[90] The policy process approach has long roots in Western analysis and has been used to good effect in empirical studies of similar Western issues.[91] One of its earliest

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[89]Chapter 7 does include a brief overview of manned space policy after 1970.

[90]These are the steps in the policy process as used by Huntington and Brzezinski in Political Power: USA/USSR, pp. 202-223. Many authors use slightly different terms, but the essential elements are the same. For another useful discussion of this approach see: William C. Potter, "The Study of Soviet Decisionmaking for National Security: What Is To Be Done?," in Valenta and Potter, Soviet Decisionmaking for National Security, pp. 298-307.

[91]For example, see: John M. Logsdon, The Decision to Go to the Moon: Project Apollo and the National Interest, Cambridge: MIT Press, 1970.

applications to the case of Soviet politics was as a comparative tool in the 1963 book by Huntington and Brzezinski, Political Power: USA/USSR. Since that time it has served as the starting point in a number of case studies of various policy issues in Soviet politics.[92] In this case the policy process methodology requires the identification of certain key pieces of evidence, which will be discussed in Chapter 3.

The specific objective in reviewing the policy process is to determine whether the chief designers played an influential role in manned space policymaking. Measuring influence is a matter of considerable methodological dispute. Nonetheless, in this case, the degree of reputed chief designer influence is clear. Reports in the Russian press suggest that the three design bureaux chiefs were able to develop and implement their own programmes and policies with little regard for the party and government leadership. The major constraint on them was competition from other bureaux. Thus, we are looking for evidence about whether the designers were able to dominate the policy process, or important parts of it. Such influence could come in numerous formal or informal ways. These will be addressed throughout the course of the dissertation.

Determining the role of the chief designers in the Soviet manned space policymaking process in the 1960s is the primary objective of this dissertation. In order to get as complete an answer to this question as possible, the following chapters will seek to answer four central questions. To recapitulate, these are: 1. What major manned space projects did the Soviet Union engage in during the 1960s, and how were these projects authorised? 2. Did the chief designers play an influential role in the promotion, selection, approval, and implementation of these projects? 3. What were the overall objectives and purposes of the Soviet manned space programme? 4. What does the example of Soviet space policy tell us about the Soviet political system?

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[92] e.g., Almquist, Red Forge; Solomon, Soviet Criminologists and Criminal Policy; and Gustafson, Reform and Power in Soviet Politics.

Chapter 2: Origins of the Soviet Space Programme

"The Earth is the cradle of reason, but one cannot live in the cradle forever."

K. E. Tsiolkovskii

Revolutionary Efforts

The Soviet space programme is a product of two historical threads. Soviet books on rocketry trace the origins of such work back to at least the 17th Century.[1] However, Soviet works on the manned space programme nearly always neglect this earlier tradition and begin with the turn of the century work of Konstantin Eduardovich Tsiolkovskii.[2] These different starting points reveal the distinct perspectives of the two important threads in the Soviet space programme. The older one - the artillery tradition - is based on the military uses of ballistics, whether in the form of cannon shells or powered missiles. The newer one - the Tsiolkovskii tradition - is specifically aimed at the use of rockets for manned spaceflight. This tradition is based on the vision that colonising space is the destiny of humanity. It is captured in several ubiquitous quotes, such as the one found at the top of this page. In the Soviet period, Tsiolkovskii's visionary dreams were woven together with the artillery tradition, but the differences in the two threads have left patterns in the fabric of missile and space programmes.

The artillery tradition may be older, but the advocates of manned spaceflight came into their own during the Soviet period. As suggested by Soviet histories, it all began with Tsiolkovskii, the man revered as the "Father of Soviet Space Flight."[3] He spent his entire adult life as a teacher in the provincial town of Kaluga.[4] There, inspired by the novels of Jules Verne, he turned his imagination and considerable mathematical skills to questions

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[1] e.g., V. N. Sokolskii, A Short Outline of the Development of Rocket Research in the USSR, trans. by US Department of Commerce, Moscow: USSR Academy of Sciences, 1960.
[2] e.g., M. Baranova and Y. Veltistov, Rags, Borya and the Rocket: A Tale of Homeless Dogs and How they Became Famous, trans. Anne Hansen, Moscow: Progress Publishers, no date(probably 1960); Evgeny Riabchikov, Russians in Space, trans. Guy Daniels, New York: Doubleday & Co., Inc., 1971; G. Titov, Golubaia Moia Planeta, Moscow: Voennoe Izdatel'stvo, 1973; A. P. Romanov, and I. G. Borisenko, Otsiuda Dorogi k Planetam Legli, Moscow: Politicheskoi Literatury, 1984.
[3] Rita DeDomenico, The Official Image of Konstantin Tsiolkovsky in the Soviet Union, 1959-1970, Harvard University: Senior thesis, 1986.
[4] 150 km south-west of Moscow.

of space travel. Tsiolkovskii wrote a number of scientific and fictionalised works detailing the physical principles of rocketry and human spaceflight.[5] In his 1903 paper, "Investigating Space with Reactive Devices," he not only advocated the use of liquid fuel rocket engines as the best propulsion system for manned spacecraft, but also revealed the basic mathematical formulae of spaceflight. These findings were dismissed by Tsarist scientific authorities and went largely unnoticed.[6] After the Bolshevik revolution Tsiolkovskii's futuristic work gained a larger and more appreciative audience among both government officials and the public. In 1918 he was elected to the Russian Socialist Academy and, in 1921, was granted a lifetime state pension in recognition of his work.[7]

Although his work remained purely theoretical, Tsiolkovskii inspired an entire generation of scientists, inventors, and engineers. In this way he earned his place in the pantheon of Soviet heroes, for not only did he support the Bolshevik cause and provide a sound theoretical basis for space exploration, but he inspired and encouraged the people who made the Soviet Union the first spacefaring country.[8] During the 1920s Tsiolkovskii's ideas found a dedicated following in the heady post-revolutionary atmosphere, especially among student engineers in a number of aviation institutes. Of particular note were the Moscow Higher Technical School (MVTU) and the Zhukovskii Air Force Academy, where Tsiolkovskii himself lectured on his ideas in 1923. Many of the young enthusiasts travelled to Kaluga to meet Tsiolkovskii and organised groups to study his ideas.[9]

Such excitement about space travel was not unique to the Soviet Union. Throughout the world the interwar period was a time of great excitement about rocketry and space travel. Many enthusiasts formed societies with the express purpose of

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[5]Tsiolkovskii's 1895 book Grezy o Zemle i Nebe was the first serious discussion of satellites in Russia.
[6]Nicholas Daniloff, The Kremlin and the Cosmos, New York: William Morrow & Co, 1972, p. 19.
[7]Daniloff, The Kremlin and the Cosmos, p. 19. The pension was granted in Council of Peoples Commissars Decree No. a16085, dated 10 November 1921.
[8]Tsiolkovskii certainly had good reason to favour the Bolsheviks since his treatment after 1917 was a marked contrast to that he endured under Tsarist scientific and religious officials. In his will he specified that his scientific papers and works be given to the party.
[9]Among the groups were: The Interplanetary Flight Group of the Zhukovskii Academy, the Central Bureau for the Study of the Problems of Rocket Flight, and the Society to Study Interplanetary Communications. (Michael Stoiko, Soviet Rocketry: Past, Present, and Future, New York: Holt Rinehart and Winston, 1970, p. 30-32.) With regard to the latter group, it should be noted that the word commonly translated as "communications" could also imply "travel."

developing rockets that would pave the way for human space exploration.[10] From April to June 1927 the Moscow Association of Inventors held an exhibition on space travel that caused a public sensation. Unfortunately for the young enthusiasts, Soviet authorities proved as sceptical as their Tsarist forebears about the immediate practicality of such futuristic ideas.[11] After the Moscow exhibition, one of Tsiolkovskii's most committed disciples, Fredrikh Arturovich Tsander, tried and failed to get government support to conduct his rocket experiments on a full-time basis.[12]

Tsander asked for support at exactly the wrong time. The emphasis in the First Five Year Plan (1928-1932), then just being developed, was on assimilating foreign technology,[13] not on developing radical indigenous ideas.[14] Government tolerance for rocketry enthusiasts evaporated as the economy was harnessed to achieve rapid industrial growth. Between 1929 and 1930 the government disbanded the rocket societies.[15] The enthusiasts were redirected into aviation work. One of the major tasks of the First Five Year Plan was to rebuild the defence industry and rapidly increase the production of arms.[16] Thus, the only rocket work that continued was that directly sponsored by the Red Army.

The military had established a rocket research centre of its own in 1921. In July 1928 this group, having moved to Leningrad to be nearer its headquarters in the artillery forces, was renamed the Gas Dynamics Laboratory (GDL). Coincidentally, one of the most highly regarded military thinkers in Soviet history was appointed Commander of the Leningrad Military District in 1928. General Mikhail Nikolaevich Tukhachevskii[17] soon

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[10]Frank H. Winter, Prelude to the Space Age: The Rocket Societies, 1924-40, Washington, DC: Smithsonian Institution Press, 1983.

[11]Daniloff, The Kremlin and the Cosmos, p. 24.

[12]F. A. Tsander (1887-1933) had completed his studies at the Riga Polytechnic Institute in 1914 and spent his working career in the aviation industry in Moscow.

[13]One of the major sources of this technology was Germany, which colluded with the Soviets to undermine the military restrictions in the Versailles Treaty. In 1929 German engineers and construction workers arrived in, among other places, the town of Podlipki near Moscow. There they built Artillery Factory Number 8, later to be the home of the Soviet post-war missile industry. In 1938 Podlipki was renamed Kaliningrad. (A. Zak, "V Kosmicheskoi Kolybeli," Nezavisimaia Gazeta, 13 April 1993.)

[14]Bruce Parrott, Politics and Technology in the Soviet Union, Cambridge: MIT Press, 1983, p. 28.

[15]Stoiko, Soviet Rocketry, p. 32.

[16]David Holloway, The Soviet Union and the Arms Race, 2nd ed., New Haven: Yale University Press, 1984, p. 7.

[17]M. N. Tukhachevskii (1893-1937) completed the Aleksandrovskii Military Academy in 1914. During the Civil War he joined the Bolsheviks and rose rapidly to command positions in the Red Army. From 1925 -

came in close contact with the work of GDL.[18] If he was not aware of it previously, he soon realised that rockets had several applications in his visionary plans for the development of the Red Army. Tukhachevskii encouraged the expansion of GDL and was so enamoured of their work that, when he returned to Moscow as Chief of Armaments for the Red Army in 1931, he put it under his direct supervision.[19]

By that time, GDL was pursuing a number of lines of research. As an artillery research laboratory, the focus at GDL had long been on the traditional solid fuel (or powder) rocket.[20] This research was led by Georgii Erikhovich Langemak.[21] However, when Valentin Petrovich Glushko joined the staff in 1929, he proposed that they also study other technologies.[22] Glushko was given charge of a new department, and he quickly established a reputation for himself by building the world's first electric rocket motors and the first Soviet liquid fuel rocket engines.[23]

While military efforts were proceeding apace, the civilian inventors and engineers managed to re-establish serious experimental work. In 1931 rocket groups sprang up again in most major Soviet cities under the auspices of the Society for the Promotion of Defence, Aviation, and Chemical Production (OSOAVIAKHIM.)[24] Osoaviakhim had sponsored these Groups for the Study of Reactive Propulsion (GIRD)[25] to promote the

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1928 he served as Chief of the General Staff. He became a candidate member of the Party Central Committee in 1934 and was promoted to the rank of Marshal of the Soviet Union in 1935.

[18]David Holloway, "Innovation in the defence sector: battle tanks and ICBMs," in Ronald Amann, Julian Cooper, eds., Industrial Innovation in the Soviet Union, London: Yale University Press, 1982, p. 386.

[19]Holloway, "Battle Tanks and ICBMs," p. 387.

[20]Milan Kocourek, "Rocketry: Level of Technology in Launch Vehicles and Manned Space Capsules," in Ronald Amann, Julian Cooper, R. W. Davies, eds., The Technological Level of Soviet Industry, London: Yale University Press, 1977, p. 492.

[21]G. E. Langemak (1898-1938) joined the Red Army in 1919 and served in artillery units. He graduated from the Military-Technical Academy in 1928, after which he worked at GDL. His work there led to the development of the famed "Katiusha" rocket weapon.

[22]For Glushko, see Appendix 3.

[23]Research on electric rockets was later dropped when they proved inefficient for use in the atmosphere. It should be noted that American and German rocket researchers had already been independently developing liquid fuel rocket engines. In fact, the first successful test of a liquid-fuelled rocket was conducted by Robert Goddard on 16 March 1926 in Worcester, Massachusetts, USA. Although Goddard was driven by dreams of manned flight to Mars, he was extremely wary of publicity. His accomplishments were little known until after his death in 1945.

[24]This organisation eventually developed into DOSAAF, and played a similar role in encouraging mass activities that would (it was hoped) improve the military strength of the country.

[25]"Reaktivnyi" is also translated as "rocket" and "jet." In Russian it means that principle of propulsion common to both jet and rocket engines - thrust produced by reaction from outflowing hot gas. "Reactive," while perhaps awkward, more accurately conveys the broader meaning of the Russian word.

ideas of jet and rocket propulsion for aircraft. The Moscow GIRD (MosGIRD) was particularly successful in its promotional efforts, conducting public lectures and courses, and publishing a number of books.[26]

Yet, MosGIRD engaged in more than education. The founding members of MosGIRD were Tsander and a group of young aviation engineers, all of whom were committed to Tsiolkovskii's ideas of spaceflight.[27] Foremost among the young engineers was Sergei Pavlovich Korolev, a recent graduate of the Moscow Higher Technical School (MVTU) who later claimed to have travelled to Kaluga to meet Tsiolkovskii in 1929.[28] The four founders of MosGIRD each set up their own design team to build rockets, apparently illicitly, in a Moscow basement.[29] Although the GIRD groups throughout the country were small, they were able to carry out significant research and development work.[30] This was due, in part, to the effects of increased government encouragement of native inventors during the Second Five Year Plan (1932-37) and the co-ordination between the various rocket groups, but the necessary condition was military investment in rocket development.

The self-supported, visionary strand of rocket development was co-opted into military research. In June 1931 B. N. Petropavlovskii, director of the GDL, complained to his superiors in the Artillery Administration that the GIRD groups were a wasteful duplication of effort and should be merged with GDL. It was at this point that S. P. Korolev began his long, chequered, high risk career as a political advocate for Tsiolkovskii's ideas. Taking advantage of his proximity to Tukhachevskii (now in Moscow as Commissar of Armaments) and the sudden death of Petropavlovskii, Korolev proposed his own merger plan. Tukhachevskii supported Korolev's version in the face of

[26]Kocourek, "Rocketry," in Amann, Cooper, and Davies, eds., The Technological Level of Soviet Industry, p. 493.
[27]The "founders" of MosGIRD were Tsander, S. P. Korolev, M. K. Tikhonravov, and Iu. A. Pobedonostsev.
[28] For Korolev, see Appendix 3. A recent biography suggests that Korolev's story about his trip to Kaluga was a colourful exaggeration. (Ia. K. Golovanov, Korolev: Fakty i Mify, Moscow: Nauka, 1995, pp. 103-113.)
[29]Riabchikov, Russians in Space, pp. 104-107.
[30]For example, the fuel chosen for the first successful rocket was originally proposed by members of the GIRD in Baku. (Iu. V. Biriukov, "Role of M. K. Tikhonravov in the Development of Soviet Rocket-Space Technology," Foreign Technology Division Translation, FTD-ID(RS)T-0683-88 (from unnamed source), Wright-Patterson Air Force Base Ohio, 14 September 1988, p. 4.)

widespread opposition. A long bureaucratic struggle ensued that lasted nearly three years.[31]

While bureaucratic struggles over the merger continued, the Leningrad and Moscow branches of GIRD won financial support from Tukhachevskii, through his Directorate of Military Inventions. Military funds allowed MosGIRD to complete and test the first two liquid-fuelled Soviet rockets. Korolev, now head of the MosGIRD Council of Technical Specialists, led the tests.[32] One of Korolev's first decisions was to concentrate MosGIRD's work on the two simplest and most promising designs: one developed by M. K. Tikhonravov, the other developed by the late F. A. Tsander.[33] Tikhonravov's GIRD 09 flew first, on 17 August 1933.[34] Although the test ended in an abrupt crash,[35] Korolev declared it a success and used this to lobby for a thirty thousand ruble government grant and for his version of the merger plan.[36]

Initially, Korolev's bold move seemed to have paid off. General Tukhachevskii merged MosGIRD and GDL into the Reactive Scientific Research Institute (RNII). The interests of the artillery researchers at GDL were almost completely ignored in the merger. Nowhere was this more evident than in the choice of leadership for the new Institute. The Director was Ivan Terent'evich Kleimenov, who, although appointed Head of GDL in 1932, had no previous connection to the artillery forces.[37] In fact, Kleimenov was a prominent aviation specialist. As Tukhachevskii's choice to succeed Petropavlovskii, Kleimenov had caused considerable irritation at GDL.[38] Kleimenov's Deputy Director at RNII was Korolev.

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[31]For details of this process see: Mikhail Tsypkin, The Origins of Soviet Military Research and Development System (1917-1941), Harvard University: Ph.D. dissertation, 1985, pp. 196-200.
[32]Tsander had died in March 1933.
[33]Biriukov, "Role of M. K. Tikhonravov," pp. 4-5. For Tikhonravov, see Appendix 3.
[34]Tsander's design, the GIRD X (10) flew on 25 November 1933.
[35]A bracket in the tail of the rocket failed causing it to veer out of control and crash after just 18 seconds of flight. (Riabchikov, Russians in Space, pp. 112-113; Peter Alway, "The Rockets of GIRD," Quest, Vol. 4, No. 1, Spring 1995, pp. 24-29.)
[36]Biriukov, "Role of M. K. Tikhonravov," p. 11.
[37]I. T. Kleimenov (1898-1938) was a graduate of the Zhukovskii Air Force Academy who served in the Soviet Trade Mission in Germany in the 1920s. Legend has it that he was on good terms with Tsiolkovskii.
[38]It also caused trouble with the Air Force and aviation industry, since Kleimenov had been slated to move to the post of head of the Technical Directorate of the Air Fleet. Stealing Kleimenov away was quite a coup, since he not only had a reputation as an excellent organiser, but had apparently learned about German rocket developments while posted there. (Tsypkin, The Origins of Soviet Military Research and Development System, pp. 187, 195.)

Korolev's success was short-lived. Just prior to Tukhachevskii's order to create RNII, a party commission investigating the idea recommended that the new institute be subordinated to the Commissariat of Heavy Industry.[39] Like many military leaders that would follow him, Tukhachevskii wanted control of weapons research and development. Despite the party recommendation, he put RNII under the command of his own Directorate of Military Inventions.[40] This move was quickly overruled. By April 1934 RNII had been moved to the Commissariat of Heavy Industry, where it came under the eye of Sergo Ordzhonikidze.[41] Even before this, Korolev had been relieved of his duties as Deputy Director of RNII and demoted to head of a design department. He was replaced as deputy of RNII by G. E. Langemak, the artilleryman and solid fuel rocket designer from GDL. In addition, Korolev's two major GIRD projects, the liquid-fuelled ballistic missile and a rocket-powered aircraft, were eliminated from RNII's research plan.[42]

Over the next few years individual departments of RNII did make a number of important advances, but the efforts were poorly co-ordinated and many projects failed to get off the drawing boards. Glushko's group produced a whole series of liquid fuel rocket engines; over fifty different models from 1934 to 1938. Yet, unlike engines, liquid-fuelled rockets were a low priority at RNII. Crucial work on guidance and control systems was stalled by opposition from artillery leaders. Parts for rockets were in such short supply that they were salvaged for re-use after each test launch. An unusually tight cloak of secrecy around RNII appears to have hampered work by the designers from GIRD who were accustomed to a more free-wheeling approach.[43]

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[39]See Appendix 4, sheet 1.

[40]Tsypkin, The Origins of Soviet Military Research and Development System, p. 199.

[41]One report, based on NKVD files, suggests that Ordzhonikidze may have taken a personal interest in Glushko's work, protecting it from those in the RNII who preferred to stick to traditional artillery-style solid fuel rockets. (N. L. Anisimov, and V. G. Oppokov, "Proisshestvie v NII-3," Voenno-Istoricheskii Zhurnal, No. 11, 1989, especially the letters from Glushko's mother quoted on pp. 66-67.)

[42]Tsypkin, The Origins of Soviet Military Research and Development System, p. 192.

[43]Such isolation may not have been so unusual for military researchers, but RNII seems to have been even more isolated than most due to its chequered administrative past. It is notable that in a comprehensive study of the Research Institutes of the Commissariat for Heavy Industry conducted in 1935, the author mentions that one Institute is not discussed. It appears that RNII was the missing institute. (A. A. Armand, Nauchno-issledovatel'skie Instituty Tyazheloi Promyshlennosti, Moscow and Leningrad, 1935, as noted in Holloway, "Battle Tanks and ICBMs," p. 387.)

In the end no one was satisfied with RNII. The artillery specialists from GDL resented the intrusion of aviation specialists, both the imposition of Kleimenov and the entry of those who had been members of MosGIRD. Tukhachevskii ultimately established a design bureau (KB-7) in the Main Artillery Administration (GAU) to continue work on rockets. It was staffed primarily by former GIRD members who "defected" from RNII.[44] Far from unifying efforts, the creation of RNII resulted in the splintering of related research programmes and the exacerbation of animosities between institutions and individuals. These tensions were a continuing motif that reappeared throughout the history of Soviet rocket development.[45]

Advocates of manned rocketry tried, unsuccessfully, to gain support for their ideas from the leading scientific institutions. In 1934 at an Academy of Sciences conference on the study of the stratosphere Korolev made a presentation advocating the use of rockets to carry instruments aloft. Later that year Korolev published a book proposing the use of a rocket-powered aircraft for similar purposes.[46] At another conference on stratospheric research in 1935, Korolev made a speech supporting the ideas in his book.[47] However, despite his success at finally getting his rocket plane research included in the RNII plan that year, Korolev's ideas had little positive effect.

In the 1930s most leading authorities in both the Academy of Sciences and the military were extremely sceptical about manned rockets. Even at ceremonies celebrating the 75th anniversary of Tsiolkovskii's birth (1932) hosted by the Institute of the History of Science of the USSR Academy of Sciences, several speakers derided Tsiolkovskii's ideas of space travel and declared that the unreliability of rockets made them impractical for serious use.[48] "Professional" researchers (like those from GDL) were particularly opposed to starry-eyed "amateur" inventors (like those from GIRD); many of whom were seen as

[44]Tsypkin, The Origins of Soviet Military Research and Development System, p. 201.
[45]Such incompatibilities between Soviet research and development organisations were not unusual. (Kendall Bailes, Technology and Society under Lenin and Stalin: Origins of the Soviet Technical Intelligentsia, 1917-41, Princeton: Princeton University Press, 1978, p. 400.)
[46]S. P. Korolev, Raketnyi Polet v Stratosfere, Moscow: Voennoe Izdatel'stvo, 1934.
[47]Daniloff, The Kremlin and the Cosmos, p. 94.
[48]Tsypkin, The Origins of Soviet Military Research and Development System, p. 210.

"crackpots" making a living at the state's expense.[49] It was not simply a matter of lack of resources, or more pressing priorities (which indeed there were), but of entrenched opposition to Tsiolkovskii's seemingly fantastic ideas.

The atmosphere for rocket research only became worse throughout the 1930s. In 1935 the government dissolved the remaining GIRD groups.[50] In mid-1938 growing dissatisfaction with amateur inventors led to the dissolution of the Society of Amateur Inventors.[51] There were also major changes in the USSR Academy of Sciences, that were reflected in the huge influx of new members in 1939.[52] These changes were not peculiar to rocketry, but were part of larger social trends that affected all aspects of life in the Soviet Union. Among these general problems were the dislocation caused by collectivisation and industrialisation, the growing threat of war, and, most importantly, the purges.

The Purges and The War

The close association of rocket research with certain leaders, and its connection to the aviation design industry, combined to create a devastating impact during the purges of the late 1930s. Following the arrest of Tukhachevskii and the death of Ordzhonikidze, the rocket institutes were scrutinised for their close association with both of these individuals. In addition, poor performance of Soviet aircraft in the Spanish Civil War led to a major purge and shake-up in aviation design bureaux.[53] Many of the rocket enthusiasts worked in, or had been associated with, the aviation industry and became targets of the purges for that reason as well.[54]

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[49]Bailes, Technology and Society under Lenin and Stalin, p. 366. As is often the case, many of the "amateurs" were more qualified, competent, and successful than their "professional" (i.e. state-supported) counterparts.
[50]Stoiko, Soviet Rocketry, p. 32.
[51]Bailes, Technology and Society under Lenin and Stalin, p. 366.
[52]See Appendix 5.
[53]See Chapter 3.
[54]Korolev, for example, had not only worked in the aviation industry prior to the creation of RNII, but had done his final academic project under the direction of A. N. Tupolev. (A. Iu. Ishlinskii, "O Zhizni i Deiatel'nosti Sergeia Pavlovicha Koroleva," in Gagarinskie Nauchnye Chteniia po Kosmonavtike i Aviatsii: 1986, Moscow: Nauka, 1987, p. 7.)

Rocket research was virtually wiped out by mid-1938. RNII chief Kleimenov and his deputy Langemak were both arrested in 1937 and executed in early 1938. Shortly thereafter many of the Tsiolkovskii advocates in RNII were arrested as members of a "counterrevolutionary trotskiite organisation." Glushko and Korolev were among those so charged.[55] Both were convicted and sentenced to long prison terms.[56] Tukhachevskii's KB-7 was shut down in 1939, and what remained of RNII was renamed NII-3.[57]

Well before the German invasion in June 1941, the Soviet Union began to focus exclusively on weapons projects that were thought to have an immediate payoff. As a result, the talents of the rocket scientists and engineers were redirected. Glushko's rocket engine group was assigned to a Moscow aviation factory to develop rocket boosters for aircraft, working as a prison design bureau.[58] NII-3, the remnant of RNII, concentrated on final development of what became famous as the "Katiusha" rocket system.[59]

Eventually, Korolev was also put to work in the prison design system. After spending two years in a labour camp in the Far East he was rescued by his former teacher, A. N. Tupolev.[60] Tupolev had been allowed to make a list of the engineers he wanted for his own prison design bureau - Korolev was on the list. Korolev's case was reviewed by an NKVD special commission on 10 July 1940. This commission found him guilty of the lesser crime of "wrecker trotskiite activities" and re-sentenced him to eight years

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[55]Glushko was arrested first. Korolev, who was in hospital recovering from injuries sustained in an engine test accident, spoke out in favour of Glushko. After being released from hospital Korolev was arrested. It appears that one of the people who denounced him was Glushko. (Golovanov, Korolev: Fakty i Mify, p. 249.)

[56]Glushko was sentenced to eight years in prison. As for Korolev, legend has it that the interrogators found him a particularly difficult customer. In any case, he was sentenced to 10 years in the infamous labour camps of Kolyma. (Anisimov and Oppokov, "Proisshestvie v NII-3," pp. 66, 68; and M. Rebrov, "Lider: Maloizvestnye Stranitsy iz Zhizni S. P. Koroleva," Krasnaia Zvezda, 1 July 1989.)

[57]Tsypkin, The Origins of Soviet Military Research and Development System, p.239; and Golovanov, Korolev: Fakty i Mify, p. 237.

[58]The Soviet Union made wide use of imprisoned engineers and scientists in this way. For a fascinating fictional account of post-war prison design bureaux see: Alexander Solzhenitsyn, The First Circle, New York: Harper & Row Publishers, 1968. (One of the characters in Solzhenitsyn's book (Bobynin) is said to be patterned on Korolev.)

[59]The Katiusha project had been largely completed before its chief designer, Langemak, was arrested and executed. (Anisimov and Oppokov, "Proisshestvie v NII-3," p. 71.)

[60]At least two Pilot-Heroes of the Soviet Union had tried to intervene on Korolev's behalf. It is unclear if this had any effect on Korolev's fate. (B. Viktorov, "Vozvrashchenie Imeni," Nauka i Zhizn', No. 5, 1988. p. 81-82.)

deprivation of freedom.[61] Korolev was then put to work designing the wing of the Tu-2 bomber.[62]

Korolev's passion for rockets was not dimmed by his imprisonment. Almost immediately after his move to Tupolev's sharaga (prison design bureau) Korolev wrote to NKVD Commissar L. P. Beriia to propose a rocket-propelled aircraft.[63] Although this proposal was ignored, Korolev devoted his limited "off-hours" to rocket design problems.[64] His relentless commitment to rocket research was even mentioned by Aleksandr Solzhenitsyn in his Gulag Archipelago.[65] Eventually Korolev's work would prove valuable, but before the war began it remained a purely personal endeavour.

Relatively early in the war with Germany the situation in prison design bureaux changed to the benefit of the rocket enthusiasts. A number of technologically demanding projects were reinvigorated, including rocket propelled aircraft work. When Korolev heard that Glushko was working on such a project at OKB-RD in Kazan he pushed for a transfer.[66] By the fall of 1942 Korolev was working under Glushko, and in January 1943 was given charge of the flight test group (Group No. 5).[67] Glushko continued to develop rocket engines for use on aircraft and Korolev led the tests of them on a Pe-2 bomber.

As the Front moved rapidly westward in 1944, there were further significant changes. The post-war economic development plan, created that year, marked a major change in R&D policy. A joint effort by the State Planning Commission (Gosplan), the Academy of Sciences, and the industrial commissariats, the economic development plan

[61]Anisimov and Oppokov, "Proisshestvie v NII-3," pp. 67-8. There was no net change in his prison term, although the move almost certainly saved Korolev's life. The vast majority of his fellow prisoners in Kolyma perished there.

[62]"Poligon" Moscow Ostankino Television Programme, broadcast 12 September 1993, as transcribed and translated in FBIS, Daily Report: Central Eurasia, FBIS-SOV-93-117, 15 September 1993, p. 34.

[63]Prison design bureaux were subordinate to the NKVD. Korolev wrote to Beriia on 24 July 1940. (Rebrov, "Lider.") For Beriia, see Appendix 3.

[64]Golovanov, Korolev: Fakty i Mify, p. 309.

[65]Aleksandr Solzhenitsyn, The Gulag Archipelago: An Experiment in Literary Investigation, Part 2, trans. by Thomas P. Whitney, New York: Harper & Row, 1974, p. 482.

[66]OKB-RD was a design bureau for "reactive" (jet or rocket) engines. This organisation has been referred to by a number of different designations, some of which obscure its subordination to the Fourth Special Department of the NKVD. OKB-RD was still a prison design bureau, and although Glushko was "chief designer of engines" he was still a prisoner. (Tsypkin, The Origins of Soviet Military Research and Development System, p.250; and Golovanov, Korolev: Fakty i Mify, p. 314.)

[67]The fact that Korolev had been his deputy was a point that Glushko never forgot. For his part, Korolev later emphasised that Group No. 5 was independent of Glushko's control. (Golovanov, Korolev: Fakty i Mify, p. 327.)

called for assignment of top priority to a number of new technologies.[68] Along with nuclear weapons, radar, and jet aircraft, it also targeted rocket technology.[69] Additionally, as part of the wider programme of rewarding successful prison designers, most of the surviving rocket enthusiasts from the 1930s were released from prison.[70] Korolev and Glushko received their releases in the summer of 1944.[71]

In September, 1944, Soviet forces advancing through Poland found fragments of German V-2s on an artillery test range. These parts were shipped back to an organisational remnant of RNII, now known as NII-1.[72] There, a small group of specialists conducted a three-month examination. The group included many of the people who would later became leaders in the Soviet space programme.[73] Their final report proposed the creation of an improved, longer range version of the V-2. However, their proposals were not adopted and they were ordered by the Commissariat leadership to discontinue all work on missile design. It is unclear why Commissar of Aviation Industry Shakhurin made this decision, but the most common reason given is that rockets were in the jurisdiction of the Commissariat of Armaments.[74] Nevertheless, a few specialists at NII-1 surreptitiously continued rocket studies.[75]

Post-War Missile Programmes

Several months after the completion of the V-2 studies the war was over and the Soviets found themselves in possession of many of the German rocket research facilities.

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[68]Parrott, Politics and Technology in the Soviet Union, p. 114. (The plan was ratified by the Academy of Sciences in late 1944.)
[69]The official interest in rockets was no doubt related to the German success with the V-1 and V-2 rockets, which were put into mass production in 1943.
[70]Tupolev and many of his top engineers had been freed in September 1943 for their work on the Tu-2. Korolev, who had left the Tupolev bureau a year earlier, was not included in that list. (Golovanov, Korolev: Fakty i Mify, p. 312.)
[71]They were released from prison, but their earlier convictions remained on their records until the 1950s.
[72]As mentioned above RNII was re-named NII-3 during the purges. This organisation underwent at least one other change of name before being fused with the Bolkhovitinov aviation design bureau in early 1944. It then became known as NII-1 and came under the Commissariat of Aviation Industry.
[73]They included N. A. Piliugin, A. Ia. Berezniak, B. E. Chertok, L. A. Voskresenskii, V. P. Mishin, M. K. Tikhonravov, and Iu. A. Pobedonostsev. (B. Konovalov, "Iz Germanii - V Kapustin Iar," Izvestiia, 6 April 1991.)
[74]Carl-Fredrik Geust, Under the Red Star, Shrewsbury, England: Airlife, 1993, pp. 113-4; and Konovalov, "Iz Germanii - V Kapustin Iar."
[75]Konovalov, "Iz Germanii - V Kapustin Iar."

The Soviet government dispatched a special state commission to assess German rocket technology. Chaired by General L. M. Gaidukov,[76] the commission flew to Germany on 24 May 1945.[77] Their orders were to provide a full description of the V-2, but they were only able to collect a partial set of documentation.[78] On 9 August a second group of more experienced rocket engineers (many of whom had worked on the Polish fragments) were sent to join the commission. This new group of over a dozen men had been hand-picked by the Central Committee just the previous day.[79] Several of them had, until recently, been prisoners in the GULag but they were summarily appointed to senior officer ranks and issued uniforms so as to be less conspicuous while in occupied Germany. Upon arrival they set up a number of different groups to study various aspects of German missile technology.[80]

As the huge scale of German aeronautical and missile research became clearer, Soviet study teams were expanded and re-organised numerous times. In addition to missile researchers, a number of other ad hoc research groups, with a variety of institutional affiliations, all engaged in a rather chaotic scramble for a variety of German technologies.[81] Korolev arrived in Germany in the fall of 1945 and was appointed technical leader of "Vystrel."[82] This group was formed to build and launch V-2s with the help of the remaining German parts and technicians. "Vystrel" did not last long, as missile work was reorganised around the underground German missile production facility at

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[76]According to one report, Gaidukov was the Chairman of a Central Committee Department at the time. (S. Averkov, "Rakety Tret'ego Reikha," Rabochaia Tribuna, 4 July 1991.) A short biographical note about Gaidukov in an RVSN history makes no mention of this fact. (I. D. Sergeev, et al., Khronika Osnovnykh Sobytii Istorii Raketnykh Voisk Strategicheskogo Naznacheniia, Moscow: TsIPK, 1994, p. 56.)

[77] Konovalov, "Iz Germanii - V Kapustin Iar."

[78]Averkov, "Rakety Tret'ego Reikha." (The German rocket scientists had deliberately surrendered to the Western allies and brought much of the technical documentation with them.)

[79]The group included N. A. Piliugin, V. P. Glushko, V. P. Barmin, V. P. Mishin, N. S. Riazanskii, V. I. Kuznetsov, B. E. Chertok. Note that this group did not include Korolev. (Averkov, "Rakety Tret'ego Reikha," and Konovalov, "Iz Germanii - V Kapustin Iar.")

[80]Averkov, "Rakety Tret'ego Reikha," and Konovalov, "Iz Germanii - V Kapustin Iar."

[81]This has been unfavourably compared by some to what was perceived as a much more deliberate and organised effort on the part of the Western allies, especially the United States. (B. Konovalov, "U Sovetskikh Raketnykh Triumfov Bylo Nemetskoe Nachalo," part 1, Izvestiia, 4 March 1992. See also Tom Bower, The Paperclip Conspiracy: The Battle for the Spoils and Secrets of Nazi Germany, Boston: Little-Brown, 1988.)

[82]Konovalov, "Iz Germanii - V Kapustin Iar." In an autobiographical note from the 1950s Korolev put the date of his arrival as September 1945, although others have named dates between August and November. (Anisimov and Oppokov, "Proisshestvie v NII-3," p. 69.)

Nordhausen. This "Nordhausen Institute" was headed by General Gaidukov with Korolev as his deputy.[83] When visited in early 1946 by a government commission, Gaidukov recommended that Korolev be placed in charge of rocket construction.[84]

The institutional structure of the Soviet rocket research programme was set shortly after the government commission visited Germany. On 13 May 1946 the Council of Ministers passed decree No. 1017-419ss.[85] The decree created a "Special Committee on Reactive Technology" under the Council of Ministers with G. M. Malenkov as Chairman, and Minister of Armaments Ustinov as Deputy Chairman.[86] The Committee was created to ensure the "reproduction with native (Soviet) materials" of the V-2 rocket and the Vasserfall anti-aircraft rocket.[87] A number of ministries[88] were assigned specific tasks to accomplish these goals, but three ministries were singled out as the lead research and production organisation for various types of weapons. Dmitrii Fedorovich Ustinov's Ministry of Armaments was given responsibility for liquid-fuel missiles. The Ministry of Agricultural Machinebuilding (until earlier the same year, known as the People's Commissariat of Munitions[89]) was assigned responsibility for solid-fuel missiles. Finally, the Ministry of Aviation Industry, under the newly appointed Minister Khrunichev, was put in charge of winged missiles.[90] This basic division of responsibilities set an extremely long-lasting precedent for the industrial ministries.

The decree also specified the creation of a number of scientific research institutions within the ministries. One of these, NII-88 in the Ministry of Armaments, was

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[83]Oral history of Iu. A. Mozzhorin in Iu. A. Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, Moscow: MAI Press, 1992, p. 137.
[84]Konovalov, "Iz Germanii - V Kapustin Iar." Minister of Armaments D. F. Ustinov was one of the members of the visiting commission.
[85]This decree is reportedly held in the Archive of the President of the Russian Federation, Fond 93. It is reproduced, in Sergeev, et al., Khronika Osnovnykh Sobytii Istorii Raketnykh Voisk Strategicheskogo Naznacheniia, pp. 227-233. For a summary of known decrees on the Soviet missile and space programmes see Appendix 6.
[86]For Malenkov and Ustinov, see Appendix 3.
[87]Decree No. 1017-419ss, Article I, paragraph 5.
[88]Commissariats were renamed ministries in 1946.
[89]See Appendix 4, sheet 2.
[90]For Khrunichev, see Appendix 3. According to the Soviet defector Tokaty, the previous Minister, Shakhurin, and the Head of the Soviet Air Force, Marshal Novikov, were fired in early 1946 for falling behind the Germans in rocket and jet technology. (Grigorii A. Tokaty, "Foundations of Soviet Cosmonautics," Spaceflight, Vol. 10, No. 10, October 1968, p. 342.)

based at Armaments Factory No. 88 in Kaliningrad, near Moscow.[91] Lev Robertovich Gonor, a protégé of Minister of Armaments Ustinov, became the director of NII-88.[92] In August 1946, while still serving in Germany, Korolev was appointed chief designer of a department of NII-88 assigned to produce V-2s.[93] The 13 May 1946 decree also suggested that German specialists would be an important part of the post-war missile effort by ordering preparations for their movement to the Soviet Union.[94] In October 1946 several hundred German rocket specialists, their families, and equipment, were shipped to various locations in the USSR.[95]

The 13 May 1946 decree not only established the responsibilities for the production ministries, but set a number of other important precedents for the Soviet missile programme. The decree assigned control over test ranges to the Ministry of Armed Forces.[96] It also encouraged the spirit of competition between the industrial ministries and their designers by authorising prizes and special payments for successful designs.[97] In addition, the decree specified the creation of a special weapons department in Gosplan to be headed by the deputy chairman of that organisation.[98] These basic assignments were never significantly altered and had major ramifications for the later development of the Soviet missile and space programmes.

In accordance with the decree, the Soviet military also began to change to accommodate the new weaponry. By July 1946 the first missile units were formed on the basis of the Guards mortar units that had used the short-range solid-fuel Katiusha rocket during the war. The new units were overseen by Marshal Mitrofan Ivanovich Nedelin, who was then Chief of Staff of the Artillery Forces.[99] In October 1946 the Council of

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[91]This was the same facility built by the Germans in 1929. However, at this point the buildings were empty because the factory equipment had been evacuated to the East during the war. (M. Rebrov, "Versiia Shifra 'PS'," Delovoi Mir, 10 October 1992, p. 10; and Zak, "V Kosmicheskoi Kolybeli.")

[92]Gonor had worked under Ustinov in the Commissariat of Armaments during the war.

[93]Averkov, "Rakety Tret'ego Reikha."

[94]Decree No. 1017-419ss, Article IV, paragraph 17.

[95]Rocket specialists were not the only ones caught in the round-up of German talent. Reports vary wildly, but recent research suggests that three thousand German "specialists" were brought to the Soviet Union after the war. (Mark Walker, "Review of Die Spezialisten and Die Sowjetische Atombombe," Isis, Vol. 85, No. 3, 1994, pp. 548-9.)

[96]Decree No. 1017-419ss, Article III, paragraph 9D.

[97]Decree No. 1017-419ss, Article V, paragraph 26.

[98]Decree No. 1017-419ss, Article III, paragraph 8.

[99]For Nedelin, see Appendix 3.

Ministers established the Academy of Artillery Sciences within the Ministry of Defence under the command of General, and Academician, Anatolii Arkad'evich Blagonravov.[100] The purpose of the Academy was to train a new corps of military engineers and commanders and to develop requirements and doctrine for the new missile forces.[101]

One of the few important aspects of the post-war Soviet missile programme not specifically mentioned in the 13 May 1946 decree was the role of the security forces.[102] The Ministry of Internal Affairs (MVD), as the NKVD was re-named in March 1946, was not mentioned by name in the decree. However, it is clear that Beriia and his lieutenants were the primary means of oversight of post-war missile design and testing.[103] Despite the fact that there had been a re-organisation of the security forces after Beriia had relinquished his post as head of the NKVD in January 1946, it was clear that he was still substantially in control of the security apparatus.[104]

One of Beriia's top protégés, I. A. Serov, was on the Special Committee for Reactive Technology and was evidently responsible for the welfare and administration of the rocket researchers in Germany.[105] It is not clear whether Serov played this role simply as a result of his position as Deputy Commander for Civil Administration in Germany, or because both the German and the Russian rocket scientists were not considered reliable.[106] Nonetheless, the security services played a direct role in locating and exploiting the German technological legacy. The MVD also continued to oversee the prison labour and design bureaux system after the war. In addition, security forces, in the form of "special

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[100]Sovetskaia Voennaia Entsiklopediia, Vol. 1, Moscow: Voenizdat, 1976, p. 94. For Blagonravov, see Appendix 3.
[101]Sovetskaia Voennaia Entsiklopediia, Vol. 1, p. 94; and Parrott, Politics and Technology in the Soviet Union, p. 119.
[102]It is possible that sections referring to the security services have been excised for publication in Khronika Osnovnykh Sobytii....
[103]M. Rebrov, "Versiia Shifra 'PS';" M. Rebrov, "Lider;" Amy Knight, Beria: Stalin's First Lieutenant, Princeton: Princeton University Press, 1993, pp. 140-41.
[104]Beriia remained Deputy Chairman of the Council of Ministers and, in March 1946, was promoted to full membership in the Politburo. It seems likely that one reason for relinquishing his NKVD post was to give Beriia more time to oversee the top-priority nuclear weapons programme. (Knight, Beria, p. 140.)
[105]Serov was assigned these duties by name in the May 1946 decree. (Decree No. 1017-419ss, Article IV, paragraph 23.) For Serov, see Appendix 3.
[106]Even in the nuclear programme, whose leading scientists had not been convicted in the purges, the Soviet leadership was deeply suspicious of its scientists. As in rocket research, the security forces played a highly intrusive oversight role in the nuclear programme. (David Holloway, Stalin and The Bomb, New Haven: Yale University Press, 1994, p. 115.)

representatives" and "bodyguards" continued to be a pervasive influence in rocket research.

Serov may have played a greater direct role in missile policy through early 1947. In May 1946 Malenkov, who was originally named Chairman of the Special Committee on Reactive Technology, fell out of favour with Stalin. He lost his position on the Central Committee Secretariat and was "exiled" to Central Asia.[107] Serov appears to have assumed control of at least some aspects of the missile programme at this time.[108] Some reports also hold that after returning from Germany, Serov became head of a missile policy institution known as "Special Commission (Spetskom) No. 2."[109]

The origin of Spetskom No. 2 and its first leader are unclear. Its membership and mission (ensuring the development of rocket weapons), make it possible that it was simply an alternative or subsequent name for the Special Committee on Reactive Technology.[110] It is also possible that it was a wholly new organisation created in 1947. Regardless of how it came into being, Spetskom No. 2 appears to have replaced the Special Committee on Reactive Technology. In fact, the numerical designation of the Spetskom fit the missile programme into the overall post-war high-priority weapons research and development structure.[111] Technically, Spetskom No. 2 was a subcommittee of the Council of Ministers, but it appears to have acted independently. Thus, Spetskom No. 2 was functionally equivalent to the First Main Administration, through which Beriia ran the nuclear weapons programme.[112] Serov may have been acting, or de facto, Chairman of Spetskom No. 2 for a while, but in early 1947 Malenkov was brought back to Moscow and became Chairman.[113]

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[107]Knight, Beria, p. 144. Malenkov retained his post as full member of the Politburo - an honour he had won along with Beriia two months before (March 1946).

[108]He is reported to have personally planned the transfer of German "specialists" to the Soviet Union in October 1946. (Frederick I. Ordway, III and Mitchell Sharpe, The Rocket Team, New York: Thomas Y. Crowell, 1979, p. 324.)

[109]Asif Siddiqi, "Soviet Space Programme: Part 2 - Organizational Structure in the 1960s," Spaceflight, Vol. 36, No. 9, September 1994, p. 320. Serov returned from Germany in November 1946.

[110]For example, Minister Ustinov was the Deputy Chairman of both organisations.

[111]See Appendix 7, sheet 1.

[112]For the organisation of the First Main Administration see: Holloway, Stalin and The Bomb, pp. 134-35. For the missile programme as a parallel organisation see: Golovanov, Korolev: Fakty i Mify, p. 454.

[113]According to Amy Knight, Beriia played a major role in winning the return to Moscow of his ally Malenkov. (Knight, Beria, p. 144.)

The issue of whether to rely on German rocket scientists or native Soviet talent sharpened shortly after Malenkov's return. Initially, Stalin and the state security forces appear to have favoured relying on the German scientists and their proven technology.[114] However, this preference was not widely shared by those in the nascent missile industry. Most of the top German scientists had wound up in the West anyway. The specialists and technicians that were moved to the Soviet Union in 1946 had a lot of useful practical knowledge about the testing rockets and mass producing them, but had little to add to the well-developed base of theory that Soviet rocket scientists had developed independently. Moreover, whether by accident or design, once the Germans arrived in the Soviet Union there was little direct contact between the rocket specialists of each country. The Germans worked largely in isolation from, and parallel to, Soviet teams.[115]

When the issue of how much to depend on the Germans came to a head during a Kremlin meeting in mid-April 1947, Stalin still favoured German technology.[116] During the meeting Soviet specialists that had been working in Germany presented their findings. Korolev, who had continued to work on his own designs at Nordhausen, spoke out in favour of immediately building a better rocket.[117] However, Stalin announced that they must first build an analogue to the V-2. Only after succeeding with this, would they discuss new projects.[118]

No doubt remembering his experience in 1933, Korolev set about launching a "Soviet" V-2 as quickly as possible. He knew that there was nothing like a successful demonstration to win government support for his plans. Korolev also knew that, not only were the Germans working on the V-2, but there were numerous other long-range delivery systems under development. These included long-range bomber projects, V-1 "buzz

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[114]Tokaty, "Foundations of Soviet Cosmonautics," pp. 343-4.
[115]Irmgard Gröttrup, Rocket Wife, London: A Deutsche, 1959. (Mrs. Gröttrup was the spouse of the senior German rocket specialist brought to the Soviet Union.)
[116]Interestingly, Stalin had just published an article in Bolshevik in March 1947 attacking the overestimation of German military theory. (Parrott, Politics and Technology in the Soviet Union, p. 119.) For discussion of the April 1947 meetings see: Tokaty, "Foundations of Soviet Cosmonautics," pp. 344-346; and M. Rebrov, "Versiia Shifra 'PS'."
[117]For Korolev's own design work in Germany see: Oral history of Iu. A. Mozzhorin in Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, p. 139.
[118]Rebrov, "Versiia Shifra 'PS'."

bomb" analogues, and other, more exotic, efforts.[119] Within six months, in October 1947, Korolev beat all of these competitors to the punch. His team modified, built, and launched a V-2 at the new Soviet missile test range of Kapustin Iar.[120] More important for Korolev and his team, many of the competing research programmes were disbanded shortly thereafter.[121] Soviet rocket designers were now in a position to directly challenge the German specialists.

Almost immediately after his first success with the V-2, Korolev took another initiative that was to have major consequences. Sometime in November 1947, he invited the other five Soviet chief designers involved in the missile programme to an informal meeting. They were V. P. Glushko, V. P. Barmin, V. I. Kuznetsov, N. A. Piliugin, and M. S. Riazanskii.[122] All of them had worked in Germany after the war and had since seen each other regularly in the course of their design and test work.[123] However, this meeting marked the beginning of a new institution: the Council of Chief Designers. The "Big Six" began to meet regularly in Korolev's office to co-ordinate their work, to discuss technical details, and to forge agreements about the overall course and direction of the missile programme.

The Council of Chief Designers has long been noted in Soviet accounts as one of the unique management innovations that made Korolev's programmes a success.[124] It is distinctly reminiscent of the Council of Technical Specialists that Korolev headed at MosGIRD. In this early period, the Council of Chief Designers functioned as an

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[119]One of the German projects that the Soviets had begun to follow-up was the Sanger-Bredt (or Antipodal) bomber. This flying spacecraft would be lifted by rockets and would then skip across the top of the atmosphere like a flat stone across water. After dropping its bombs the Sanger-Bredt would, like current space shuttles, glide back to land on earth. Since it had wings, under the 13 May 1946 decree this weapon was being developed by the Ministry of Aviation Industry.

[120]The first test took place on 18 October 1947 and a second successful launch was conducted two days later. (B. Konovalov, "U Sovetskikh Raketnykh Triumfov Bylo Nemetskoe Nachalo," part 4, Izvestiia, 7 March 1992.) Kapustin Iar is located in the Ukraine, south of Volgograd.

[121]G. A. Tokaty, a Soviet Air Force Lieutenant Colonel and scientist involved in the Sanger-Bredt project, defected to the British in occupied Germany in 1947. It is unclear what effect this event had on Soviet rocket research. (Jeane Vronskaya and Vladimir Chuguev, The Biographical Dictionary of the Former Soviet Union, London: Bowker-Saur, 1992, p. 543.)

[122]M. Rebrov, "Sovet Glavnykh," Krasnaia Zvezda, 8 April 1989. See Appendix 8. Also see Appendix 3 for each of the chief designers.

[123]Averkov, "Rakety Tret'ego Reikha."

[124]Rebrov, "Sovet Glavnykh;" and Holloway, "Battle Tanks and ICBMs," p. 392.

unofficial, independent, and "democratic" body for collective thinking.[125] Although its key members worked within the Ministry of Armaments, the Council of Chief Designers cut across ministerial boundaries. It had no legal standing, "but its decisions had another force, the force of moral duty..."[126] Frequent technical disagreements led to long discussions and chalk board calculations, "but the basic idea was already clear..."[127] Thus, from the very beginning, the native Soviet post-war missile programme was dominated by a fairly cohesive group of like-minded engineers, most of whom had been working on rockets since the 1930s. The leading figure in this group was clearly Sergei Pavlovich Korolev.

Through the Council of Chief Designers the Soviets were remarkably successful in systematically improving the range and reliability of their missiles. By October 1948 they had built, and successfully tested, the first truly Soviet ballistic missile, the R-1.[128] The R-1 may have looked similar to the German V-2, but on the inside it was a classic Soviet weapon. It was more rugged, reliable, and accurate than the German model. The R-1 soon entered series production and was in operational military service by 1950.[129] The Soviet missile designers simultaneously began work on the next generation of missile, the R-2.[130] On its first successful test flight, in October 1950, the R-2 proved it had more than twice the range of the R-1.[131]

With the R-2 and their next project the Soviet designers finally displaced the German rocket specialists. In 1948 Korolev's R-2 design supplanted a similar German design (known by the Germans as the R-10) as the primary new missile research project.[132] Korolev now had the initiative, and he used it to advance a highly ambitious

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[125]The reported independence of the Council of Chief Designers, especially in light of the tight supervision by the security forces, has yet to be explained. Circumstances suggest that this institution was "protected" at higher levels, perhaps by Minister Ustinov.
[126]Rebrov, "Sovet Glavnykh."
[127]Rebrov, "Sovet Glavnykh."
[128]The first R-1 launch attempt on 17 September 1948 failed. The test on 10 October 1948 was successful. (G. A. Kustova, ed., Ot Pervogo Sputnika do Energii - Burana i Mira, Moscow: RKK Energiia, 1994, p. 6.) See Appendix 2.
[129]A. V. Karpenko, Rossiiskoe Raketnoe Oruzhie 1943-1993gg., Saint Petersburg: Pika, 1993, p. 38.
[130]Zak, "V Kosmicheskoi Kolybeli."
[131]Zak, "V Kosmicheskoi Kolybeli." The R-2 flew over 600 kilometres.
[132]Ordway and Sharpe, The Rocket Team, p. 337.

project known as the R-3.[133] The 3,000 kilometre range and 120 tonne thrust engines of the R-3 were a major leap over the, yet to be built, R-2 with 600 kilometres range and engines producing 35 tonnes of thrust. In early 1949, Minister of Armaments Ustinov assigned the German rocket scientists the task of designing a missile with the same performance as the R-3. The Germans apparently did not know about Korolev's proposal. When they briefed the leadership of NII-88 on 1 October 1949, the German designers apparently confirmed much of Korolev's work.[134] In December Korolev's Draft Project (EP) for the R-3 was accepted and the deadline for completion of the project was set for 1953.[135]

The R-3 confirmation job was the last missile design project for the German specialists. With the Soviet rocket enthusiasts proving so successful, and the expansion of the base of Soviet missile expertise, the Germans were phased out of missile research. By 1950 only about fifty of the four hundred German rocket specialists remained in the Soviet Union.[136]

One important result of the phasing out of the Germans was that the role of the security forces in missile research declined somewhat. The security organs were still a major presence in missile R&D, as in every field, for they were responsible for security within and outside the programme.[137] There was also no reduction in high-level attention and pressure, for Serov served as Beriia's personal representative at missile tests throughout the period.[138] However, the security forces no longer had direct control over "their own" missile designers.

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[133]Korolev had been working on the R-3 since 1947.

[134]Ordway and Sharpe, The Rocket Team, p. 337.

[135]V. S. Avduevskii, ed., M. V. Keldysh: Raketnaia Tekhnika i Kosmonavtika - Izbrannye Trudy, Moscow: Nauka, 1988, p. 139.

[136]US Central Intelligence Agency, National Intelligence Estimate Number 11-6-54: Soviet Capabilities and Probable Programs in the Guided Missile Field, (Top Secret) Washington DC, 5 October 1954, as declassified 29 June 1993 by CIA Historical Review Program, pp. 5-6. Those that remained were guidance and control specialists, most of whom returned to Germany by the mid-1950s.

[137]The involvement of the MVD in the missile programme probably contributed to earlier reports that Korolev was re-imprisoned after the war. Although there was a tightening of control over research institutions during this period and prison design bureaux continued to exist, there is no solid evidence that Korolev or his comrades were re-imprisoned.

[138]M. Rebrov, "Tainy Raketnykh Shifrov" Krasnaia Zvezda, 3 June 1995; and Oral history of N. N. Smirnitskii in Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, p. 144.

By the late 1940s the priorities in weapons research had become considerably more clear within the Soviet leadership. War with the capitalist West may not have been imminent, but in Stalin's view it was inevitable.[139] His immediate priority was to establish a defence against nuclear attack from the string of US bases that now surrounded the Soviet Union.[140] This goal required the acquisition of both defensive systems (like the Vasserfall surface to air missile) and continental range nuclear forces.[141] Originally, these latter efforts appear to have concentrated on aviation forces.[142]

In the long term Stalin knew that he also had to achieve nuclear "parity;" that the Soviet Union had to be able to threaten the US heartland with nuclear weapons. By around 1948 the practical alternatives for an intercontinental weapon had narrowed to three: long range aircraft, winged (cruise) missiles and ballistic missiles.[143] The more exotic projects, like the Sanger-Bredt bomber, were shelved.[144] Initially, the emphasis was still placed on projects under the Ministry of Aviation Industry - i.e. aircraft and winged missiles.[145] The ballistic missiles being developed by the Ministry of Armaments had not even proven themselves as weapons, so an intercontinental missile must have seemed an unlikely proposition.[146]

Despite their unproved prospects, Ustinov appears to have mortgaged the future of his ministry to ballistic missiles. By mid-1950 he had carried out a major re-organisation of NII-88. In the process he jettisoned all artillery research at NII-88 and turned it to ballistic missiles.[147] In April 1950 Korolev's Department in NII-88 was upgraded to

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[139] Holloway, Stalin and the Bomb, p. 151.
[140] Holloway, Stalin and the Bomb, p. 242.
[141] For example, the Long-Range Aviation bomber force was re-created in 1946.
[142] None of the early ballistic missiles was designed to carry a nuclear warhead.
[143] Sergei N. Khrushchev, Nikita Khrushchev: Krizisy i Rakety, Vol. 1, Moscow: Novosti, 1994, p. 41.
[144] As early as mid-1947 a study of the Sanger-Bredt bomber found it to be infeasible with existing technology. (Asif Siddiqi, History of the Soviet Space Programme, Washington DC: NASA, forthcoming.)
[145] When ordered to produce an intercontinental bomber during this period aircraft designer Tupolev reportedly refused. He noted, correctly, that such a project was impossible with the available technology. Younger designers were more willing to try.
[146] Even the highly ambitious R-3 proposal of 1949 had less than half the range necessary to reach the continental US from Soviet territory.
[147] Golovanov, Korolev: Fakty i Mify, p. 435.

Experimental Design Bureau No. 1 (OKB-1).[148] Ustinov also managed to collect an amazingly talented group of designers for NII-88.[149]

The resurrection of Soviet missile design after the war was accompanied by the return of Tsiolkovskii-inspired dreams of spaceflight. This had been evident as early as September 1947, a month before Korolev's first successful V-2 test. On the anniversary of Tsiolkovskii's birth (17 September) that year a commemorative meeting was held in the Red Army House in Moscow. Not only was the opening speech delivered by the head of the Academy of Artillery Sciences, General Blagonravov, but Korolev also gave a major speech. The event was favourably covered the next day in Pravda.[150]

One of the first Tsiolkovskii advocates to "go public" with serious plans was M. K. Tikhonravov, one of the founders of MosGIRD. After the war Tikhonravov was employed at NII-4, a research institute under the Main Artillery Administration (GAU).[151] Immediately after the war he took it on himself to design the VR-190 capsule, which could be used to launch a man on a sub-orbital flight with a V-2 rocket.[152] While delivering a paper to the Academy of Artillery Sciences in July 1948 Tikhonravov also suggested that it was possible to launch a satellite with existing technology.[153] This presentation caught the attention of Korolev, who was a corresponding member of the Academy of Artillery Sciences. The two MosGIRD alumni began to work informally together on designs for a satellite launcher.

However, Tsiolkovskii's ideas were still formally discouraged. For example, when Tikhonravov directly raised the issue of satellite launching at an unnamed conference in March 1950 he got a "sharply negative" reaction.[154] The Academy of Sciences did

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[148] G. Tiulin, "Semerka: Gody, Svershenia, Liudi," Krasnaia Zvezda, 1 April 1989.
[149] By 1950 the designers Babakin, Iangel', and Isaev had all been transferred into NII-88. (Golovanov, Korolev: Fakty i Mify, p. 436.) All three of these men played a major role in the later Soviet missile and space programmes. (For Babakin, Iangel', and Isaev, see Appendix 3.)
[150] Pravda, 18 September 1947. (as quoted in Daniloff, The Kremlin and the Cosmos, p. 98.)
[151] See Appendix 7, sheet 1.
[152] B. N. Kantemirov, "15 Iiulia - 40 let so dnia doklada M. K. Tikhonravova o vozmozhnosti polucheniia kosmicheskoi skorosti pri sovremennom urovne tekhniki (1948g.)," Iz Istorii Aviatsii i Kosmonavtiki, Vol. 59, 1989, p. 67.
[153] Kantemirov, "15 Iiulia - 40 let so dnia doklada M.K. Tikhonravova...," pp. 72-73.
[154] Kantemirov, "15 Iiulia - 40 let so dnia doklada M.K. Tikhonravova...," pp. 72-73.

publish the first volume of Tsiolkovskii's collected works in 1951[155], but for the most part space travel was relegated to the children's press.[156] Information about current rocket and missile research was strictly classified, thus limiting the public discussion of Tsiolkovskii's ideas.[157] Yet, such secrecy could also protect the spread of spaceflight ideas within the missile industry. For example, a limited edition Russian translation of Robert Esnault-Pelterie's L'Astronautique, a book first published in 1930 that detailed the mechanics of interplanetary spaceflight, was published by the defence industry in 1950.[158]

In addition, rocket enthusiasts found some support in scientific circles. In 1949 the USSR Academy of Sciences formed a "Commission for the Investigation of the Upper Layers of the Atmosphere" headed by General Blagonravov.[159] This Commission sponsored many scientific rocket launches. On 21 April 1949 Korolev launched the first of a number of variations on the R-1, modified specifically for such research.[160] These efforts were not purely scientific, for knowledge about the density of the upper atmosphere did have military applications in both aviation and missile programmes. However, at the end of 1949 Korolev began work on yet another modification of the R-1 to carry out biological investigations. The new design was used to launch dogs and other small animals on ballistic flights.[161] This work became increasingly more complex as four more versions of the R-1 were used to test parachute landing systems and pressure suits, with dogs serving as test subjects. In the summer of 1951 alone, there were six of these "biological" flights.[162] It seems likely that biological research had military

[155] Kocourek, "Rocketry," in Amann, Cooper, and Davies, eds., The Technological Level of Soviet Industry, p. 491. The series consisted of four volumes, the last of which came out in 1964.

[156] For example, Tikhonravov published an article on spaceflight in Pionerskaia Pravda on 2 October 1951.

[157] In June 1947 the distinction between military and non-military technical information was abandoned. Research projects and inventions in all fields were classified as state secrets until completed and authorised to be published. (Parrott, Politics and Technology in the Soviet Union, p. 120.)

[158] Rober Eno-Pel'tri, Kosmicheskie Polety (Astronavtika), Moscow: Gosudarstvennoe Izdatel'stvo Oboronnoi Promyshlennosti, 1950. Esnault-Pelterie's book made a number of significant contributions to spaceflight theory, especially in the field of navigation. (For more on Esnault-Pelterie see: Michael Rycroft, ed., Cambridge Encyclopedia of Space, Cambridge: Cambridge University Press, 1990, p. 30.)

[159] A. P. Romanov and V. S. Gubarev, Konstruktory, Moscow: Politizdat, 1989, p. 73.

[160] Kustova, ed., Ot Pervogo Sputnika do Energii - Burana i Mira, p. 6.

[161] Daniloff, The Kremlin and the Cosmos, p. 53.

[162] Christian Lardier, L'Astronautique Sovietique, Paris: Armand Colin, 1992, p. 81.

justifications[163], but it also proved that complex animals could survive rocket flights to extreme altitudes.[164]

It is important to note that even the scientific research launches were conducted as part of the missile effort. Therefore, the rockets were requested by the Academy of Sciences, but designed and manufactured by the Ministry of Armaments. The actual launches were conducted by military personnel as part of their training programme.[165] Finally, oversight was still exercised by the security forces.[166] Scientific research was carried out, but within the existing framework of the missile development programme.

The rapid pace of rocket development soon meant major changes for both producers and users. In the early 1950s it became apparent that facilities in the Moscow area were unable to deal with the demands of series production of all the new missiles.[167] On 10 May 1951 the Dnepropetrovsk automobile factory was transferred to the Ministry of Armaments for conversion to a missile factory.[168] It was completely modernised and renamed the Southern (Iuzhnyi) Machinebuilding Factory.[169] A branch of OKB-1, called the Iuzhnoe Design Office, was established at the factory under the direction of V. S. Budnik.[170]

The military also began to make important changes to accommodate this new technology. With series production of military missiles beginning, Marshal Nedelin moved (in 1950) from controlling development and acquisition, as head of the Main Artillery Administration (GAU), to integrating the new weapons into service as

[163] e.g. in developing pressure suits and escape systems for high-flying aircraft.

[164] These early tests with dogs reached altitudes of over 100 kilometres. The US Space Shuttle and the Russian Mir space station orbit at altitudes between 300-400 kilometres.

[165] Oral history of N. F. Shlykov in Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, p. 207.

[166] For the role of the security forces in overseeing the early scientific launches see: Andrei D. Sakharov, Memoirs, trans. Richard Lourie, London: Hutchinson, 1990, p. 103.

[167] The R-1 was being put into service and the R-2 was in final development. There were also a number of other ballistic missile projects being developed in addition to anti-aircraft (surface-to-air) missiles.

[168] V. Pappo-Korystin, V. Platonov, and V. Pashchenko, Dneprovskii Raketno-Kosmicheskii Tsentr, Dnepropetrovsk: PO Iuzhnyi mashinstroitel'nyi zavod and KB Iuzhnoe, 1994, p. 52.

[169] Averkov, "Rakety Tret'ego Reikha."

[170] Budnik had worked at OKB-1 until this time. (Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 8.)

Commander-in-Chief of Artillery of the Soviet Army.[171] The GAU itself was reorganised to concentrate on acquisition of series-produced (vice experimental) missiles.

For reasons that remain unclear, military research on wider applications of rocketry was sharply curtailed in 1950. Although NII-4 had just won the State Prize, its leader was fired and the research work it had been doing in conjunction with the Ministry of Armaments dried up.[172] The Academy of Artillery Sciences was also purged at the same time. In March 1950 Marshal Voronov (until Nedelin's promotion, the Commander-in-Chief of Artillery) was named President of the Academy of Artillery Sciences. Blagonravov was demoted to Vice President.[173] One source suggests that these changes were a result of the jealousy of Korolev and others at the Ministry of Armaments over the award of the State Prize to NII-4.[174] Another source suggests that Blagonravov, like Korolev, was not liked or trusted by many senior military officers.[175] Whatever the reason, Tsiolkovskii advocates in the military were stymied by the changes. NII-4 narrowed its focus to ballistic missile work. As for the Academy of Artillery Sciences, it was now under the control of a traditional artillery officer, instead of an Academician-cum-General.

Around the same time, Korolev's ambitious R-3 missile project encountered difficulties with it's most critical component - the rocket engines. The problem was producing a combustion chamber that could withstand the extreme temperatures and pressures called for by the design. Soviet metallurgy was not yet up to the task. In 1951 Glushko effectively abandoned this engine project and Korolev was forced to admit that the R-3 was too ambitious. He redesigned the missile as the R-3A, based on an engine

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[171]This post carried with it an appointment as a Deputy Minister of Defence.

[172]The head of NII-4, General A. I. Nesterenko, was temporarily replaced by his deputy G. A. Tiulin. (Oral history of I. E. Shashkov in Mozzhorin, ed., Dorogi v Kosmos, Vol. 2, p. 93.) Nesterenko had apparently crossed Ustinov several years earlier. (Oral history of A. A. Maksimov in Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, p. 113.)

[173]In Soviet-era sources Blagonravov's demotion was explained as the "expiration of the normal term of office." (Sovetskaia Voennaia Entsiklopediia, Vol. 1, p. 94.)

[174]Oral history of I. E. Shashkov in Mozzhorin, ed., Dorogi v Kosmos, Vol. 2, p. 93.

[175]Marshal Nedelin reportedly told Korolev in July 1949 that the military was planning to replace Blagonravov. In this same (re-created) conversation Nedelin warned Korolev that he was not well liked either. (A. P. Romanov, Korolev, Moscow: Molodaia Gvardiia, 1990, pp. 201-4.)

which produced only half as much thrust as originally planned.[176] As a stop-gap measure Korolev also started an intermediate range missile known as the R-5 (SS-3).[177]

Just as Korolev's dreams of making a quantum leap in rocket power seemed to be fading, Soviet scientists came up with two important breakthroughs. In 1951 a group under the leadership of M. V. Keldysh at the V. A. Steklov Institute of Mathematics of the USSR Academy of Sciences (MIAN) completed a study that confirmed the effectiveness of clustering rockets.[178] The idea of building a rocket by joining a number of smaller rockets side by side had been advanced by Tikhonravov as the basis of his 1948 satellite proposal.[179] Korolev had asked Keldysh for a detailed mathematical analysis of this rocket cluster idea in 1949. The positive results of the 1951 report laid the basis for much more powerful rockets.[180]

The second breakthrough came a year later, in 1952, when Glushko applied the cluster principle to his engine problems. Rather than build one large combustion chamber Glushko cleverly decided to build an engine with several smaller chambers. Thus, he began work on his RD-107 and RD-108 engines, both of which had four combustion chambers fed by one set of pumps and equipment. By the beginning of 1953, Soviet scientists had developed the two ideas behind the "cluster of clusters" concept. This concept was the key to the success of Korolev's famed R-7 (SS-6) - the first Soviet "ICBM" and satellite launcher.

With curious rapidity the idea of creating an ICBM was adopted by Stalin. On 13 February 1953 Stalin signed a decree authorising design work on an ICBM by NII-88 and

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[176]The R-3A was to be equipped with a Glushko engine producing 65 tonnes of thrust. (Lardier, L'Astronautique Sovietique, p. 83.)

[177]The actual design work on the R-5 was led by M. K. Iangel'. This project began in 1952, the same year that Iangel' was appointed director of NII-88. (This appointment made Iangel' Korolev's immediate supervisor, even though he had only begun work on missiles in 1950 as an engineer under Korolev.) On the "stop-gap" nature of the R-5 see: Siddiqi, History of the Soviet Space Program.

[178]Keldysh's group became the Department of Applied Mathematics of MIAN in 1953. In 1966 it became a separate institute of the Academy of Sciences (now known as the Keldysh Institute of Applied Mathematics). For Keldysh, see Appendix 3.

[179]Until this time designers tended to think of multiple stage rockets in the way that Tsiolkovskii had described them. That is, as a series of rockets stacked vertically atop each other. In 1948 Tikhonravov had suggested that it would be possible to develop enough thrust to launch a satellite by bundling together several R-1 rockets. In Russian such a rocket cluster is known as a "paket."

[180]The study is reprinted in: Avduevskii, M. V. Keldysh, pp. 39-139. (A summary and commentary are found on pp. 139-40.)

also declaring that a large engine (with 500 tonnes of thrust) was a military necessity.[181] Given the development problems with the R-3 and the weapons design conservatism typical of the Stalin era, this seems an unusual decision.[182] For the satellite enthusiasts it was just the signal they were waiting for. Tikhonravov and a team of engineers immediately began design work on a scientific satellite.[183]

Conclusion

By the time of Stalin's death in March 1953, the intertwined threads of Soviet rocket research reflected the triumphs and tragedies of the Stalin era. The artillery tradition found that its equipment had advanced from the ineffective powder rockets of the 1920s to the world's most powerful, reliable liquid-fuelled rockets. The Soviet Union had benefited from the German rocket programs, but more significantly, it had gained from the imagination and dedication of its own space enthusiasts. As for Tsiolkovskii's disciples, they had paid a heavy price for their faith, but were now beginning to make their wildest dreams come true. After the failed attempt to fuse with the artillery researchers in the 1930s, the purges, and war work on a variety of peripheral projects, they were at last able design, build, and test rockets on a large scale. Such rockets could provide the means to fulfil Tsiolkovskii's vision.

The success of the post-war rocket programs also hid a number of important divisions and animosities. Long-standing personal disputes contributed to tensions between individual scientists and engineers. In addition, there were a number of institutional cleavages centred around the divisions between artillery and aviation. These tensions extended through both research institutes and industry.

Nonetheless, by 1953 the advocates of Tsiolkovskii's ideas had moved in from the lunatic fringe. No longer were they viewed as crackpot amateurs; their faith in liquid-fuelled rockets had been proven correct, and they had shown that they could quickly

[181] Lardier, L'Astronautique Sovietique, p. 106; and German Nazarov, "You Cannot Paper Space With Rubles: How to Save Billions," Molodaia Gvardiia, No. 4, April 1990, pp. 192-207, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-UPS-90-003, 30 July 1990, p. 53.
[182] No details of this decision have come to light.
[183] Lardier, L'Astronautique Sovietique, p. 106.

produce a better missile than the German specialists. Now, the advocates of humanity's destiny in space were respectable professionals at the centre of a high priority government programme.

Chapter 3: Processes and Institutions

"In this trying time ... the paramount task ... is the ensuring of uninterrupted and proper leadership ... which demands the maximum unity of the leadership, and avoidance of any confusion and panic..."

Joint Resolution of Party and Government
Pravda, 7 March 1953

Although his successors worried about confusion and panic, Stalin's death on 5 March 1953 was not as disruptive as they had, perhaps, imagined. Important aspects of the Stalinist politico-economic system proved remarkably robust, with many of its central features remaining effectively unchanged for almost forty more years.[1] Weapons research and development (R&D) procedures and institutions were among the many Stalinist inventions that long outlived their creator. While the formal procedures and institutions remained, informal aspects had to change along with the changing political environment after Stalin's death.

Since the Soviet space programme grew out of ballistic missile R&D, manned space policy can only be understood with a solid knowledge of both the formal and informal aspects of Soviet weapons R&D, and the political context of weapons programmes. In order to set the stage for the chapters to follow, this chapter will review what is known about the procedures of Soviet weapons R&D and the political context of such programmes at the time of Stalin's death. With this understanding of how the R&D process worked, we can better identify the types of evidence needed to answer the four central questions of this dissertation.

The Weapons Research and Development Process

As noted in Chapter 1, much of what was known in the West about Soviet weapons research and development was based on information from the aviation industry. Since aircraft were one of the highest priority sectors of the Soviet defence industry this may have

[1]Among other things, the Soviet Union retained a command economy, with its faith in the efficacy of planning and its heavy industry bias. In politics the total political monopoly of the Communist Party also remained.

induced some bias in our understanding of weapons R&D. However, studies of technological innovation in the USSR suggest that procedures in the aviation sector were typical of weapons R&D as a whole, even if some policies were different.[2] In fact, the direct involvement of parts of the aviation industry in the space programme and the similarities in managing such high-priority emerging technologies, suggest that detailed information about aviation R&D might be an asset.

The formal procedures followed in Soviet weapons R&D were a product of the Stalin era.[3] In the aviation industry at least, the organisation and procedures for R&D solidified around 1939.[4] Prior to this point aircraft design had largely been dominated by two design bureaux. Large aircraft and bombers, which had been the favourites of Stalin, were designed in the bureau led by Andrei Nikolaevich Tupolev.[5] Fighter aircraft were developed primarily by Nikolai Nikolaevich Polikarpov's design bureau. However, after a poor showing against German aircraft during the Spanish Civil War, Tupolev was arrested.[6] Although Tupolev continued to design bomber aircraft from a prison design bureau (or sharaga), the emphasis shifted to small aircraft.[7]

Not only was there a shift of emphasis, but the entire weapons development and production process was overhauled. Stalin set up a system of competitive aircraft design bureaux led by young, ambitious designers. The competition among these designers gave the political leadership a better understanding of the technical possibilities of the highly complex field of aircraft design.[8] In addition, the previously disjointed aircraft industry was

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[2]David Holloway, "Innovation in the defence sector," in Ronald Amann, Julian Cooper, eds., Industrial Innovation in the Soviet Union, London: Yale University Press, 1982, p. 294.

[3]See: Mikhail Tsypkin, The Origins of Soviet Military Research and Development System (1917-1941), Harvard University: Ph.D. dissertation, 1985.

[4]Arthur Alexander, R&D in Soviet Aviation, R-589-PR, Santa Monica, California: RAND, November 1970, p. 4.

[5]Following the ideas of Guilio Douhet, many other countries also favoured the idea of bomber aircraft as the ultimate weapon.

[6]Kendall Bailes, Technology and Society under Lenin and Stalin: Origins of the Soviet Technical Intelligentsia, 1917-41, Princeton: Princeton University Press, 1978, pp. 397-8.

[7]For the story of Tupolev's prison design bureau see: G. A. Ozerov, Tupolevskaia Sharaga, 2nd ed., Frankfurt-am-Main: Possev Verlag, 1973. There were purges in the Polikarpov bureau as well, but it is unclear whether Polikarpov himself was arrested. (Irina V. Strazheva, Tiul'pani s Kosmodroma, 3rd ed., Irkutsk: Vostochno-Sibirskoe Knizhnoe Izdatel'stvo, 1986, pp. 120-122.) In any case, this is when designers like Mikoian, Iakovlev, Lavochkin, and Sukhoi got their own bureaux.

[8]Bruce Parrott, Politics and Technology in the Soviet Union, Cambridge: MIT Press, 1983, p. 73.

pulled together into a Commissariat of its own; the People's Commissariat of Aviation Industry.[9] This change occurred in conjunction with the division of the People's Commissariat of Defence Industry into four specialised Commissariats in January 1939.[10] Thus, the characteristic division of aviation R&D into three functional types of institutions[11] under a Commissariat/Ministry-level organisation dates from this period.[12] Based on the parallel creation of separate ministries for other defence industries it seems likely that these institutional forms were established throughout the defence industry by this time. The subsequent success of these arrangements during the Great Patriotic War firmly established the legitimacy of this system.

Another legacy from this period is the central role of the chief designer in the R&D process. The young designers, who had suddenly found themselves at the top of their professions following the purges, carried a sense of their own priority and the lessons of the war with them throughout their long careers.[13] Stalin himself reinforced the role of the designer.

> "He felt that the designer was the one individual who could be held responsible for the success or failure of a product."[14]

In Stalin's estimation, a designer should be resourceful, inventive, down-to-earth, and tough enough to "protect his machine from irresponsible advisors."[15] The chief designer became the crucial link tying R&D institutions together; shepherding a weapons programme from authorisation to production.

Personal and institutional continuity contributed to the remarkable consistency of formal procedures for weapons development from 1939 onward. Even as research and

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[9]Alexander, R&D in Soviet Aviation, p. 6.

[10]See Appendix 4, sheet 1.

[11]The three functional organisations are: the Scientific Research Institute (NII), the Design Bureau (KB), and the production factory. See Chapter 1 for an explanation of these terms.

[12]Alexander, R&D in Soviet Aviation, p. 4.

[13]The young designers who came to the fore during the purges later dominated their fields. Many of them led their bureaux until they died in the later 1960s to early 1970s.

[14]Alexander, R&D in Soviet Aviation, p. 22.

[15]Aleksandr S. Iakovlev, Tsel' Zhizni: Zapiski Aviakonstruktora, Moscow: Izdatel'stvo Politicheskoi Literatury, 1966, as translated by the US Air Force Foreign Technology Division, FTD-HT-23-956-67, 18 January 1968, pp. 282-283. Iakovlev, a designer and Deputy Minister of Aviation Industry at the time, quotes Stalin: "It's hard to make a good machine and easy to spoil it. And it's the designer who is responsible"

development grew more expensive and important in the post-war years, the procedures remained largely unchanged.[16] There were a number of attempts to improve the output of the defence industry, but these appear to have led, primarily, to changes in names of agencies and oversight responsibilities rather than any fundamental change in the formal procedures.

A knowledge of these formal procedures can serve as a key to understanding the available evidence about policymaking and priorities in R&D programmes. The weapons R&D process, from initiation to acceptance into the inventory, is summarised in graphic form at Appendix 9: The Soviet Weapons Research and Development Process.[17] It is particularly important to note the major documents that govern and accompany the R&D process and understand their function. In addition, there are a number of points about Appendix 9 that deserve special emphasis and explanation.

For this dissertation one of the most significant questions is how R&D projects originate. If chief designers could play a significant role in initiating new R&D projects, then there would be more opportunity for them to influence policy. Although not immediately evident in Appendix 9, there are at least four ways for a weapons project to begin; three of these are associated with specific documents. The first way a military R&D project can begin is for the military to identify a capability it needs and forward a request for a new weapon through the defence ministry to the government.[18] The document used to make such a request is known as a Tactical-Technical Requirement (TTT).

The second way a project could begin is for a designer to propose it by himself. Such a proposal, known as a Predraft Project, undergoes a similar review process within the industrial ministry that supervises the design bureau. Ambitious designers could generate lots of Predraft Projects. The sheer number and variety of such speculative proposals can obscure the actual assignments of the design bureau. However, the content

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[16]Alexander, R&D in Soviet Aviation, p. v.

[17]Appendix 9 is based on a number of sources including: US Central Intelligence Agency, The Soviet Weapons Industry: An Overview, (DI 86-10016), Washington DC: US Government Printing Office, September 1986, p. 18.

[18]After the late 1950s such proposals were probably routed to the Military-Industrial Commission (VPK). As will be discussed in the next chapter, between Stalin's death and the establishment of the VPK this responsibility was the subject of a leadership and bureaucratic struggle.

of Predraft Projects is indicative of the interests and desires of the chief designer. Moreover, attention to the documents that appear later in the R&D process make it possible to determine which Predraft Projects were successful in gaining official support, and which were not.[19]

The third method of starting a weapons R&D project involves a combination of the first two. Because the industrial ministries had limited resources to support speculative proposals, the designer sometimes collaborated informally with the military. This way a TTT matching the Predraft Project was generated simultaneously by the military. For the industrial ministry and the designer this collaborative approach had a number of advantages. In the first place, a proposal from the industrial ministry that matched a military requirement (TTT) appears more likely to have been approved by the leadership. Secondly, at least from the late 1950s, a project undertaken at the request of the military would lead to an increase in the resources allocated to the industrial ministry involved. Projects not requested by the military might be approved, but such a speculative project might have to be funded by the industrial ministry. Finally, from the designer's perspective, a TTT that matched his Predraft Project gave him an advantage over other designers during the design competition phase. In at least some of the collaborative cases, the Soviet leadership skipped the design competition altogether.

For some weapons projects, the formal proposal process never occurred - the project was started by the political leadership. This is the fourth way that a weapons project could begin. These projects began with a programme decision by the leadership which imposed a weapons project on the industrial ministries and the military. An example of this was Stalin's demand that the Soviet aircraft industry duplicate the US B-29 bomber after World War II.[20] In this case, as in some others, the design competition phase was bypassed. The leadership assigned the B-29 project to the Tupolev design bureau. Such demands sometimes came in the form of a party/government decree, but it is not clear that this was always the case.

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[19]Many chief designers lavished considerable time and energy on "pet" projects that had not won official approval. Such longevity of ideas should not be misconstrued as official approval of a project.

[20]Sergei N. Khrushchev, Nikita Khrushchev: Krizisy i Rakety, Vol. 1, Moscow: Novosti, 1994, pp. 39-41.

After the decision to start an R&D programme was made, a number of other documents were generated during the subsequent phases of the programme. The document characteristic of the design competition period was the Draft Project (EP). An EP was developed by the senior design staff at each of the competing design bureaux. It contained a fairly rough outline of how the bureau proposed to meet the criteria specified for the project. The EP was generally only a few pages long.[21] It appears that even for leadership-directed projects the design bureau had to produce an EP that was reviewed and approved by the appropriate institutions. Thus, EPs were the lifeblood of the design bureau. As with Predraft Projects, designers produced many EPs, but even if a concept advanced to this phase of the R&D process it did not necessarily reflect anything about state policy.

The crucial policy question was whether or not the political leadership authorised the R&D project. Such a decision would end the formal competition among designers, by designating one design as the official project.[22] The "design decision" was accompanied by two important documents. The first was a decree authorising the design bureau to proceed with the project. For major weapons programmes this generally took the form of a joint decree by the Central Committee (TsK) and the USSR Council of Ministers (SM). Such decrees serve as useful indicators for the adoption of major new programmes and policies. The joint decree dictated the creation of the second document, the Tactical-Technical Requirement (TTZ). The TTZ was drawn up by the military, in co-ordination with the design bureau. It served as the basic document governing the technical aspects of the design and development process.[23]

If, after tests of prototypes, the Soviet leadership decided to authorise production of the new weapon, a similar pair of documents would be produced. Another joint decree by the TsK and SM would formally accept the new weapon as part of the inventory and

[21] Arthur Alexander mentions an EP for an interceptor aircraft that was only 3 pages long. (Alexander, R&D in Soviet Aviation, p. 18.) What appear to be a few of Korolev's space programme EPs are reprinted in M. V. Keldysh, ed., Tvorcheskoe Naslediia Akademika S. P. Koroleva, Moscow: Nauka, 1980.

[22] In certain very high-priority, high-risk fields (notably fighter aircraft development) more than one proposal was sometimes approved for full-scale design. In this case the competition between designs was carried through to prototype testing.

[23] Tsypkin, The Origins of Soviet Military Research and Development System, pp. 221-2.

authorise full-scale production.[24] The decree would also direct the military to produce a document, known as the Technical Conditions (TU).[25] This latter document specifies the requirements for the manufacture, control, formal acceptance, delivery and storage of new items of military technology.[26] In Western terms, the TU served as a contract between the military and the production ministry and was the basis for quality control during series production.

The documents described above can provide important evidence about specific R&D programmes and Soviet policy. Although there is, as yet, no way to systematically study these documents, numerous Russian sources now specifically mention them.[27] By compiling this data it is often possible to identify which of the four ways a project started. It is also possible to determine a number of other facts, including: which projects were "official" and which were "speculative," what designers preferred to do versus what they had to do, and when R&D programmes were adopted or cancelled.

There are two other aspects of the military R&D process shown in Appendix 9 that deserve further comment. The first of these is the intricate system of formal checks that normally constrained the weapons designer. There were numerous peer and customer reviews of both his proposals and the progress made during the design process. In the aviation industry at least, there was another major constraint on the designer: the "design handbook." These handbooks were one of the most important innovations in Soviet aviation R&D during its formative years.[28] The young, inexperienced designers of the 1930s needed some way to find out the latest research results, and the state needed to ensure that design bureaux were not wasting time and resources repeating research, or following technological dead ends. The handbooks solved these problems by providing an approved list of technologies, materials and techniques.

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[24]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 459.
[25]Holloway, "Innovation in the defence sector," p. 325.
[26]Voennyi Entsiklopedicheskii Slovar', Moscow: Voennoe Izdatel'stvo, 1984, p. 738.
[27]The least evident of these documents are the military ones - TTTs, TTZs, and TUs.
[28]Arthur J. Alexander, "Weapons Acquisition in the Soviet Union, the United States, and France," in Frank B. Horton III, Anthony G. Rogerson, Edward L. Warner III, eds., Comparative Defense Policy, Baltimore: Johns Hopkins University Press, 1974, p. 427.

> "The handbooks prevent the design bureaux from incorporating into their designs new technologies that appear promising but that are not yet tested, proven, and approved."[29]

Handbooks were a valuable way to manage an emerging technology. These, and other reviews, should have allowed the Soviet leadership to control missile and space programme designers.

The second aspect of the military R&D that deserves further attention is the role of three institutions; the Scientific Research Institute, the Scientific-Technical Commission, and the State Commission. The "leading" Scientific Research Institute (NII) in the industrial ministry held a check over designers in several ways. As noted in Chapter 1, specialised test equipment was often located at, and controlled by, the leading NIIs. This may seem an efficient allocation of expensive, limited-use equipment, yet it also kept control of a valuable resource out of the hands of designers.[30] Additionally, the design handbooks mentioned above were written and controlled by the leading NII in the ministry. Finally, the leading NII was responsible for reviewing Predraft Projects and TTTs for their technical feasibility.[31]

Another important, but little understood institution was the Scientific-Technical Commission.[32] It is not completely clear how this institution was used when Stalin was in power. However, from at least the 1960s, such Commissions had a significant effect at three of the most important points in the R&D process. The Scientific-Technical Commission was used to review proposals (TTTs and Predraft Projects), screen Draft Projects (EPs), and prescribe the tests to be used to evaluate prototypes. We know that the members of the Scientific-Technical Commissions were chosen from among the senior staffs of research and user organisations, but their identities, and how they were selected, are generally not known. It is thought that, in practice, these commissions provided some

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29Alexander, R&D in Soviet Aviation, p. 15.

30In the early years of the aviation industry, for example, the Central Aerohydrodynamic Institute (TsAGI) conducted most wind tunnel tests for the aviation design bureaux.

31In the period between the war and Stalin's death this review may have come before the proposal reached the leadership, rather than afterward (as shown in Appendix 9).

32Scientific-Technical Commissions were a common review mechanism and existed at many levels. Within the Ministry of Defence, for example, there were Scientific-Technical Commissions for each branch of service as well as at the General Staff, and the Ministry headquarters. (Holloway, "Innovation in the defence sector," p. 324.) The relative abundance of these institutions makes it difficult to make generalisations about them.

of the higher level push that forced co-operation across institutional boundaries; thereby making military R&D more effective.[33] Yet, commissions of this sort also tended to be conservative and seem to have acted as a restraint on highly innovative or unconventional work by designers.

Another institution that has long been shrouded in secrecy is the State Commission. The State Commission conducted the formal evaluation of prototype weapons and reported its findings directly to the leadership. Although it included representatives from the industrial ministries involved in the design of the project, the State Commission was headed by a senior military officer. This was a significant control mechanism that helped to ensure that the weapon met the criteria set by the military. Other than these basic facts, State Commissions have been little understood.

The formal procedures shown in Appendix 9 and discussed above were, ostensibly, all that was involved in weapons R&D programmes. However, like so much of Stalin-era governance, such programmes were also shot-through with informal procedures and players. Perhaps the most significant result of this is that it allowed Stalin to exercise personal control over weapons policy when he desired.

Even within the formal procedures, there was considerable room for "informal" leadership influence. The determination of which weapons were the responsibility of which military units and industrial ministries had important effects on the direction of R&D programmes.[34] Similarly, the selection of leaders and members of the various institutions and commissions could affect the outcome of reviews and tests. The party not only controlled such appointments through the nomenklatura, but Stalin, and perhaps other members of the Politburo, could select personnel in such a way as to pre-determine the outcome of weapons programme reviews or tests.

Prior to 1953, the most significant influence on Soviet weapons R&D policy was Stalin himself.

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[33]Holloway, "Innovation in the defence sector," p. 331.
[34]One of the most significant of these decisions was to entrust ballistic missiles to artillery units and the "artillery" production ministry (the Ministry of Armaments.)

> "Memoirs on the Stalin period suggest that he took part in every major design and development decision and in every major production decision from the late 1930s on."[35]

His approach to such decisions was extremely conservative. R&D priority went to proven technology, or projects known to be under development by other countries.[36] Thus rocket research was suppressed until the Germans had demonstrated its practicality for military use.[37]

Stalin himself must have been involved in the suppression of rocket research in the 1930s.[38] In discussing Stalin's role before the war, Marshal Zhukov noted that

> "...without Stalin's approval not a single item of armament or materiel was either adopted or discarded..."[39]

B. L. Vannikov, Commissar of Armaments prior to the war stated that Stalin "showed the greatest concern" about artillery and the artillery industry and "dealt with the aviation industry every day."[40] These were the two industries directly involved in rocket research. It seems unlikely in the extreme that the military rocket R&D programme would have been wiped out without Stalin's approval.

Stalin could not only stop a programme, but, as noted above, he could bypass the preliminary steps and start an R&D programme by fiat. It appears that many such decisions were related to suggestions by scientists and designers who bypassed the usual proposal process. These suggestions often took the form of letters sent directly to Stalin by those who had been frustrated by the formal R&D mechanisms. For example, it has been claimed

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[35]David Holloway, "Innovation in the defence sector," p. 302.

[36]David Holloway, "Military Technology," in Ronald Amann, Julian Cooper, and R. W. Davies, eds., The Technological Level of Soviet Industry, London: Yale University Press, 1977, p. 455.

[37]Tsypkin, The Origins of Soviet Military Research and Development System, p. 194.

[38]Stalin may have had personal motives for attacking Tukhachevskii and organisations that he had associated with (like RNII) in the mid-1930s. (Tsypkin, The Origins of Soviet Military Research and Development System, p. 200.)

[39]G. K. Zhukov, The Memoirs of Marshal Zhukov, New York: Delacorte, 1971, p. 284 as cited in Vernon V. Aspaturian, "The Stalinist Legacy in Soviet National Security Decisionmaking," in Jiri Valenta and William Potter, eds., Soviet Decisionmaking for National Security, London: Allen & Unwin, 1984, p. 57. (emphasis added)

[40]B. L. Vannikov, Voprosy Istorii, No. 10, 1968, pp. 118-119, as quoted in Holloway, "Innovation in the defence sector," p. 302. For Vannikov, see Appendix 3.

that the decisions to begin the Soviet nuclear weapons programme and jet aircraft development were both influenced by letters to Stalin.[41]

Thus, in practice, scientists and designers could affect policy decisions in the Stalin era, but there were substantial limits to their influence.[42] Designers were not allowed to create radical, unproved technologies, but they were able to "sell" their new designs to both the military and political leadership. They were also able to modify the demands of their "customers" on occasion. In one notable case, aviation designers were able to convince Stalin to retract his insistence on the construction of a duplicate of the German wartime jet fighter aircraft, the Me-262.[43] In other cases scientists were able to advocate and protect R&D programmes by pointing out the threat of foreign competition.[44] Such regular exceptions to the formal procedures were possible because weapons policy was an item of particular interest to Stalin. He was able, and willing, to personally control weapons R&D policy.

In cases where Stalin did intervene to begin a high-priority weapons programme, the projects were kept under especially close scrutiny by the political leadership. Leaders of the programme were carefully screened for their reliability, as well as their effectiveness. Special committees and Scientific-Technical Councils were created, or bolstered, so that the designer could more easily cut across departmental barriers while remaining under scrutiny.[45] On occasion this sort of intervention even meant the assignment of high-level government officials to expedite a project.[46] Such extreme priority treatment only seems to

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[41]For the nuclear programme see: David Holloway, Stalin and The Bomb, New Haven: Yale University Press, 1994, p. 78. For jet aircraft see: Iakovlev, Tsel' Zhizni, pp. 363-4. (As Holloway points out the legend that Flerov's April 1942 letter to Stalin single-handedly started the nuclear programme is belied by the facts now available. However, Flerov's letter did have some influence.)

[42]Alexander, R&D in Soviet Aviation, p. 28.

[43]Iakovlev, Tsel' Zhizni, pp. 363-4. This case is all the more striking because Stalin did insist on building duplicates of many other advanced weapons systems including the V-2 missile and the US B-29 bomber.

[44]This was the case with the Soviet nuclear programme in 1943. (Holloway, "Innovation in the defence sector," p. 319.)

[45]During the war there were Scientific-Technical Councils for radar, chemicals, and nuclear weapons research. (Holloway, "Innovation in the defence sector," pp. 331-2.) There may have been other such organisations as well.

[46]Iakovlev relates an interesting story about the creation of the first post-war Soviet jet fighter aircraft. A Deputy Minister of Aviation Industry was assigned to each of the competing design bureaux (his and the MiG Bureau) to "lend any necessary aid on the widest scale." The goal was to produce ten or more of each prototype to fly over Red Square on 7 November 1946. The design bureaux met the nearly unbelievable two and a half month deadline only to be grounded by fog on the day. (Iakovlev, Tsel' Zhizni, pp. 368-70.)

have occurred when Stalin was directly involved in a project. Thus, on projects of particular salience he could create new structures and procedures by personal intervention.

Another way that Stalin asserted his authority and undermined the formal procedures was in the use of the security forces to oversee weapons R&D. The security forces were ever-present under Stalin, and they were used not only to control slave labour (both in research and construction), but also as an extremely intrusive means of oversight.[47] There had long been non-specific reports that Beriia, although not in the formal chain of command, exercised direct control over both the nuclear and rocket programmes.[48] S. A. Afanas'ev, later Minister of the missile and space industry, recently stated that Beriia called Ustinov daily about the missile programme in the early 1950s. Afanas'ev himself was summoned to Beriia's office and threatened, when rocket engine production was deemed too slow. On this occasion Beriia assigned two MVD "bodyguards" to watch Afanas'ev and report back on him.[49] It appears that this kind of "protection" was common for leaders of high-priority projects. Such complete penetration of R&D by the security forces under Beriia, gave him, and Stalin, alternative sources of information that bypassed the formal R&D system.

This tight control and scrutiny of the R&D system served a number of purposes. It ensured that the workers on high priority projects remained focused on their assignments. It may also have been intended to lead to more efficient use of resources. However, the most compelling reason for such measures was simply that Stalin did not trust his scientists.[50] Such distrust dated back to the early years of Stalin's leadership and was reinforced by "failures" like those of the aircraft industry in the Spanish Civil War.[51]

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[47] See Appendix 7, sheet 1.

[48] e.g., Nikita S. Khrushchev, Khrushchev Remembers: The Last Testament, ed. and trans. by Strobe Talbott, Boston: Little, Brown & Co., 1974, p. 58; and M. Rebrov, "Lider: Maloizvestnye Stranitsy iz Zhizni S. P. Koroleva," Krasnaia Zvezda, 1 July 1989.

[49] V. Pappo-Korystin, V. Platonov, and V. Pashchenko, Dneprovskii Raketno-Kosmicheskii Tsentr, Dnepropetrovsk: PO Iuzhnyi mashinstroitel'nyi zavod and KB Iuzhnoe, 1994, pp. 9-11; and Oral History of S. A. Afanas'ev in Iu. A. Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, Moscow: MAI Press, 1992, pp. 40-42.

[50] Holloway, Stalin and The Bomb, p. 24.

[51] Bailes, Technology and Society under Lenin and Stalin, p. 398.

Obviously the formal procedures detailed in Appendix 9 do not fully explain the Soviet military R&D process. Through informal, as well as formal methods, Stalin made himself the focus of weapons R&D policymaking.[52] The result was that policymaking in this field assumed an amorphous, unpredictable hub-and-spoke character. Stalin's ability to bypass layers of party and government institutions undermined collective decisionmaking bodies at all levels. Thus, the rights and responsibilities of intermediate authorities remained unclear.[53] Stalin could intervene in weapons R&D when it suited him. The question for those under him was always, when and how the intervention might come.

Nonetheless, the formal procedures, institutions, and traditions were important because other actors had to operate within their framework - they gave the R&D process its basic shape.[54] This highly effective system had been tailored to Stalin originally, but it did not collapse upon his death. There was relatively little immediate confusion or panic because the institutions and traditions carried on without him. Yet, with the focus of the R&D policymaking system missing, there were issues that had to be resolved. The resolution of these questions depended a great deal on the domestic political context at the beginning of the succession struggle. It is to that question, that we must now turn.

The Political Context and Missile Programme Institutions

As much as a knowledge of R&D procedures is a useful research tool, understanding the political context of missile R&D is more important. In fact, for many years the central dilemma in analysing Soviet missile and space policy was the inability to establish the domestic political context of such decisions. Answering the question of which institutions and individuals were even involved in the space programme, and what their interests were, is a major point of this dissertation. The immediate task is to establish the political context of the missile programme at the time of Stalin's death.

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[52] In many ways the entire political system was a highly personalised. For example, the government worked on a twenty four hour schedule to suit Stalin's nocturnal working habits.

[53] Aspaturian, "The Stalinist Legacy in Soviet National Security Decisionmaking," p. 33.

[54] Alexander, "Weapons Acquisition in the Soviet Union, the United States, and France," p. 429.

Since Stalin had exercised personal control over weapons R&D policy, and had made such control one of the trappings of leadership, this issue was bound to be an object of the succession struggle. Such a struggle was probably inevitable, because when Stalin died it was completely unclear who and what would, or should, succeed him. He had carefully prevented the emergence of an heir or powerful institutional alternative to his personal leadership by playing the members of his entourage off against each other. The result was that his top lieutenants represented different institutional bases, in either the party or the government. As a general rule, his successors seemed willing to accept the formal procedures that they had long worked within. The question was what to do about the informal systems and powers. These informal arrangements had been central to the success of the weapons R&D system in the past. But would the new collective leadership allow one person to gain control of weapons policy and the prestige that went with it? This problem remained unresolved for quite some time after Stalin's death.

Party Institutions

The Presidium of the Central Committee was the first of many pre-existing institutions that Stalin's successors fell back on to govern the Soviet Union, but it was far from useful as a policymaking body. The phenomenal power vested in Stalin, reinforced by the terror system, had served to mute normal political processes, especially at the highest level.[55] Formal deliberative bodies like the Politburo had atrophied from disuse in Stalin's later years. Policy had flowed instead from the late-night dinner parties at Stalin's dacha.[56]

Such dinners, and the extensive use of special commissions and leadership subgroups, allowed Stalin to manipulate the policy process by selecting who would participate. Jerry Hough correctly notes that Stalin's elaborate committee structures enabled

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[55]Peter Hauslohner, "Politics Before Gorbachev: De-Stalinization and the Roots of Reform," in Alexander Dallin and Gail W. Lapidus, eds., The Soviet System in Crisis: A Reader of Western and Soviet Views, Boulder, Colorado: Westview Press, 1991, p. 41.

[56]T. H. Rigby, "The Soviet Political Executive, 1917-1986," in Archie Brown, ed., Political Leadership in the Soviet Union, Bloomington: Indiana University Press, 1989, p. 35; and Jerry F. Hough and Merle Fainsod, How the Soviet Union is Governed, Cambridge: Harvard University Press, 1979, p. 210.

a wide range of individuals from outside the party to participate in defence policymaking.[57] Yet, this process was far from "pluralist" for it was also used to exclude certain participants from policymaking.[58] This was one of the ways Stalin maintained personal control on issues of his choosing. He did not refrain from calling for expert opinion, or allowing open deliberation of ideas in committee meetings, yet it was always clear to the participants that the discussion was on Stalin's terms, and that the final decision was his to make.[59]

Not only had the Presidium fallen into disuse for well over a decade, but, at the Nineteenth Party Congress in October 1952, Stalin had begun an attack on the organisation and its members. The Politburo (as it had been called until that time) was disbanded at the Party Congress. An unwieldy twenty five member Presidium was erected in its place.[60] In practice a nine member "Bureau" of the Presidium served as the inner circle of the leadership. The members of this Bureau were: Stalin, Beriia, Malenkov, Khrushchev, Voroshilov, Kaganovich, Saburov, Pervukhin, and Bulganin.

As Stalin lay dying on the night of 4-5 March 1953, the members of the Bureau met to sort out the succession. They dissolved the enlarged Central Committee Presidium, renamed themselves the Presidium, and added Molotov, Mikoian and four candidate members to their ranks.[61] These changes were sanctioned by an extremely brief joint session of the Central Committee, the Council of Ministers, and the Presidium of the Supreme Soviet the next evening.[62]

Almost all of the members of the new Central Committee Presidium were familiar with weapons R&D or defence issues. The two leading political figures of the post-Stalin

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[57] Jerry F. Hough, "The Historical Legacy in Soviet Weapons Development," in Valenta and Potter, Soviet Decisionmaking for National Security, p. 88.

[58] Aspaturian, "The Stalinist Legacy in Soviet National Security Decisionmaking," p. 46.

[59] Stephen Fortescue, The Communist Party and Soviet Science, Baltimore: Johns Hopkins University Press, 1986, p. 59.

[60] These changes, together with the announcement of the notorious "doctors' plot" in January 1953, appeared to herald a new purge of the party leadership. However, it had barely got under way at the time of Stalin's death.

[61] Molotov and Mikoian had fallen foul of Stalin and had been dropped from the party leadership at the 19th Party Congress. The new candidate members were Bagirov (an associate of Beriia), and three members of the former (large) Presidium: Mel'nikov, Ponomarenko, and Shvernik.

[62] Apparently this occurred just an hour and a half before Stalin died. For an account of the events surrounding Stalin's death, based on newly released archival evidence, see: Amy Knight, Beria: Stalin's First Lieutenant, Princeton: Princeton University Press, 1993, p. 181.

Presidium, L. P. Beriia and G. M. Malenkov, were the most directly involved in supervising post-war R&D programmes.[63] Beriia had overseen the nuclear weapons programme as well as the prison design bureau system in his role as supervisor of the NKVD/MVD. These connections and his relationship with Stalin also gave him the primary role in oversight of virtually all weapons projects. Malenkov had supervised the aviation industry during the war and headed the Committee charged with removing German industry and technology afterward.[64] He also served as the senior political leader of at least two high priority R&D programmes. Malenkov was chairman of the Scientific-Technical Council for Radar development until 1947.[65] More importantly, in 1946 he had been named chairman of the Special Committee on Reactive Technology. In 1947, he became chief of Special Commission (Spetskom) No. 2. Thus, Malenkov had long been the senior leader responsible for the development of long-range delivery systems (aircraft and missiles). Whether he was as active in managing these programmes as Beriia is open to question, but his authority in these programmes is not.

The two most junior members of the Presidium were also heavily involved in post-war weapons R&D. M. G. Pervukhin had made his name in the electrical industry, but also served as first deputy Commissar for Heavy Industry in the late 1930s.[66] After the war he served as a member of the Special Committee on the Atom Bomb.[67] Also, as Minister of the Chemical Industry, he oversaw the development of nuclear materials and was a key working member of the nuclear bomb project.[68] The other junior member of the post-Stalin Presidium, M. Z. Saburov, was a leading planning official and had been deputy head of the Soviet military administration in occupied Germany.[69] By 1947 Saburov was one of the handful of leaders entrusted with major defence programmes, having taken over the

[63]For Malenkov and Beriia, see Appendix 3.
[64]Known as the "Committee for Rehabilitation of the Economies of Liberated Areas."
[65]Holloway, "Innovation in the defence sector," p. 331.
[66]For Pervukhin, see Appendix 3.
[67]This Committee, which appears later to have been paralleled by the Special Committee on Reactive Technology, was formed on 20 August 1945. The Special Committee on the Atom Bomb was headed by Beriia and included Malenkov and Voznesenskii (head of Gosplan). (Knight, Beria, p. 135.)
[68]Holloway, Stalin and The Bomb, p. 135.
[69]For Saburov, see Appendix 3.

Scientific-Technical Council for Radar after Malenkov left the post.[70] Immediately after Stalin's death Saburov became Minister of one of the industrial "superministries" (Machinebuilding). Pervukhin and Saburov appear to have been up-and-coming industrial technocrats at the time of Stalin's death.

Two other Presidium members appear not to have been involved in the post-war crash weapons programmes, but each had considerable experience with military affairs.[71] V. M. Molotov must have known something about military R&D since he oversaw tank production during the war and headed the nuclear weapons programme until June 1945.[72] N. A. Bulganin was Deputy Minister, and then Minister, of Armed Forces between 1944-1949. After a reorganisation of this Ministry, he became deputy chairman of the Council of Ministers; a post from which he supposedly supervised the defence ministry and the defence industry. Although neither of these men appear to have been directly involved in R&D supervision after the war, their duties, combined with their membership in the ruling elite, might have exposed them to the major research programmes.

This leaves only four of the ten full members of the Presidium with little known connection to military R&D during or after the war; Mikoian, Voroshilov, Kaganovich, and Khrushchev. Anastas Ivanovich Mikoian probably had limited exposure to weapons programmes in his long career with the Ministry of Trade. However, he almost certainly had some knowledge of R&D because his brother, Artem Ivanovich Mikoian, was an aircraft designer (one of the leaders of the famed MiG design bureau). K. E. Voroshilov had headed the Commissariat of Defence from 1925-1940. Although he had not been involved in military affairs after the debacle in Finland, Voroshilov certainly had lengthy experience in dealing with the output of the weapons development complex. L. M. Kaganovich had been one of Stalin's master political trouble-shooters until the late 1940s. He had succeeded Ordzhonikidze as Commissar for Heavy Industry in 1937, although this

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[70]Holloway, "Innovation in the defence sector," p. 331.

[71]It is quite possible that there were major weapons R&D projects during that period that have not yet come to light. These, and other Presidium members, may have been involved in such programmes.

[72]He was replaced by Beriia, apparently at the request of the chief scientist of the programme, I. V. Kurchatov. (Knight, Beria, pp. 134-5; and Holloway, Stalin and The Bomb, p. 103.)

was after much of the defence industry had been put in a ministry of its own.[73] Nonetheless, Kaganovich oversaw transportation during the war, and served in a number of government posts that probably brought him into direct contact with post-war projects, even if he did not directly supervise R&D.[74] N. S. Khrushchev's only evident connection to weaponry was his service as a party leader on the Ukrainian Front during the war. He is not known to have had any role in military R&D prior to Stalin's death.[75]

Based on this evidence it seems that Khrushchev probably overstated the case when he said that Stalin "...refused to discuss military matters with us; he gave us no training in the management of the army. Defense was his exclusive concern..."[76] Stalin may well have refused to discuss these issues with Khrushchev, but this was certainly not the case for the heads of major programmes and ministries. In fact, of all of Stalin's successors, Khrushchev was uniquely inexperienced in military matters, especially weapons R&D.

It is important to note that involvement in military R&D was virtually a pre-requisite for members of the leadership after Stalin's death. When the Presidium of the Central Committee was reduced on 5 March 1953, only one of the eleven full members that were dropped had any known connection to military R&D.[77] At least six of the ten members left on the Presidium had played a significant role in managing and overseeing defence issues, industry, or research projects. Three of the remainder had some contact with, or connection to, the military or military R&D. The single exception was Khrushchev.

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[73]See Appendix 4, sheet 1.

[74]The post-war missile programme was particularly dependent on the railroads to connect the Moscow design bureaux and production facilities with the new missile test range at Kapustin Iar. New lines and special railroad cars had to be developed and built to support the missile effort. This may have been one of Kaganovich's responsibilities.

[75]The notable exception to this is Khrushchev's claim that he was involved in getting the location of the first missile test-range moved to the more remote Kapustin Iar. As party leader in the Ukraine he objected to the originally proposed site for taking up valuable farmland and being too close to population centres. He states that Beriia rejected his first complaint, so he appealed directly (and successfully) to Stalin. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 108-9.)

[76]Khrushchev, Khrushchev Remembers: The Last Testament, p. 11. (In his son's memoir Khrushchev is frequently quoted referring to himself by the plural/formal pronoun. Thus the English translation of this passage, perhaps inadvertently, adds to the impression that none of Stalin's successors was well versed in defence and weapons issues.)

[77]This person was V. A. Malyshev. He had run the nuclear programme under Beriia and became the Minister of Medium (nuclear) Machinebuilding when that organisation was created several months later. (For Malyshev, see Appendix 3.) There are four "dropped" members whose careers are not completely clear. It is possible that one or more of them was involved in weapons programmes.

Outside of the Presidium and its subcommittees, it appears that the party itself played little role in missile policymaking. Many of the senior leaders of military R&D were members of the Central Committee, but it appears that most of the policymaking and oversight were carried out by ministries, special commissions, and the security organs rather than by the Central Committee or its Secretariat.[78] Other party organs, including regional and primary party organisations, may have played a role in expediting resources, vetting personnel, and monitoring compliance with central directives. However there is no evidence to suggest that lower party organs had any substantial input to missile policymaking.

State Institutions

Most of the evidence on weapons R&D policymaking and execution from the late-Stalin era concerns state organisations. This corresponds with Stalin's post-war preference for using state institutions for governing.[79] There were a considerable number of organisations that played significant roles in the post-war missile programme. From the Council of Ministers down to the design bureaux, government institutions were the most numerous actors in the policymaking process.

On an organisational chart it appears that major weapons programmes were subordinate to the Council of Ministers.[80] In fact, they were not. Major programmes like the nuclear and missile projects were personally supervised by members of the inner leadership circle through specially created organs like Spetskom No. 2. These were subordinate to Stalin, who was Chairman of the Council of Ministers, but they appear to have operated largely outside the Council of Ministers system.

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[78]Fortescue, The Communist Party and Soviet Science, p. 96.

[79]Rigby, "The Soviet Political Executive," p. 35. Rigby notes that it is easy to exaggerate this effect and warns that "...at all levels below the centre, party officials remained the most important and powerful agents of the regime."

[80]See Appendix 7, sheet 1.

Even the organisations below the policy organs, i.e. the Scientific-Technical Councils, appear to have been set up to bypass the Council of Ministers.[81] The Scientific-Technical Councils were also chaired by high-level officials; e.g. Malenkov, then Saburov, for the radar programme. In practice, they served as an executive agency to co-ordinate the work of ministries involved in the project. In this respect they duplicated the function of the Council of Ministers. Like the First Main Administration (nuclear programme) and Spetskom No. 2 (missile programme), the Scientific-Technical Councils worked "on top of" the usual ministerial system, thereby subverting the formal structures of the Soviet government.

Arguably, an extremely complex, high-priority project like the missile programme needed special managerial arrangements. The missile programme was centred in D. F. Ustinov's Ministry of Armaments, but it involved the efforts of numerous other ministries.[82] By the early 1950s the missile effort involved institutes, design bureaux, and factories from at least eight other ministries including: the Ministries of Aviation Industry, Shipbuilding Industry, Means of Communication, Machine and Instrumentbuilding, Defence, Chemical Industry, Radio-Technical Industry, and Heavy Machinebuilding Industry.[83] Co-ordination of these organisations was accomplished through the Scientific-Technical Council (headed by Ustinov) and, ultimately, through Spetskom No. 2. At lower levels, missile programme co-ordination was assisted by both the security forces and by the Council of Chief Designers.

State planning institutions were also participants in weapons R&D in the post-war period, but they played a secondary role. The head of Gosplan was a member of the important, top-level commissions and committees.[84] For high priority, resource intensive

[81]Scientific-Technical Councils at the head of major programmes are not to be confused with Scientific-Technical Commissions which were ad hoc panels appointed to evaluate proposals and programmes. See Appendix 7, sheet 1 and Appendix 9: The Soviet Military Research and Development Process.

[82]The other ministries involved in the programme were producing sub-systems, ancillary equipment, or other essential supplies.

[83]US Central Intelligence Agency, National Intelligence Estimate Number 11-6-54: Soviet Capabilities and Probable Programs in the Guided Missile Field, (Top Secret), Washington DC, 5 October 1954, as declassified 29 June 1993 by CIA Historical Review Program, pp. 6, 28-33; and Oral History of V. I. Chepa in Mozzhorin, ed., Dorogi v Kosmos, Vol. 2, p. 76.

[84]Voznesenskii, while still head of Gosplan, was a participant in both the nuclear and missile programmes. For example, Voznesenskii and his agency were assigned specific tasks for the early missile programme in

research programmes of this type, participation by, and co-ordination with, the planning officials was a necessity. This would have been particularly important because it is impossible to make a crash, high-technology programme fit into the usual planning process.[85] Such programmes fell outside the bounds of the normal planning, because they over-rode previously established priorities.[86] The role of the planning organs appears to have been to identify and allocate the necessary resources, and to continually adjust existing plans to accommodate the higher priority weapons programmes.

The industrial ministries were the executors of state weapons R&D policy. As noted in Chapter 2, these organisations became highly specialised during the Stalin era. The Ministry of Aviation Industry controlled aircraft development and a number of missile projects.[87] However, ballistic missiles were assigned to the Ministry of Armaments. Industrial ministries were typically organised by function into Main Administrations (Glavnie Upravlenie or Glavki).[88] Under the Ministry of Armaments, missile R&D had been the business of the 7th Main Administration (7GU).[89] The Korolev missile design bureau was subordinate to a research institute (NII-88) that was under the 7GU.

Supervision by the security forces was not only a means of co-ordination, it was a way to assert priorities and maintain oversight of post-war weapons R&D. In the missile programme, vigilance may well have been heightened by the apparent fanaticism of the rocket advocates, as well as their convictions for various anti-Soviet crimes in the 1930s. It is worth re-emphasising that the rocket specialists sent to Berlin in August 1945 were interviewed at the Central Committee before being dispatched. Interestingly, Korolev was not included in the first group, even though he was clearly one of the leading Soviet rocket

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Council of Ministers decree No. 1017-419ss (13 May 1946). (I. D. Sergeev, et al., Khronika Osnovnykh Sobytii Istorii Raketnykh Voisk Strategicheskogo Naznacheniia, Moscow: TsIPK, 1994, pp. 228-233.)

[85]For a brief description of the usual planning procedures see: Joseph Berliner, The Innovation Decision in Soviet Industry, London: The MIT Press, 1976, p. 42.

[86]See: Louvan Nolting, The Planning of Research, Development and Innovation in the USSR, Foreign Economic Report #14, Washington DC: Department of Commerce, July 1978.

[87]The Ministry of Aviation Industry had responsibility for winged (cruise) missiles and may have been involved in anti-aircraft missile development.

[88]Arthur Alexander, Decision Making in Soviet Weapons Procurement, Adelphi Paper No. 147/8, London, International Institute for Strategic Studies, Winter 1978/79, p. 22.

[89]Iu. Mozzhorin and A. Eremenko, "Ot Pervykh Balisticheskikh do...," Aviatsiia i Kosmonavtika, No. 8, August 1991, p. 34.

engineers.[90] By the late 1940s the direct role of the MVD in the ballistic missile programme may have declined, but the security organs were still a major presence in missile R&D. As in every field they were responsible for security (and oversight) within and outside the programme.

Despite its prominence in the formal R&D process, the Ministry of Armed Forces played a somewhat limited role in the Stalin-era ballistic missile R&D programme. The military was supposed to set the design requirements, develop employment doctrine and training programmes, plan and conduct state acceptance tests, and exercise quality control during production. However, the first of these functions, missile design requirements, was driven by high level political choices. Military doctrine followed, rather than prompted, these decisions.[91]

The other military functions in the ballistic missile R&D process were handled by the artillery forces. The Main Artillery Administration (GAU), was the administrative locus for military efforts on the missile programme. The work of the GAU was divided among several organisations. The Academy of Artillery Sciences, which reportedly supervised NII-4, had apparently been one of the most important of these organisations.[92] However, the month after Stalin's death the Academy of Artillery Sciences was disbanded.[93] The state tests themselves were conducted by the military at the GAU-operated State Central Test Range, at Kapustin Iar. To a considerable extent, the military part of the missile development programme concentrated on one man, Marshal of Artillery M. I. Nedelin. By the time of Stalin's death Nedelin was Deputy Minister of Armed Forces for Armaments and Commander-in-Chief of Artillery.

Another major state institution involved in missile R&D was the USSR Academy of Sciences. Formally subordinate to the Council of Ministers, the Academy of Sciences was one of the few major state institutions not directly represented on the Council of Ministers.

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[90]See Chapter 2.
[91]Holloway, "Innovation in the defence sector," p. 352, 394.
[92]Oral History of I. E. Shashkov in Mozzhorin, ed., Dorogi v Kosmos, Vol. 2, p. 89.
[93]This occurred in April 1953. Marshal Voronov then became commander of the Military Artillery Command Academy. Academician Blagonravov moved to the USSR Academy of Sciences as director of the Institute of Engineering Science. See: Voennyi Entsiklopedicheskii Slovar', pp. 24, 83, 163.

The Presidency of the Academy of Sciences, and membership in the Academy Presidium, were prestigious posts, but they did not convey formal access to the government leadership. Members of the Academy played a role as expert advisors and leaders of important research institutes, but not simply because they were Academicians. Outside of their advisory role, their influence on policy was confined to informal appeals that, in the case of a few scientists, occasionally won the attention of Stalin.[94]

Historically, the Academy had long prided itself on its devotion to "pure" science, but this had been diluted under Stalin. In the 1930s the Academy of Sciences was forced to accept engineers as members when the Technical Section was created. During the Second World War the Academy had also become heavily involved in applied (weapons) science work. The Academy did not run design bureaux and none of the major missile designers were members of the USSR Academy of Sciences prior to 1953, but some of the Academy's institutes worked with design bureaux on weapons projects. In addition, much of the rocket research that was not directly related to weapons development was conducted by Academy institutes. For example, the geophysical and biological rocket research flights that began in 1949 were conducted under the auspices of various Academy institutes, although the launches themselves were carried out by the military rocket units at Kapustin Iar.

Conclusions

The weapons R&D policymaking system under Stalin was clearly highly centralised and personalised. There were certainly weapons programmes that did bubble up from below; being initiated by either the military or by designers. By looking at the sequence and timing of Predraft Projects and Tactical-Technical Requirements (TTTs) (when that information is available) it is possible to determine which institutions or individuals initiated these projects. However, as was often the case in the highest-priority post-war projects,

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[94]e.g. noted physicist P. I. Kapitsa kept a channel to the leadership open through his letters to Stalin. He used this method to save a talented colleague from prison during the height of the purges. (Roald Z. Sagdeev, The Making of a Soviet Scientist: My Adventures in Nuclear Fusion and Space from Stalin to Star Wars, New York: John Wiley & Sons, 1994, p. 88.)

this proposal phase was easily circumvented by Stalin because he was the hub of the weapons R&D policymaking system. The absence of Predraft Projects and TTTs is evidence that a programme was imposed by the leadership in this way.

The Draft Projects (EPs) also contain a number of clues about policymaking. Their appearance generally signalled a decision by the leadership to pursue a particular capability. The EPs not only show when a programme began, but, when available, can show if there was competition among design bureaux. The existence of EPs without a decree by the Central Committee and Council of Ministers suggests that a programme was abandoned by the leadership after initial inquiries had been made.

Decrees on weapons programmes are direct evidence of Soviet leadership policies. These decrees came in two types. Major R&D projects began with a joint decree by the Central Committee and Council of Ministers. This "design decision" was particularly crucial to designers, for it was the one that gave them the power to carry out a full-scale development project. The second type of decree ("production decision") was used to accept a prototype system and put it into production. The presence or absence, and timing, of such decrees provides further evidence about the progress of weapons programmes and the success or failure of designers.

Unfortunately, decrees are not conclusive evidence about policy choices. For example, the absence of a production decree may indicate a change of policy, or insurmountable technical difficulties. One way to distinguish between these alternatives it to look at more informal indications. Specially assigned officials, priority access to resources, and high levels of leadership attention would tend to indicate that a programme was still part of leadership policy. On the other hand, the absence of such attention to a programme that had not yet gone into production would suggest a change of policy rather than development problems.

Based on the limited documentary evidence available about the missile and space programmes, these latter types of distinctions are difficult to make. However, the available evidence, combined with data about the political context of the missile and space programmes makes it possible to be more certain about policymaking in these fields. It is particularly important to understand which individuals and institutions were permitted to play a role in policymaking.

For the Stalin-era missile programme, it is clear that decisions initially came from the top down. After the war native rocket enthusiasts like Korolev wanted to develop their own projects. However, it was only after the missile programme had been established, and the native designers had proven themselves "superior" to the German specialists, that missile projects began to be initiated by designers. Even so, designers and their bureaux were tightly constrained by a web of formal and informal reviews and oversight. They could propose and advise, but once a programme decision was made they had little alternative but to carry it out. What little influence designers had was confined to the initiation and persuasion phases of the policymaking process.

Stalin's distrust of his designers and scientists had far-reaching effects on policymaking. For high-priority projects like the missile programme he added extra layers of both formal and informal institutions to ensure that the programme was successful.[95] As a result, major weapons R&D programmes were highly politicised. Seemingly extraneous issues and incidents could have a significant influence on major actors and their roles.[96]

The R&D process itself enjoyed a fairly high degree of legitimacy due to its success both during and after the war. In addition, the major figures in weapons R&D, unlike their military counterparts, were all members of the political leadership. To change the policies and procedures in high priority R&D programmes would require a major political upheaval. Such "confusion and panic" was something that Stalin's successors wanted to avoid.

Yet, with Stalin gone, it was clear that parts of the policy process would have to change. There would either have to be a new Stalin, or his successors would have to come up with an alternative to his informal control and oversight mechanisms. This was clearly an issue of Central Committee Presidium politics. Evidence of how the new leadership addressed this problem can be seen in the changing roles and functions of both individuals and institutions in the post-Stalin period. It is particularly important to trace which

[95]e.g., the creation of Spetskom No. 2 and the use of the security forces for oversight.
[96]For example: Malenkov's brief exile in 1946 came at a time when important questions about the role of the German specialists in the missile programme were being decided. Such events also had an influence on institutional roles.

individuals and institutions fulfilled which functions, especially the crucial oversight function. With these perspectives in mind we now turn to the question of how the Soviet space programme began.

Chapter 4: The Sputnik Decisions (1953-1957)

"For several years, research and experimental designing work have been underway in the Soviet Union to create artificial satellites of the Earth...as a result of the intensive work, by research institutions and design bureaux, the first artificial Earth satellite in the world has now been created."

TASS Press Release
4 October 1957

Overview

After the launch of Sputnik on 4 October 1957, the Soviet Union tried to convince the world that their space programme was the product of a long, carefully planned research effort aimed at scientific ends. However, it is now clear that there was no state-sponsored space effort prior to Stalin's death. How did Sputnik get on the political agenda? Did the chief designers have any influence in this preliminary step toward a manned space programme? What was the purpose of Sputnik? Finally, what do the decisions about Sputnik tell us about the post-Stalin political system?

Prior to 4 October 1957, Soviet international behaviour suggested that space exploration was not an important state objective. In May 1954 the deadline for International Geophysical Year (IGY) satellite proposals passed without a word from the Soviet Union. After the meeting to discuss IGY satellite proposals had already begun that October, the Soviet Union announced that a delegation from the USSR Academy of Sciences would join the meeting.[1] Although the meeting concluded with a resolution recommending the launch of scientific satellites during the upcoming IGY (1957-58), the Soviet Union remained silent on this issue for nearly a year. This was a marked contrast to the United States, where a wide variety of IGY satellite projects were being discussed and developed. By Spring 1955 there were five separate programmes in competition to build a US satellite for the IGY.[2]

[1]The meeting was held in Rome, 30 September - 4 October 1954. The Soviet Ambassador in Rome notified the IGY organising committee that a group of Academicians who were already in Rome for another conference, had been appointed to attend the IGY meeting. (Harold Spencer Jones, "The Inception and Development of the International Geophysical Year," in M. Nicolet, ed., Annals of the International Geophysical Year, Vol. 1, London: Pergamon Press, 1959, p. 392.)

[2]Giles Alston, International Prestige and the American Space Programme, Oxford University, DPhil. dissertation, 1989, p. 110.

In mid-1955 the Eisenhower administration decided to sponsor one of these IGY satellite projects. The approval by the US National Security Council (NSC) in May 1955 "...stipulated that its peaceful nature be stressed and that the project not interfere with military programs."[3] This decision to launch several "small earth-circling satellites" for IGY research was announced on 29 July 1955.[4] The announcement coincided with the beginning of the International Astronautical Federation (IAF) Congress in Copenhagen.[5]

Three days after the White House announcement, the Soviet Union stated its intention to launch an IGY satellite as well. Academician L. I. Sedov called a press conference at the IAF Congress and announced that the Soviet Union was developing a similar programme. Sedov, chairman of the Commission on Interplanetary Communication of the USSR Academy of Sciences, noted that the Soviet satellite would be significantly larger and heavier than its US counterpart.[6] Such claims by Sedov and other scientists were not repeated by Soviet political leaders, and were largely ignored in the West.

From the Western perspective Moscow's relative silence on satellites could easily be attributed to the numerous problems the Soviet Union faced in the mid-1950s. It was fairly clear that the Soviet leadership was engaged in a succession struggle. In addition, the Soviet economy was suffering, especially after 1956, under the demands of the Sixth Five Year Plan.[7] There were international problems as well. Although the new Soviet leadership was becoming more active in world affairs, the results were not consistently effective. For example, in the wake of de-Stalinization in 1956, Hungary and Poland violently revolted against Moscow. Only Khrushchev's missile threats against France and Britain during the Suez Crisis saved Soviet foreign policy from complete humiliation following the East European revolts of Fall 1956.

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[3]Walter A. McDougall, ...The Heavens and the Earth: A Political History of the Space Age , New York: Basic Books, 1985, p. 121.

[4]Frank H. Winter, Rockets into Space, London: Harvard University Press, 1990, p. 71; and Nicholas Daniloff, The Kremlin and the Cosmos, New York: William Morrow & Co., 1972, p. 59.

[5]The decision on which of the US proposals would be pursued was not announced until September 1955. The US selected a project known as "Vanguard."

[6]Daniloff, The Kremlin and the Cosmos, p. 59. For Sedov, see Appendix 3.

[7]Alec Nove, An Economic History of the USSR 1917-1991, 3rd ed., London: Penguin, 1992, p. 351. (The Sixth Five Year Plan was to have lasted from 1956 to 1960. It was later abandoned.)

As early as 1954 the US was convinced that the Soviets were making "a concerted effort to produce an I(C)BM."[8] The need for an ICBM was driven by a number of factors, including advances in anti-bomber defences. During 1956, this seemed to be confirmed by Khrushchev's public fixation on missiles. An ICBM might also serve as a satellite launcher, but the prevailing US assumption was that the Soviet Union was giving top priority to the missile programme.[9] The idea that the Soviet Union would commit itself to a scientific space programme seems not to have occurred to most Western leaders.

In fact, Western confidence in the superiority of their own missile and space programmes continued to grow. The flawless test of the first Vanguard rocket prototype in December 1956 led to confident predictions that a US satellite would be in orbit in less than a year. In early 1957 a report to the US Congress stated that the American ICBM programme was far more advanced than its Soviet counterpart.[10] Tests, albeit unsuccessful, of the American Atlas ICBM began in mid-1957. Even the Soviet announcement, on 26 August 1957, that they had tested their own ICBM caused barely a ripple in the West.[11]

However, two months later, the Soviet space programme elicited quite a different reaction. The sight and sound of Sputnik passing overhead undermined Western confidence. The Eisenhower administration struggled to respond, but the damage was already done.[12] With the launch of Sputnik the Soviet Union had scored its biggest coup of the Cold War.

Yet, we now know that until Stalin died in 1953, the Soviet Union had systematically suppressed satellite research. The idea of a space programme did have a

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[8]US Central Intelligence Agency, National Intelligence Estimate Number 11-6-54: Soviet Capabilities and Probable Programs in the Guided Missile Field, (Top Secret) Washington DC, 5 October 1954, as declassified 29 June 1993 by CIA Historical Review Program, p. 4.

[9]In the US, military efforts (both missiles and satellites) had priority over the scientific satellite programme. The logic of mirror-imaging in this case was very strong.

[10]C. Peebles, "A Traveller in the Night," Journal of the British Interplanetary Society, Vol. 33, No. 8, August 1980, p. 282.

[11]Daniloff, The Kremlin and the Cosmos, p. 60. The TASS announcement of the ICBM test was publicised in the Soviet Union on 27 August 1957. (Bol'shaia Sovetskaia Entsiklopediia: Ezhegodnik 1958, Moscow: Sovetskaia Entsiklopediia, 1958, p. 26.)

[12]The US actually had a much more advanced satellite programme in development. However, it was a military reconnaissance programme, and President Eisenhower was unwilling to reveal it.

number of key supporters among defence industry designers and engineers, and a few scientists in the Academy of Sciences. Some of these people were leading engineers in the ballistic missile programme and had even managed to divert some resources toward designing a satellite. However, their pleas for state support had been fruitless. State policy had been set by Stalin, administered by the defence ministries, and diligently overseen by the security services under Beriia. This system was highly effective, and very hostile to space proposals. In light of this, how did the Sputnik proposal ever get approved? To answer this question we must first look at the numerous changes to institutions and the policymaking environment after Stalin's death. After that, we will turn our attention to the ICBM programme and the satellite programme that became attached to it.

Institutions and the Policymaking Environment

The Party

The Presidium of the Central Committee

Soviet domestic politics from 1953 to 1957 is largely the story of Khrushchev's rise to power. Through a series of temporary alliances Khrushchev systematically neutralised his political opponents and shifted the locus of power from the state to the party.[13] Surprisingly, he was able to accomplish much of this task without significantly changing the composition of the Presidium of the Central Committee from mid-1953 until the political showdown of the summer of 1957.

The first problem for Khrushchev, and the other members of the Presidium, was Beriia. With his hold on the security organs, Beriia was the most powerful, and most dangerous, of Stalin's successors.[14] Khrushchev was in a relatively weak political position. He was the only Presidium member without a major state responsibility after Stalin's death. He was also the only Presidium member left in the Central Committee

[13]Khrushchev applied the same strategy in a number of different policy areas. "In his bid for the control of foreign policy, Khrushchev based his strategy on the following guidelines: to assert the party's supremacy over the state apparatus; to politicise the diplomatic establishment; and to neutralise potential rivals by engaging them in policy disputes." (Marie Mendras, "Policy Outside and Politics Inside," in Archie Brown, ed., Political Leadership in the Soviet Union, Bloomington: Indiana University Press, 1989, p. 139.)

[14]After Stalin's death the Ministry of State Security (MGB) was re-subordinated to the MVD and Beriia was appointed Minister.

Secretariat.[15] Thus, he was now isolated in the party bureaucracy; an organisation that appeared to be of secondary importance in the calculations of other Presidium members.

In late June 1953, claiming that Beriia was about to launch a coup, Khrushchev masterminded a bold plan to dispose of his rival.[16] With the help of Bulganin and Molotov, and the assistance of Malenkov, he had Beriia arrested at a meeting of the Presidium on 26 June 1953.[17] The military held Beriia incommunicado until his execution, reportedly in December. A Central Committee Plenum on Beriia's crimes from 2-7 July led to a sweeping purge of Beriia's closest associates and major changes to a number of institutions.[18]

After the removal of Beriia, Khrushchev began to play a more important role in the leadership. At the September Plenum of the Central Committee Khrushchev was elevated to "first secretary".[19] The Plenum also instituted a new rule for high-level decisionmaking - henceforth, all Council of Ministers decrees had to be countersigned by the first secretary. This was the beginning of a gradual increase of party power and influence over the government.

Khrushchev's next target was the head of government, Malenkov. Taking issue with him in a number of areas, Khrushchev built an alliance with both the old "conservatives" and the young industrialists on the Presidium. The old Stalinists were unhappy with Malenkov's ideological and doctrinal deviations, especially his statements about the unwinnability of thermonuclear war. The junior members of the Presidium who had been involved in defence industry, like Pervukhin and Saburov, were upset with Malenkov's espoused preference for consumer goods. Although Malenkov remained a full member of the Presidium, his other duties were whittled away. In the course of two years he went from Chairman of the Council of Ministers and heir apparent, to Minister of

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[15]Malenkov "resigned" his position in the Secretariat shortly after Stalin's death. Whether Khrushchev arranged this to enhance his power is not clear.
[16]John Löwenhardt, James R. Ozinga, and Erik van Ree, The Rise and Fall of the Soviet Politburo, London: UCL Press, 1992, p. 47.
[17]Sergei N. Khrushchev, Nikita Khrushchev: Krizisy i Rakety, Vol. 1, Moscow: Novosti, 1994, p. 30.
[18]Amy Knight, Beria: Stalin's First Lieutenant, Princeton: Princeton University Press, 1993, p. 203. Regarding the changes to other institutions, see below.
[19]From Stalin's death until this time there had been no first secretary.

Electrical Stations. Malenkov was replaced as Chairman of the Council of Ministers by Khrushchev's ally Bulganin.[20]

After Malenkov's demotion in early 1955, Khrushchev immediately moved against his former allies in the Presidium. By the end of the summer of 1955, Kaganovich and Molotov had suffered the same fate as Malenkov. Although they remained in the Presidium, their government roles and authority had been severely undermined. Pervukhin and Saburov moved, or were moved, out of their ministerial positions and into the planning organs.[21] Pervukhin became First Deputy Chairman of the Council of Ministers and Chairman of the new State Economic Commission (Gosekonomkom). Saburov became head of Gosplan, an organisation whose function was now restricted to long-range planning.

Although no-one had yet been removed from full membership of the Presidium since the purge of Beriia and his allies, Khrushchev began to add supporters. This began with the elections of Kirichenko and Suslov to full membership in July 1955. After the Twentieth Party Congress in 1956, five new candidate members joined the Presidium. Of the five new candidates, three (Brezhnev, Furtseva, and Shepilov) were Secretaries of Khrushchev's Central Committee Secretariat and the other two (Zhukov and Mukhitdinov) were otherwise associated with Khrushchev.[22] Finally, in February 1957, Frol Romanovich Kozlov, joined the Presidium as a full member.[23] Now all of the candidate members and three of the full members of the Presidium owed their promotion to Khrushchev.

However, control of at least one third of the votes of the Presidium was not enough to save Khrushchev from criticism for his evident failures, especially in economic policy.[24] The failures of the Sixth Five Year Plan, a plan approved at the Twentieth Party Congress

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[20]Malenkov resigned as Chairman of the Council of Ministers in February 1955, citing his own "administrative inexperience." (Löwenhardt et al., The Rise and Fall of the Soviet Politburo, p. 487.)
[21]See Appendix 10.
[22]Löwenhardt et al., The Rise and Fall of the Soviet Politburo, p. 50. For Brezhnev, see Appendix 3.
[23]For Kozlov, see Appendix 3.
[24]Khrushchev could probably depend on at least four of the twelve votes in the Presidium - his own and that of the three people he had sponsored as full members.

and closely associated with Khrushchev, were a particular weak point.[25] With Presidium opponents now in charge of the planning organs, Khrushchev was vulnerable. The Central Committee Plenum in December 1956 decided to scrap the Sixth Five Year Plan. Even worse for Khrushchev, the revision of the plan was handed over to Pervukhin's Gosekonomkom. This effectively gave Gosekonomkom direct control over the ministerial structure.[26]

At the February 1957 Central Committee Plenum Khrushchev counterattacked. He pointed to centralised ministries as the source of economic troubles and proposed a radical solution. Rather than concentrating power in Gosekonomkom, yet another central organ, he demanded that the ministries be abolished and economic planning be devolved to regional authorities known as Sovnarkhozes.

> "Khrushchev was responding to a very real problem, but doing so in a manner calculated to harm his political opponents, and to weaken the state-ministerial hierarchy."[27]

This proposal was heavily criticised in private by all of the senior leaders in the Presidium[28], yet the clever Khrushchev's hold on power was already so strong that it was difficult to stop him from advancing his plan. On 10 May 1957 Khrushchev bypassed the Presidium of the Central Committee and had his proposal ratified by the Supreme Soviet.

As Khrushchev's plan began to go into effect, his opponents on the Presidium decided to act. In Moscow, at the Presidium session on 18 June 1957, Malenkov and Molotov lead a revolt against Khrushchev, his Sovnarkhoz plans, and the growing power of the party over the state.[29] Seven of the eleven members of the Presidium present voted

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[25]Nove, An Economic History of the USSR, pp. 349-51.
[26]Nove, An Economic History of the USSR, pp. 351-2.
[27]Nove, An Economic History of the USSR, p. 352.
[28]Including Khrushchev's long-time ally Bulganin, whose Council of Ministers would become redundant under the Sovnarkhoz proposal.
[29]Löwenhardt, et al., The Rise and Fall of the Soviet Politburo, p. 51. The list of criticisms comes from then-candidate Presidium member Mukhitdinov.

for Khrushchev's resignation.[30] Although he only had the support of Mikoian, Suslov, and Kirichenko, Khrushchev refused demotion or retirement.[31]

In a now famous reversal of fortunes, Khrushchev appealed this decision to the Central Committee. The Central Committee was dominated by regional leaders who had largely been appointed by Khrushchev, and who would benefit most from the Sovnarkhoz reforms. With the help of Marshal Zhukov, the Central Committee was quickly assembled. By the end of the Central Committee session, on 29 June 1957, Khrushchev had won. The leaders of the so-called "Anti-Party Group" were purged.

The party organisation that Khrushchev had been nurturing now came to the fore. The "Anti-Party Group" was largely replaced on the Presidium by Khrushchev's party underlings. Ten of the fifteen Presidium members in Fall 1957 were Secretaries of the Central Committee, the highest such percentage in Soviet history.[32] Although some of Khrushchev's opponents lingered in the Presidium for several years, the body had largely become Khrushchev's own in the summer of 1957.

Moreover, the state institutions that had been the power base for his opponents came under the control of the party. This was not simply a matter of eliminating state agencies like Gosekonomkom, but of creating alternative policy and oversight organs.[33] From at least 1955 Khrushchev had been building a more experienced and expert Central Committee staff.[34] After the "Anti-Party Group" affair, the enhanced Central Committee apparat took control over missile and space policy.

The Party Leadership and Missile / Space Policy

Control of weapons R&D policy was a significant issue in the succession struggle. Initially, Khrushchev was in the weakest position relative to his peers. However, he took it

[30]Kozlov was absent from the meeting, because he was in Leningrad organising the city's 250th Anniversary celebrations. In the days following he led the effort to rally support for Khrushchev in the Central Committee. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 307-310.)

[31]Khrushchev's opponents had hoped to demote him to Minister of Agriculture. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 307.)

[32]Löwenhardt, et al., The Rise and Fall of the Soviet Politburo, p. 52.

[33]Gosekonomkom was eliminated by the 10 May 1957 Supreme Soviet decision to implement the Sovnarkhoz reforms.

[34]e.g., in 1955 the head of the Central Committee Science Department was replaced by V. A. Kirillin, a corresponding member of the Academy of Sciences and a newcomer to the party apparatus. (For Kirillin, see Appendix 3.)

upon himself to remedy his weaknesses in this field and soon began to assert himself in weapons R&D decisions. By 1956 he apparently had almost complete access to weapons programmes and sufficient legitimacy and power to control many weapons R&D policy decisions.

As in other aspects of leadership power, Beriia was the major figure to contend with in weapons R&D in March 1953. It appears that Beriia moved quickly to assume Stalin's position as the centre of weapons R&D policy. He was, of course, the only one in the leadership who had a complete picture of weapons policy, since he had overseen it under Stalin. During the July 1953 Plenum on his crimes, Beriia was accused by Malenkov of usurping control over nuclear weapons policy.[35]

After Beriia's arrest, control over weapons R&D policy became unclear. In addition to the purge of the security organs, Beriia's institutional mechanism for control of nuclear weapons programmes, the First Main Administration, was downgraded to a Ministry.[36] Nonetheless, the Ministry of Medium Machinebuilding (MSM) appears to have continued as the de facto locus of policymaking for advanced weapons programmes for some time. Many of the people with practical weapons programme management experience wound up in the MSM, an organisation known as a "preserve" for Beriia's former associates.[37] Notably, the new deputy ministers at MSM were the leaders of the main high-priority weapons programmes of the time.[38]

The first Minister of Medium Machinebuilding was V. A. Malyshev, a man closely associated with both Malenkov and with weapons programmes.[39] As Minister, Malyshev

[35]The government decision to test the first thermonuclear bomb in the summer of 1953 had been prepared for Malenkov's signature. Beriia had simply crossed out Malenkov's name and signed it himself. (David Holloway, Stalin and The Bomb, New Haven: Yale University Press, 1994, p. 321.) Beriia's efforts to keep Malenkov in the dark on nuclear questions are also confirmed by Andrei Sakharov. (Andrei D. Sakharov, Memoirs, trans. by Richard Lourie, London: Hutchinson, 1990, p. 169.)

[36]This occurred on the day of Beriia's arrest, 26 June 1953.

[37]Sakharov, Memoirs, p. 146.

[38]See Appendix 7, sheet 2. Vannikov had been head of the nuclear weapons programme, Khrunichev had been Minister of Aviation Industry, and Riabikov had been involved in the missile programme - and may have been head of the Main Administration in charge of developing the Moscow Air Defence system.

[38]Sakharov, Memoirs, p. 169.

[39]For Malyshev's association with Malenkov see: Sakharov, Memoirs, p. 169. Malyshev had become a member of the Presidium at the Nineteenth Party Congress in late 1952. He was one of the many new members dropped after Stalin's death and the only removed member with a known connection to weapons programmes.

is reported to have supervised the advanced technology programmes, including missiles and nuclear weapons.[40] However, over the course of the next few years the Presidium, and especially Khrushchev, asserted control over policy in these programmes.

Khrushchev scattered hints about his acquisition of control over weapons policy throughout his memoirs. It appears that he first gained access to military information by having himself appointed Commander-in-Chief of the Soviet military.[41] Then, in 1954, Khrushchev launched himself on a self-education programme, by visiting weapons plants and design bureaux.[42] In the course of these visits he not only began to assert his authority, but also undermined the expertise of the old weapons R&D elite, including other members of the Presidium.

Khrushchev's initial foray into R&D policy appears to have been in the aircraft industry. This must have been a tempting and easy target for him. In the first place, the aircraft industry had long been associated with Malenkov. Secondly, the Soviet Air Force was the weakest of the branches of the military.[43] Sometime in early 1954 Khrushchev humiliated the aircraft designer Miasishchev and the Soviet Air Force leadership during a visit to the designer's bureau.[44] By attacking the Air Force plan for using the aircraft against the US, Khrushchev effectively stopped the M-4 (Bison) bomber programme.

As early as 1955 it was clear that Khrushchev had a significant degree of control over strategic policy and weapons R&D decisions. By the middle of that year virtually all of the Presidium members with any experience had been moved out of positions with direct

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[40] Sakharov, Memoirs, p. 169.

[41] Ostensibly, this was because of Minister of Defence Bulganin's weaknesses as a military leader. (Nikita S. Khrushchev, Khrushchev Remembers: The Last Testament, ed. and trans. by Strobe Talbott, Boston: Little, Brown & Co., 1974, p. 12.)

[42] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 48-9. This may have been motivated as much by curiosity as by political ambition. Khrushchev had hoped to be an engineer himself, but got involved in party work and never finished his course of study. According to his son, Khrushchev loved to spend time in the company of inventors and scientists.

[43] The Soviet Air Force had long been dominated by the Army. Although the Navy was also relatively weak, it had a much longer historical tradition, and had existed as a separate Commissariat / Ministry at various times.

[44] The visit to the Miasishchev bureau is described in Khrushchev, Khrushchev Remembers: The Last Testament, p. 39. This same meeting is described in greater detail by his son, Sergei Khrushchev, who claims to have been present. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 49-53) For Miasishchev, see Appendix 3.

responsibility for weapons programmes.[45] Khrushchev claims to have torpedoed Admiral Kuznetsov's proposal to build a large surface fleet in 1955.[46] He also re-instated an aviation design bureau that had been disbanded by Stalin, thus beginning a new weapons programme.[47] In the latter case Khrushchev admits that Bulganin opposed him, but:

> "Bulganin dropped his objection. The rest of the leadership acknowledged my authority where armaments were concerned. In the end we approved the proposal."[48]

In 1956 Khrushchev unilaterally announced a major change in military-political doctrine.[49] While on a visit to England in April he extolled the virtues of missiles with nuclear warheads. He told his audience at the Royal Naval College, Greenwich, that the era of surface fleets and aircraft was already over; future wars would be fought with nuclear missiles. As his son notes:

> "This was the first public announcement of the change in doctrine. But not everyone in Moscow agreed with this view."[50]

Indeed, Khrushchev had a long battle trying to implement his vision of nuclear missile warfare, but the fact that he could articulate it without repudiation is evidence of the remarkable growth of his authority in this field.

Although Khrushchev was an ardent supporter of nuclear missiles, it appears that the nuclear and missile programmes were among the last of the weapons programmes he gained full access to. Although he railed against the high degree of secrecy surrounding the arms industry, he claimed that there was little he could do about it.[51] In fact, the evidence

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[45] Note especially that Pervukhin and Saburov moved to the planning organs at about the same time that Malyshev was removed as Minister of Medium Machinebuilding.

[46] Khrushchev, Khrushchev Remembers: The Last Testament, pp. 21-7.

[47] Although not identified as such in this source, this was the Chelomei design bureau. Khrushchev, Khrushchev Remembers: The Last Testament, p. 45.

[48] Khrushchev, Khrushchev Remembers: The Last Testament, p. 45. (Emphasis added) For a similar comment regarding the Kuznetsov naval proposal see: Khrushchev, Khrushchev Remembers: The Last Testament, p. 27.

[49] In the Soviet Union military doctrine was highly codified and taken extremely seriously. There were two aspects of doctrine: Politico-Military and Military-Technical. The former was theoretically the preserve of the political leadership, and the latter of the military, especially the General Staff.

[50] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 147.

[51] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 44.

to date suggests that nuclear R&D policy was the province of the experts at the Ministry of Medium Machinebuilding until at least 1955.[52]

As for missiles, Khrushchev had met Chief Designer Korolev, but his first visit to the design bureau did not come until January 1956. Khrushchev had tried to arrange visits earlier, but they "never worked out."[53] Interestingly, Sergei Khrushchev's account of this visit highlights his father's loud and flagrant disregard of the usual standards of secrecy.[54] It is as if the elder Khrushchev were making the point that he was entitled to know secret information about missiles and military plans. What Khrushchev learned at Korolev's missile design bureau had a major influence on his thinking and apparently contributed to the new doctrine he espoused three months later in England.

By the end of the "Anti-Party Group" affair, Khrushchev did not have to depend on visits to design bureaux for information, or on state agencies to formulate and oversee weapons policy. In 1957, the responsibility for new military technology policy was at last removed from state control (Ministry of Medium Machinebuilding) and given to Central Committee (TsK).

> "Questions of the development of heavy industry and construction, equipping the armed services of the country with the latest military technology, and the development of cosmonautics..."

became the responsibility of Leonid Il'ich Brezhnev, TsK Secretary for Heavy Industry.[55] Until this time there appears to have been little, if any, Central Committee oversight of the start of missile projects. However, Central Committee approval does appear to have been necessary for the creation of new facilities and organisations, and for the authorisation of serial production of weapons.

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[52]This was when Malyshev was removed as Minister of Medium Machinebuilding. See: Sakharov, Memoirs, p. 184.

[53]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 97-8.

[54]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 97-112. Although he claims to have been present during this visit, the younger Khrushchev contradicts himself earlier in the book. On page 54 he mentions that he never had a chance to visit the Korolev bureau. For Sergei Khrushchev, see Appendix 3.

[55]Bol'shaia Sovetskaia Entsiklopediia, 3rd ed., Moscow: Sovetskaia Entsiklopediia, Vol. 4, 1971, p. 17. Several works from later years state that Brezhnev's personal office was "a kind of staff headquarters where the most important problems of missile technology were resolved..." (V. F. Tolubko, Nedelin, Moscow: Politizdat, 1982, p. 183.) However, it is not clear how much of the material published about Brezhnev's role during his years as leader of the Soviet Union is reliable.

The Government

The Council of Ministers and the Ministry Structure

The post-Stalin period was one of great turmoil for the Soviet government. Initially, a new ministerial structure enhanced the prestige of the ministries. However, by the end of 1957 the party was supreme; the old ministerial structure was largely destroyed and its leaders vanquished. This is particularly noticeable in the changes to the number of ministries and their leaders.

Within two days of Stalin's death major changes in the ministerial structure of the Soviet government were announced on the front page of Pravda.[56] The number of ministries was halved to twenty five, as those in similar fields were combined into super-ministries.[57] Moreover, the leaders of the Council of Ministers and the most important ministers were now all members of the Presidium of the Central Committee.[58] In March 1953 only two of the ten members of the Presidium of the Central Committee were not also members of the Council of Ministers.[59]

This arrangement did not last for long. For a variety of reasons the super-ministries were soon re-divided. By 1956 the number of ministries had more than doubled to fifty six. As noted above, during this same period Presidium members were largely removed from significant ministerial posts.

This trend toward the weakening of the ministerial structure of the Soviet Union reached a peak after the "Anti-Party Group" affair in 1957. As part of the Sovnarkhoz reforms the industrial ministries, were disbanded. This left only a few ministries of all-Union significance, such as the Ministries of Foreign Affairs, Defence, and (initially) the weapons production ministries. The reversal in leadership involvement with the ministries is equally striking. By Fall 1957 the only minister who was also a member of the

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[56] Pravda, 7 March 1953. The full list of all ministries was published on 16 March 1953.
[57] Nove, An Economic History of the USSR, p. 331.
[58] The Chairman of the Council of Ministers (Malenkov) and the Ministers of Foreign Affairs (Molotov), Internal Security (Beriia), Defence (Bulganin), Trade (Mikoian), Machinebuilding (Saburov), and Electricity (Pervukhin) were all members of the Presidium.
[59] The two were Voroshilov (Chairman of the Presidium of the Supreme Soviet) and Khrushchev (Secretary of the Central Committee).

Presidium was Marshal Zhukov, Minister of Defence.[60] The percentage of the Presidium holding posts in the USSR government/ministry structure dropped from eighty percent in 1953, to twenty percent in mid-1957.

The Defence Industrial Ministries

As one of the state sectors that attracted intense leadership attention, it should not be surprising to find that the defence industry was an important part of the succession struggle. However, compared to the ministry structure as a whole, there were a number of differences in the effect of the political turmoil in this sector. While there were important changes in the functions and organisation of the defence industrial ministries, these institutions largely survived the shift in power to the party and the regions. Moreover, the leadership of most of the defence industrial ministries was fairly stable from 1954 onward.[61] In fact, one of the Ministers, D. F. Ustinov, made substantial gains in power and influence during this period.

Ustinov's first success came shortly after Stalin's death. The consolidation of ministries in March 1953 included the merger of Ustinov's Ministry of Armaments with the Ministry of Aviation Industry. The new organisation, the Ministry of Defence Industry (MOP), was headed by Ustinov.[62] Where the Minister of Aviation Industry, M. V. Khrunichev, went is unclear. He did not assume his next known post until July 1953. Given Malenkov's prominence, and previous association with the aviation industry, the subordination of the Ministry of Aviation Industry under the former Minister of Armaments seems unusual.[63] On the other hand, Ustinov had proven remarkably effective in his post. He had produced a series of spectacular missile successes, while the aviation industry was struggling to produce jet powered aircraft, winged missiles and longer-range bombers.[64] Nonetheless, the reasons for Ustinov's "victory" remain unclear.

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[60]Zhukov was stripped of all posts by the end of 1957. See below.

[61]See Appendix 4, sheet 2.

[62]A similarly named Commissariat for Defence Industry had existed from December 1936 to January 1939. (See Appendix 4, sheets 1 and 2.)

[63]It is worth noting that the creation of the MOP was not announced in the first wave of mergers on 7 March 1953. The merger of armaments and aviation industry was not publicised until 16 March 1953. (Pravda, 16 March 1953.)

[64]Ustinov's relative power is suggested by his ability to protect one of the members of the Council of chief designers, M. S. Riazanskii, from being arrested by the security forces in early 1953. (David Easton Potts,

Like many of the other "super-ministries," the union of Armaments and Aviation Industry, did not last. On 24 August 1953 the Ministry of Aviation Industry was re-established outside of the Ministry of Defence Industry.[65] However, Ustinov had been the top ministerial official for a significant part of the defence industry during the crucial first few months after Stalin.[66] He thus had influence over the allocation of weapons projects, and over personnel selection for defence industry posts.[67]

Throughout this time the missile programme was still being carried out by Ustinov in the new Ministry of Defence Industry (MOP), but supervision of the programme was in the hands of Minister of Medium Machinebuilding, Malyshev. Although Malyshev had to respond to Presidium directives, the evidence shows that he had considerable latitude in policy decisions on weapons R&D.[68] His freedom of action at this point appears to be largely the result of the ignorance of the Presidium about the technical details of the advanced nuclear weapons programmes.

After the demotion of his sponsor Malenkov in early 1955, Malyshev's days were numbered. His close ties with Malenkov were, perhaps, reason enough to remove him, but the proximate cause is telling. Apparently, Malyshev refused directives to set up a competitor to the first nuclear weapons design bureau (the one that employed Sakharov). The "sponsors" of this idea

> "hoped that competition between the two organizations would generate new ideas and new leaders and spur an overall expansion of research."[69]

Soviet Man in Space: Politics and Technology from Stalin to Gorbachev, Vol. 1, Ph.D. dissertation, Georgetown University, June 1992, p. 86.)

65 Bol'shaia Sovetskaia Entsiklopediia, 2nd ed., Vol. 27, Moscow: Sovetskaia Entsiklopediia, 1954, p. 532.

66 His powers did not extend to the nuclear weapons programme which still fell under the First Main Administration until July, then under the Ministry of Medium Machinebuilding. While Beriia was still in charge, Ustinov's missile industry continued to be closely supervised by the security organs.

67 For example, Ustinov was involved in the decision to start two new long-range winged missile programmes. These were assigned to aviation design bureaux (Lavochkin and Miasishchev). (V. Aslanov, "'Sovetskii Shattl' iz 50-kh: 'Raboty Prekratit', Materialy Unichtozhit''," Propeller, No. 18, June 1993, p. 1.) For Ustinov's control over cadre issues in the missile programme see: S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 284.

68 For example, Malyshev changed the terroristic style of managing scientists. (Sakharov, Memoirs, p. 177.) He also sold the leadership on a new nuclear bomb design in late 1953. (Sakharov, Memoirs, pp. 180-1.)

69 Sakharov, Memoirs, p. 184. Sakharov does not name the "sponsors".

Malyshev saw it as a waste of precious resources. However, his deputy, A. P. Zaveniagin, showed no such reservations and set up the new organisation immediately after being promoted to Minister.[70]

The new Minister was substantially less powerful than his predecessor. Although Zaveniagin inherited all of Malyshev's posts (Minister of Medium Machinebuilding and Deputy Chairman of the Council of Ministers) it is clear that he was not able to assert the same sort of authority.[71] Khrushchev's only Presidium competitors in weapons policy questions had been diverted along with Malyshev, so Zaveniagin had little alternative but to co-operate with the First Secretary. Zaveniagin may have been more pliable than Malyshev, but he served as minister for a very short period. Very early in 1957 he died of a heart attack.

This gave Khrushchev's opponents a perfectly timed opportunity to re-seize the initiative in weapons policy. Presidium member and head of Gosekonomkom, Pervukhin, was selected to replace Zaveniagin as Minister of Medium Machinebuilding. This new duty made Pervukhin a very busy man, but it brought him control over the nuclear industry and authority over a key aspect of the country's defence. Unfortunately for Pervukhin, this move came too late to break Khrushchev's hold on power. Yet, it did significantly enhance Pervukhin's powers at a crucial time. It is worth noting that even though the Sovnarkhoz reforms, passed on 10 May 1957, disbanded Gosekonomkom, the Ministry of Medium Machinebuilding was one of the five industrial ministries that was not eliminated. Thus, unlike many other members of the "Anti-Party Group," Pervukhin still had a major government job during the June 1957 attempt to unseat Khrushchev.

In fact, all five of the industrial ministries that survived the initial wave of the Sovnarkhoz reforms were defence industrial ministries. Although control of weapons factories was supposed to shift to the regional authorities, the defence industrial ministries

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[70]For Zaveniagin, see Appendix 3.
[71]Sakharov, Memoirs, p. 184.

were retained specifically to conduct weapons R&D.[72] In effect, these ministries were largely untouched by the first wave of the Sovnarkhoz reforms.

Although the defence industrial ministries were not destroyed in the Sovnarkhoz reforms they came under a new form of government control - the Military-Industrial Commission (VPK). An institution with the same name had been established in the 1930s, but it appears that its oversight function had been usurped by the security organs. Thus, it is unclear whether the VPK existed as a functioning institution in the post-Stalin period prior to 1957.[73] In any case, the VPK assumed an important role when "Ustinov started this new organization."[74] Promoted from Minister of Defence Industry to Deputy Chairman of the Council of Ministers, Ustinov now supervised all defence industry. The VPK replaced the executive functions that had fallen to the MSM after the purge of Beriia. The role of the VPK was to transform the party's weapons policy decisions into co-ordinated plans and assignments, and to ensure that those tasks were accomplished as directed.[75]

This shift in government control and oversight is confirmed by something that did not happen. After the "Anti-Party Group" affair, Pervukhin was removed from his post as Minister of Medium (nuclear) Machinebuilding.[76] His replacement as Minister was E. P. Slavskii.[77] Unlike all of his predecessors in this post, Slavskii was not appointed a Deputy Chairman of the Council of Ministers. It was Minister Ustinov who was promoted to Deputy Chairman and given responsibility for execution of weapons R&D policy.

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[72]David Holloway, "Innovation in the defence sector," in Ronald Amann, and Julian Cooper, eds., Industrial Innovation in the Soviet Union, London: Yale University Press, 1982, p. 305; and Bruce Parrott, Politics and Technology in the Soviet Union, Cambridge: MIT Press, 1983, p. 172.

[73]Some Western studies suggest that the VPK was a significant organisation throughout the 1950s. According to this view, Malyshev was a Deputy Chairman of the Council of Ministers because he was head of the VPK. Russian and Soviet sources generally do not mention the VPK from the war through early 1957. One source suggests that in 1955 there was a special committee of the Council of Ministers that oversaw weapons programmes, but that it became known as the VPK only at a later date. (A. A. Zapolskiy, Rakety Startuiut s Moria, Moscow, 1994, as translated in FBIS, Central Eurasia: Military Affairs, JPRS-UMA-95-010, 14 March 1995, p. 36.)

[74]Roald Z. Sagdeev, The Making of a Soviet Scientist: My Adventures in Nuclear Fusion and Space from Stalin to Star Wars, New York: John Wiley & Sons, 1994, p. 187. Sagdeev, a junior researcher at the time, may not have been in a position to know whether this was a new organisation or not, but his comment is echoed by a number of other sources. e.g., Holloway, "Innovation in the defence sector," p. 311.

[75]For an interesting description of how the VPK functioned in later years see: Sagdeev, The Making of a Soviet Scientist, pp. 189-91.

[76]Pervukhin was dispatched to the GDR as Soviet ambassador.

[77]For Slavskii, see Appendix 3.

After the "Anti-Party Group" affair control over weapons R&D policy shifted decisively from government institutions to the party. The policy prerogatives that had previously been associated with the Ministry of Medium Machinebuilding were transferred to Brezhnev in his capacity as a Central Committee Secretary.[78] His supervision of Heavy Industry now included the Defence Department of the Central Committee.[79] The head of that department, I. D. Serbin,

> "...was now doing almost the same job that until a few years ago had been done by Beria."[80]

The Security Forces

Changes in the security forces began immediately after Stalin's death, but their role in weapons R&D did not undergo a substantial change until the arrest of Beriia.[81] Upon the removal of Beriia and the demotion of the First Main Administration, the oversight function of the security forces was effectively destroyed. Although Beriia's informants and "bodyguards" appear to have remained in place, they had no one of significance to report to. Malyshev, who had inherited control over Beriia's weapons empire had very different ideas about how to run these programmes.

One of Malyshev's new policies as Minister of Medium Machinebuilding was to foster closer links among weapons designers. Andrei Sakharov describes a series of "excursions" to other defence research facilities arranged by Malyshev in 1953.[82] This was not simply an enlightened policy, but a way for "Malenkov's man" (Malyshev) to circumvent and replace the old co-ordination and oversight mechanisms that had been controlled by Beriia's lieutenants.

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[78]See: Sakharov, Memoirs, p. 214 for an anecdote about Brezhnev's control over weapons policy in early 1958.

[79]Brezhnev had become Secretary for Heavy Industry in 1956. It is not clear whether Brezhnev supervised the TsK Defence Department prior mid-1957. He may have had the responsibility, but not enough authority to carry out the job.

[80]Sagdeev, The Making of a Soviet Scientist, p. 75. For Serbin, see Appendix 3.

[81]As early as March 1953, Beriia began to make major changes in his security forces empire. He even proposed a 2.3 million person amnesty for political prisoners. (Knight, Beria, p. 184.)

[82]Sakharov, Memoirs, p. 177. The place that most impressed Sakharov was Korolev's missile design bureau. "We had always thought our own work was conducted on a grand scale, but this was something of a different order. I was struck by the level of technical culture: hundreds of highly skilled professionals co-ordinated their work on the fantastic objects they were producing, all in a quite matter-of-fact, efficient manner."

This change of policy eventually caused major problems for Malyshev. In his memoirs, Sakharov writes about an incident in the nuclear weapons industry that shows how the absence of the security forces weakened Malyshev's control over his scientists.[83] In late 1953, Malyshev sold the Soviet leadership on a new thermonuclear bomb design that was based on "hasty" calculations by Sakharov. This project was authorised by a joint decree of the Central Committee and Council of Ministers. Unfortunately for Malyshev, Sakharov and the other nuclear scientists soon discovered that the calculations had been wrong. They abandoned Sakharov's initial plan in favour of a new idea. Malyshev tried to force them to work on the original idea, but the scientists simply refused. The only repercussion for this "flagrant insubordination" was a party reprimand for the head nuclear scientist, I. V. Kurchatov. The rest of the nuclear scientists were left alone. In fact, Kurchatov's reprimand was expunged after Malyshev's demotion.[84] Such an outcome is difficult to imagine when Beriia was in charge.

Throughout the 1950s there were a number of other purges of the security organs. These included the re-division of the MVD in March 1954 and the disassembly of most of its slave labour and economic organisation. By 1955 the role of the security organs in weapons R&D was reduced to providing security.

The Military

Unlike many other organs of the state, the professional military enjoyed a remarkable renaissance during Khrushchev's rise to power. Certain senior military officers played a critical role at key points during the succession struggle. Particularly notable is Marshal Zhukov, who was involved in the arrest of Beriia and in saving Khrushchev during the "Anti-Party Group" affair.[85] Zhukov was handsomely rewarded for his service. He became Minister of Defence in 1955 and a full member of the Presidium in 1957.

Zhukov's rise reflected the increasing political involvement of the officer corps during this period. Notably, he was the first military officer to hold the post of Minister of

[83] Sakharov, Memoirs, pp. 180-3.
[84] Sakharov, Memoirs, p. 183.
[85] Zhukov was one of the six people in the party that carried out the arrest of Beriia. The others were: K. S. Moskalenko, L. I. Brezhnev, M. I. Nedelin, A. L. Getman, S. S. Shatilov, and A. M. Pronin. (Knight, Beria, p. 197.)

Defence since before World War II. This was especially important, because Zhukov was moving into the leadership just as the Soviet Union was carrying out a sweeping doctrinal change. Thus, the military was in a strong position to participate in the redefinition of policy and its own role in the policymaking process.

The military led the way in rejecting the major tenets of Stalinist military doctrine.[86] The role of nuclear weapons was one of the many issues that was addressed during this period. The military, along with the defence industry, pushed for the rapid "nuclearisation" of the Soviet armed forces. This included the missile forces, which, until 1953, had only been equipped with conventional warheads.[87]

Not only did the military want to change the official view of nuclear weapons, but they wanted to change the way in which such views were codified. Under Stalin, politico-military and military-technical doctrine were largely dictated by the leader himself. Military experts wanted to play a greater role in such decisions, and appear to have done so during the 1950s. In order to gain, and maintain, this influence military leaders were willing to accept major changes in force structure. After Zhukov became Minister of Defence, the Soviet Union made deep cuts in the size of the Army while shifting the emphasis toward new weapons, especially nuclear missiles.

The USSR Academy of Sciences

The USSR Academy of Sciences had long existed as a relatively weak, peripheral organ of the state, but in the post-Stalin atmosphere it began to play a greater role. Central control of the Academy had been strong, but tended to be informal. As with the military, the passing of Stalin weakened the controls and gave the Academy of Sciences an opportunity to pursue long-suppressed prerogatives and priorities. To some extent this enhanced the position of the Academy of Sciences, but it also led to a divisive period of internal debate.

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[86] Harriet Fast Scott and William F. Scott, The Armed Forces of the USSR, 3rd ed., Boulder: Westview Press, 1984, p. 41.

[87] In October 1953 industrial leaders and designers met to discuss modifying the R-5 (SS-3) to carry a nuclear warhead. After this the R-11 (SS-1B) was also modified. Most new ballistic missile projects after 1953 were designed to carry nuclear warheads.

One of the most important of prerogatives for Academicians of the Academy of Sciences was the election of new members. Under Stalin "elections" had been unpredictable in frequency and in the number of new members allowed.[88] On 23 October 1953 the Academy of Sciences held the first post-Stalin election; the results were startling. Not only was the "Class of 1953" the biggest of the mid-Soviet era, but, for the first time, it included a substantial number of weapons scientists and engineers.[89] At least seven nuclear scientists were elected to various degrees of membership.[90] Missile designer Korolev and rocket engine designer Glushko were also elected as corresponding members.[91] Although the percentage of missile scientists joining the Academy in 1953 was relatively small, they were to have a disproportionate influence in the years to come.

When the military abolished the Academy of Artillery Sciences in April 1953, the space enthusiasts found a new and more hospitable home in the USSR Academy of Sciences. General and Academician Blagonravov, the former President of the Academy of Artillery Sciences, became director of the Institute of Engineering Science of the Academy of Sciences. Perhaps more important was the elevation of M. V. Keldysh. In 1953 his Mathematical Institute became a department (the Department of Applied Mathematics) and Keldysh became a member of the Presidium of the Academy of Sciences. Academy President Nesmeianov also appears to have been sympathetic to the space enthusiasts. He spoke positively of satellites and piloted spacecraft in his appearance at the World Peace Council in Vienna in November 1953.[92]

The Academy of Sciences began to organise itself for space research shortly after the 1953 elections. Sometime in 1954 it established the "Interdepartmental Commission for the Co-ordination and Control of Scientific-Theoretical Work in the Field of Organisation and Accomplishment of Interplanetary Communications", otherwise known at Commission on

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88 The 1946 election resulted in forty three new Academicians and 112 new candidate members, in 1949 one Academician was "elected." (See Appendix 5.)

89 By mid-Soviet era, I mean 1934-1972.

90 Sakharov, Memoirs, p. 179.

91 M. V. Keldysh wrote a letter supporting Korolev's nomination for membership. Korolev was apparently nominated by the Scientific Council of NII-88. (Keldysh's letter can be found in: V. S. Avduevskii, ed., M. V. Keldysh: Raketnaia Tekhnika i Kosmonavtika - Izbrannye Trudy, Moscow: Nauka, 1988, pp. 146-7.)

92 Daniloff, The Kremlin and the Cosmos, p. 58. Nesmeianov was elected President of the Academy in 1951. He was the first party member to hold that post. For Nesmeianov, see Appendix 3.

Interplanetary Communication. This group was established under the Academy's Astronomy Council

> "to organize work concerned with building an automatic laboratory for scientific research in space."[93]

This organisation was apparently a response by Soviet scientists to the IGY satellite discussions. The Commission included at least twenty seven members and was chaired by Academician L. I. Sedov. Thus, the Academy had two commissions dealing with "space" research: Sedov's Commission on Interplanetary Communication, and the Commission for the Investigation of the Upper Layers of the Atmosphere, founded in 1949 by Blagonravov. Moreover, the elections for the Academy of Sciences Presidium in February 1957 put a number of people with an interest in the space research into the leading body of the Academy.[94]

While the space enthusiasts were prospering, the Academy of Sciences itself was in the midst of a debate about its role and composition. President Nesmeianov was leading an effort to free the Academy from control over its research agenda.[95] This effort focused on the Department of Technical Sciences and its array of institutes. This Department had been forced on the Academy of Sciences in 1935 as a way to enhance applied, as opposed to fundamental, science work in the Soviet Union. Abolition of the Department of Technical Sciences, and the transfer of its institutes to the appropriate government ministries, became an important objective for many Academicians in the 1950s. President Nesmeianov argued that the Academy should concentrate on fundamental research and that the engineers of the Department of Technical Sciences should not be members. This issue became a major topic of debate. Nesmeianov raised it at the Twentieth Party Congress and Khrushchev appeared to support his demand for the re-organisation of science.[96] Interestingly, many of the weapons researchers, including both of the missile programme members admitted in 1953

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[93]As quoted in: Daniloff, The Kremlin and the Cosmos, pp. 56-7.

[94]The Academy of Sciences Presidium chosen on 23 February 1957 included: Keldysh, Blagonravov, Ambartsumian (an astronomer interested in space), Kurchatov (head of the nuclear programme and close friend of Korolev), and Kapitsa (a famous physicist who appears to have been peripherally involved in rocket research).

[95]John Löwenhardt, Decision-Making in Soviet Politics, London: Macmillan, 1981, p. 137.

[96]Löwenhardt, Decision-Making in Soviet Politics, p. 136.

(Korolev and Glushko), were admitted to the Department of Technical Sciences. The tension between "scientists" and "engineers", and questions about re-organisation and control of the Academy of Sciences persisted throughout the early post-Stalin years.

State Commissions

In keeping with the changes to nuclear R&D management and oversight, the Special Commission supervising the missile programme was eventually eliminated. However, Spetskom No. 2 underwent some interesting changes before it vanished. Malenkov relinquished control of Spetskom No. 2 in the early 1950s, possibly as late as March 1953.[97] V. M. Riabikov, formerly First Deputy Minister of Armaments, became Chairman of the Commission.[98] This was an astounding leap. Riabikov had become Chairman of a Commission of which his long-time superior, Ustinov, was Deputy.

The reasons for the promotion of Riabikov are not clear. In fact, Riabikov is something of an enigma. His promotion may have been a deliberate attempt to downgrade the importance and power of the Commission. However, if Riabikov had been installed as Ustinov's deputy by Beriia (to monitor and report on the Ministry of Armaments), then an entirely different explanation is possible.[99] In this case, Riabikov's promotion could represent an attempt by Beriia and/or his clique to increase control of the missile programme. Without further information this riddle can not be solved. No matter the reason for Riabikov's promotion, it had little long-term influence. Spetskom No. 2 faded from importance after 1953.

Design Bureaux and Policy

The Council of Chief Designers

The Council of Chief Designers remained a crucial element in Korolev's ballistic missile projects, but during the 1950s it appears to have declined in its overall importance. In the second half of the 1940s the Council of Chief Designers had been the repository of

[97]Malenkov may have given up this post as early as 1951. (Asif Siddiqi, "Soviet Space Programme: Part 2 - Organizational Structure in the 1960s," Spaceflight, Vol. 36, No. 9, September 1994, p. 320.)
[98]For Riabikov, see Appendix 3.
[99]This is one of the few explanations that appears to fit with Riabikov's highly unusual career pattern.

Soviet expertise on missile design. However, the expansion of rocket design training programmes and the emergence of a number of missile R&D programmes diluted the importance of the Council of Chief Designers. By the time of Stalin's death there were several ballistic missile projects that were not being co-ordinated through the Council of Chief Designers. This may explain why most of the glowing accounts of the importance of the Council of Chief Designers concentrate on events in the late 1940s and the post-Sputnik period.

Although the Council of Chief Designers may have declined in overall importance prior to Sputnik, it was still Korolev's institution of choice for co-ordinating his most demanding and important projects. During the 1950s "Problem Number 1" for Korolev was the development of the R-7 (SS-6).[100] A project of this scale and importance required the co-operation of numerous design organisations. Once again, Korolev used the Council of Chief Designers, both to co-ordinate work on the project and present a "united front" to "government organs."[101]

OKB-1: Korolev

Another implication of the expansion of the missile industry in the 1950s was that Korolev's design bureau grew in size and became more distinct as an institution.[102] OKB-1 was clearly the leading ballistic missile design organisation in the Soviet Union. It wound up specialising in extremely powerful, long-range ballistic missiles. In fact, Korolev's organisation held a virtual monopoly on long-range missile design until the very late 1950s. Other projects were spun-off to separate organisations or subsidiaries.[103] In part this represented a deliberate attempt by the Soviet leadership to diversify the missile development and production base. Khrushchev had specifically assigned this task to

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[100] I. S. Prudnikov, "Reshenie 'Problemy No. 1'," Aviatsiia i Kosmonavtika, No. 1, January-February 1994, p. 39.
[101] B. Chertok, "Lider," Aviatsiia i Kosmonavtika, No. 1, January 1988, p. 31.
[102] For a graphical summary of the development of the major missile/space design bureaux see Appendix 11.
[103] e.g., one of the winged missile projects assigned by Ustinov to the Lavochkin design bureau in 1953 had begun in OKB-1.

Minister Ustinov.[104] Korolev argued that all of these new organisations should be subordinate to OKB-1, but he was over-ruled by Khrushchev.[105]

Nonetheless, OKB-1 did grow dramatically, in size, influence, and importance. As part of the overhaul of weapons R&D during the mid-1950s, OKB-1 was removed from subordination to NII-88 in August 1956.[106] The design bureau and its associated factory became an autonomous organisation under the Ministry of Defence Industry.

Korolev himself also became more respectable. With help from Ustinov he was able to shed much of the stigma associated with his past. On 6 August 1953 Korolev's long delayed application to join the Communist Party was finally approved.[107] In April 1957 Korolev's conviction from the 1930s was formally expunged from his records.[108]

OKB-586: Iangel'

The most important, independent ballistic missile design organisation created by Ustinov during the diversification of missile R&D was OKB-586. As noted in Chapter 2, a missile "design office" was established at the newly converted missile plant in Dnepropetrovsk in 1951. For several years this organisation served as a filial (subsidiary) of OKB-1 to co-ordinate the production of Korolev's missiles. By the end of 1954 this organisation had become a completely independent OKB under the control of Chief Designer M. K. Iangel'.

Iangel' was one of the aviation designers brought into the missile programme when it was expanded in the late 1940s. A loyal party activist before he entered the aviation industry in the 1930s, Iangel' rose quickly during the purges and war. While working in the Ministry of Aviation Industry after the war he was selected to go to a special missile

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[104] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 281. Such diversification was thought to be needed to ensure that Soviet military industry could survive a nuclear attack.

[105] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 283.

[106] A. Zak, "V Kosmicheskoi Kolybeli," Nezavisimaia Gazeta, 13 April 1993.

[107] Although Korolev had shown little interest in joining the party, he was strongly urged to do so by his superiors. He applied for membership in the summer of 1952. Ustinov is said to have played the crucial role in getting Korolev into the party. (Brian Harvey, "'I Was Last to Touch the Sputnik'," Spaceflight, Vol. 33, No. 1, January 1991, p. 17.) Notably, Chief Designer Glushko, a man with a less-serious offence on his record, was not admitted to the party until 1956.

[108] The decree on this was issued on 18 April 1957. (This date was observed by the author on the decree - which is shown in the biographical film at the Korolev House Museum in Moscow.)

training programme. After studying the theory of missile design for two years he went to work as head of a department in Korolev's design bureau.[109] In May 1952 Iangel' was promoted over Korolev, and others, to head of NII-88.

Unlike Korolev and the other rocket enthusiasts, Iangel' had shown no prior interest in spaceflight - his attention was clearly focused on the military utility of missiles. While running NII-88, Iangel' also served as the lead designer on "the first truly indigenous Soviet ballistic missile", the R-5 (SS-3).[110] After Stalin's death the R-5 was modified to carry a nuclear warhead and became the backbone of the Soviet theatre nuclear force.

Iangel' also pushed for the development of propellants that were easier for the military to use. Liquid oxygen, with its extremely low temperature, presented numerous problems, so Iangel' advocated the use of higher boiling-point propellants.[111] In February 1953 his proposal for the medium-range R-12 (SS-4), a missile that used nitric acid rather than liquid oxygen, was approved.[112] Responsibility for designing this missile was given to the design department at the missile plant in Dnepropetrovsk.[113] Simultaneously, Korolev's medium range R-11 (SS-1B) missile, a project that had been in development since 1949, was redesigned to use nitric acid instead of liquid oxygen.[114] While it is not clear that the R-11 design change was ordered by Iangel' (who was then head of NII-88), it is clear that he was pushing the development of missiles that were more oriented to the desires of the military.

During the course of 1954 Iangel' moved, or was moved, from head of NII-88 to become chief designer of his own missile design bureau. A government decree on 10 April

[109]"7 Noiabria - 70 let so dnia rozhdeniia M. K. Iangel" (1911g)," Iz Istorii Aviatsii i Kosmonavtiki, vol. 44, 1981, p. 72. (Note that the title of this article and numerous other sources are misleading about Iangel"s birthday. It appears that he was actually born on 25 October (12 October - old calendar) 1911.)

[110]Asif Siddiqi, History of the Soviet Space Programme, forthcoming.

[111]Virtually all of Korolev's rocket designs used liquid oxygen. One of the problems with liquid oxygen is that it cannot be stored in the missile. Launching such a missile requires a lengthy fuelling and preparation process that leaves the missile exposed to pre-emption by the enemy. The military wanted a quick reaction missile that could remain fuelled for long periods of time.

[112]The idea of using nitric acid as an oxidiser was not new. A number of rocket engines had been developed in the 1940s using a variety of fuels and oxidisers, including nitric acid. However, nitric acid is extremely volatile and poisonous. Korolev, who avoided using it, called nitric acid "devil's brew."

[113]V. Pappo-Korystin, V. Platonov, and V. Pashchenko, Dneprovskii Raketno-Kosmicheskii Tsentr, Dnepropetrovsk: PO Iuzhnyi mashinstroitel'nyi zavod and KB Iuzhnoe, 1994, p. 55.

[114]The R-11 was a development of the R-1, hence it's Western designation SS-1B. It was proposed by Korolev, but the actual design work on this project had been conducted by Korolev's deputy, V. P. Mishin. For Mishin, see Appendix 3.

1954 converted the design department at the Dnepropetrovsk missile plant into an experimental design bureau; OKB-586.[115] Iangel' was officially named Chief Designer of OKB-586 on 9 July 1954.[116] Then, on 27 November 1954 the Ministry of Defence Industry (MOP) approved Iangel''s proposal to give his design bureau an independent budget and financing.[117]

Initially, Iangel' had only the R-12 project, but by the end of 1957 his bureau had been assigned several different missile projects. In August 1956 OKB-586 began work on a project known as the R-15.[118] Later that same year, on 17 December, the Council of Ministers assigned Iangel' to develop the R-16 (SS-7).[119] The R-16 was to be an ICBM, and thus a competitor to Korolev's own project (the R-7 (SS-6)).

OKB-52: Chelomei

The Chelomei design bureau had just been eliminated at the time of Stalin's death. V. N. Chelomei had led the ill-fated post-war effort to build a large analogue to the German V-1 "buzz bomb".[120] This project, and Chelomei's design bureau, had been under the jurisdiction of the Ministry of Aviation Industry. None of Chelomei's designs had ever been put into production. One of Stalin's last acts (in early 1953) had been to sack Chelomei and hand his design bureau over to the prominent aviation designer Artem Ivanovich Mikoian.[121]

After losing his design bureau in 1953, Chelomei languished for two years before he managed to win control of one of the new design bureaux authorised for the aviation

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[115]Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 14.
[116]Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, pp. 56-7.
[117]Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 57. It is unclear whether this means independence from OKB-1 or NII-88.
[118]Aside from the designation and the dates when design work was begun and ended, little is known about this project. The R-15 was cancelled in December 1958.
[119]Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 59. Note that this project was begun without a decree by the Central Committee and during the time that Khrushchev was under political attack for the failures of the Sixth Five Year Plan. Khrushchev did not find out about this project until later.
[120]For Chelomei, see Appendix 3.
[121]Khrushchev, Khrushchev Remembers: The Last Testament, p. 35.

industry.[122] Interestingly, he did this by going outside the aviation industry leadership, enlisting the help of naval officers, and appealing directly to Khrushchev.[123] Despite objections from Bulganin, Khrushchev brought Chelomei to a meeting of the Presidium of the Central Committee.[124] Chelomei's proposal for a naval missile with folding wings, that could be fired from a tube was approved by the Presidium. As a result, OKB-52 was established in 1955 to develop the P-5 (SS-N-2) missile.[125]

Despite his success "selling" the P-5 to Khrushchev, Chelomei's organisation remained a small, peripheral part of the aviation industry until the late 1950s. His design bureau was located in extremely modest accommodations in the Moscow suburbs, and remained assigned exclusively to developing the P-5 missile for the Navy.[126] Since the P-5 was a winged missile OKB-52 remained within the Ministry of Aviation Industry (MAP). However, Chelomei's organisation remained outside the mainstream of the MAP.

The ICBM Programme

In the four years after Stalin's death, the Soviet ICBM programme underwent a remarkable metamorphosis. What was certainly a long-range research effort was transformed into a top state priority, fraught with domestic and international political implications. In the end the Soviet ICBM became a vehicle not only for nuclear warheads and satellites, but for the ambitions of both Khrushchev and Korolev.

The February 1953 decree authorising NII-88 to work on an intercontinental range missile design was not an authorisation to begin an ICBM programme. Stalin had shown an interest in long-range nuclear missiles at least as early as 1947.[127] However, he consistently demonstrated a keen appreciation for the limitations of missile technology. Although great progress had been made in the 1940s, an ICBM was still not an immediate

[122]Several new, "mini-" design bureaux were authorised in 1954. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 371.)
[123]For an account of how he did this see: S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 371-2.
[124]Khrushchev, Khrushchev Remembers: The Last Testament, pp. 44-45.
[125]The P-5 entered the Soviet inventory in 1959. It was also used on land as a coastal defence missile. In this role it superseded a design by Mikoian.
[126]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 360.
[127]Holloway, Stalin and the Bomb, p. 248.

prospect. Korolev's problems with the ambitious R-3 missile were certainly powerful evidence that much work remained to be done to create an ICBM.[128] The decree in February 1953 appears to have been aimed at beginning research about the possibility of an intercontinental missile. It was not an approval to begin R&D work on a specific design.[129]

Most of the missile industry and the military appear to have viewed the ICBM decree as the beginning of a long-term research project. After all, in early 1953 they were already extremely busy coping with a number of major rocket projects. The R-1A and R-2 had gone into series production in Dnepropetrovsk, the R-5 (SS-3) intermediate range missile and the R-11 (SS-1B) shorter range missile were both being prepared for tests.[130] The long-range R-3A was far behind schedule. An ICBM would certainly be a logical next step, but the traditional solution would be to build up to it by concentrating design efforts on the troubled R-3A project.

However, within a year of Stalin's death the R-3A was abandoned and Korolev's ICBM proposal became the centrepiece of the Soviet ballistic missile programme. This change in R&D policy would not have occurred without major changes in the Soviet political system. It was also a direct result of Korolev's efforts to force the development of high-powered rockets.

In May 1953 Spetskom No. 2 met to discuss the status of the missile programme. The meeting was led by the Commission chairman, V. M. Riabikov. V. A. Malyshev, then a Deputy Chairman of the Council of Ministers, was the ranking political leader at the meeting.[131] Also present were Minister of Defence Industry D. F. Ustinov, Deputy Minister of Machinebuilding A. S. Tomilin, Marshal M. I. Nedelin (then Commander in Chief of Artillery) and Chief Designer Korolev. The overdue R-3A missile was to be a major topic of discussion. However, Korolev stunned the Commission by proposing that the R-3A be abandoned in favour of an intercontinental-range missile. In the heated debate

[128]In 1951 the R-3 had to be scaled back when it became clear that the needed rocket engines could not be built. The more modest version was known as the R-3A. See Chapter 2.
[129]i.e. it was not a design decision decree.
[130]The R-5 was first test flown on 2 April 1953, and the R-11 on 28 April 1953.
[131]Malyshev had just been dropped from the Presidium of the Central Committee in March. It is not clear if he held any other formal position at this time.

that followed, only Ustinov supported Korolev's bold proposal. Malyshev refused to allow cancellation of the R-3A. The meeting ended on an acrimonious and (according to one source) threatening note.[132]

Ultimately, Korolev's proposal was approved. Perhaps most persuasive was his argument about the range of the R-3A. A 3,000 kilometre range missile like the R-3A would not be sufficient to reach the United States and was not necessary to reach Western Europe. The R-5 could reach virtually all of Europe. There was little to be gained by designing a slightly longer range missile when the means for a major leap seemed to be at hand. This argument eventually won the support of Marshal Nedelin, Korolev's main customer.

Ironically, the policies that Malyshev put in place when he became Minister of Medium Machinebuilding helped to put an end to the R-3A. Despite his disagreement with Korolev over the R-3A, Malyshev was reportedly a strong supporter of missile development.[133] More importantly, Korolev took advantage of the openness in weapons R&D initiated by Malyshev in the summer of 1953. Immediately after the August 1953 thermonuclear bomb test, Korolev dropped in at the office of the USSR's chief nuclear scientist. Kurchatov sent his security services "minder" on an errand so that he and Korolev could have a long personal talk. They parted "with a good understanding of each other" and Kurchatov also came out in favour of Korolev's ICBM proposal.[134]

In December 1953, Malyshev gave another, perhaps inadvertent, boost to Korolev's ICBM proposal. This was the month that Malyshev promised the Presidium a new thermonuclear warhead based on Sakharov's "hasty" calculations.[135] The warhead would weigh between five and six tonnes. The R-3A could not have handled such a payload. In fact, Korolev had originally planned on a smaller payload for the R-7, so he had to redesign

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[132]According to Aleksandr Romanov, Malyshev said of Korolev: "People are not irreplaceable. Others can be found." (A. P. Romanov, Korolev, Moscow: Politizdat, 1990, p. 211.)

[133]In fact, Sakharov claims that Malyshev "...deserves much of the credit for the priority given to missile technology." (Sakharov, Memoirs, p. 183.)

[134]M. Rebrov, "Versiia Shifra 'PS'," Delovoi Mir, 10 October 1992.

[135]Sakharov, Memoirs, pp. 180-81.

his ICBM to significantly increase its power. Thus, Malyshev himself had added to the arguments in favour of designing a bigger, more powerful missile.

By mid 1954, the R-7 formally replaced the R-3A as the major project for Korolev's design bureau. On 20 May 1954 the Soviet government issued a decree authorising the development of the R-7.[136] This was the all-important step needed to begin a major weapons R&D programme. Interestingly, Korolev did not complete the Draft Project (EP) for the R-7 until after the decree. The EP was reviewed and approved by an expert commission in July-August 1954.[137] Although Korolev clearly initiated the R-7 proposal, he did not do so through the usual formal channels.

Although the EP came later, the R-7 project was already fairly advanced before the May 1954 decree. Korolev had been working on design ideas for a rocket capable of launching a satellite since at least the late 1940s. These designs were also applicable to an ICBM. Moreover, by the end of 1953, when the basic parameters for an ICBM were finalised, work began immediately on supporting projects.[138] For example, at the end of 1953, a commission was established to find a new location for testing the R-7. Calculating backward from a target zone on the Kamchatka peninsula,[139] the State Commission narrowed the choice to three possible sites in the south-central part of the USSR.[140]

The State Commission for choosing the R-7 test site, headed by General V. I. Vozniuk, heard testimony from a number of people in 1954, including Korolev.[141] None of the possible sites were militarily advantageous, because the R-7 would not be able to reach the US from any of them. The site near Tiura-Tam, Kazakhstan had the disadvantages of being both relatively close to the potentially hostile Southern border of the USSR, and of being particularly remote. Despite the harsh climate and distance from building supplies and the space industry, Korolev lobbied in favour of this site because of

136Timothy Varfolomeyev, "Soviet Rocketry that Conquered Space: Part 1: From the First ICBM to Sputnik Launcher," Spaceflight, Vol. 37, No. 8, August 1995, p. 261. This decree was a design decision.

137Christian Lardier, L'Astronautique Sovietique, Paris: Armand Colin, 1992, p. 91.

138This was when the weight of the warhead was set - based on Malyshev's promises.

139S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 288.

140The sites were: the Mariiski ASSR, the region of Makhachkaly on the western shore of the Caspian Sea, and the Kazakh desert.

141B. Konovalov, "Uroki Pervogo Sputnika," Izvestiia, 29 September 1987. Vozniuk was head of the missile test range at Kapustin Iar. For Vozniuk, see Appendix 3.

its proximity to the Earth's equator. This, he explained, was a significant advantage when launching satellites.[142] The effect of this argument on the State Commission is not known, but they did agree to the site in Kazakhstan, and to Korolev's demand that it be built in two years.[143] This decision was made in early 1955, and work around-the-clock began immediately.[144] Known as "Scientific-Research Test Range 5" (NIIP-5), the site in the Kazakh desert became the home of the Soviet long-range missile programme when it opened in 1957.[145] From 1961, it was publicly identified as the Baikonur Cosmodrome.[146]

For nearly two years, development of the R-7 continued at a fairly rapid pace without any known party leadership involvement. Then, in early 1956, Khrushchev became personally involved in the ICBM programme. Although Khrushchev knew of the R-7 programme prior to his visit to Korolev's OKB-1 in January 1956, it is clear that he did not know much about it.[147]

Khrushchev spoke obliquely about this visit in his memoirs, but his son Sergei describes it in great detail in his own recent book.[148] During this visit Khrushchev was not the only senior political leader in the entourage. He was accompanied by the remaining Presidium leaders involved in defence policy: Molotov, Bulganin, and Pervukhin.[149] They

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[142]As in the game of "crack the whip" the further you are from the axis of rotation the faster you have to move to keep up. At the equator the surface of the earth is at its maximum distance from its axis of rotation (the north-south axis). Thus the closer a launch site is to the equator the more it can take advantage of this "free" boost toward orbital velocity.

[143]G. Durov and N. Narovlianskii, "Put' k Pervomu Startu," Aviatsiia i Kosmonavtika, No. 10, October 1987, pp. 12-13.

[144]One source gives the date of the decision as 12 February 1955. (Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 57.) The first survey teams are also said to have arrived in February 1955. (Durov and Narovlianskii, "Put' k Pervomu Startu," pp. 12-13; and M. Rebrov, "Kliuch - Na Start!" Krasnaia Zvezda, 2 June 1995.)

[145]NIIP-5 was also known as military unit 11284. (Rebrov, "Kliuch - na start!")

[146]The Soviet government used the name of a village some 350 kilometres north-east of the actual launch site in an attempt to confuse the West. Western analysts were not so easily fooled (for one thing they had U-2 photographs of the launch complex by June 1957) and insisted on referring to the facility as "Tyuratam", the nearest pre-existing town. For purposes of this dissertation the Russian public designation, Baikonur, will be used.

[147]Khrushchev had been briefed "in detail" on the programme by Minister Ustinov. But it is evident from his actions during the visit that he had limited knowledge of the programme. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 97.)

[148]Khrushchev, Khrushchev Remembers: The Last Testament, p. 46; and S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 97-112.

[149]The visiting party also included a variety of ministers, military leaders, party officials and A. I. Adzhubei (Khrushchev's son-in-law - soon to be editor of Pravda.)

were met at the door of the workshop by Korolev and taken on a carefully arranged tour of OKB-1's projects. Even Khrushchev was stricken speechless when the tour culminated in the dramatic revelation of a full-scale mock-up of the R-7.

Khrushchev was extremely excited about the ICBM. When Korolev assured him that the missile would be able to fly the 8,000 kilometres required to strike the United States, and that air defences would be unable to intercept the warheads, Khrushchev simply "beamed." As Khrushchev is reported to have said:

> "We will not rush you. Everything needs to be carefully worked out and checked, but you know how much we need this rocket."[150]

His son also notes:

> "The meeting with Korolev decisively influenced the thinking of my father. It stiffened his spine, and for many years afterward rockets were his favourite argument in political battles."[151]

Seeing in the R-7 a simple and inexpensive solution to the "damned problem" of nuclear delivery inequality, Khrushchev latched onto the R-7 - and its creator.[152] He recognised that the Chief Designer had offered him a solution to both the international strategic problems and the domestic economic problem of building and maintaining the military forces needed to protect the country. If the R-7 worked, it would solve these two problems in one, relatively inexpensive stroke. It was just three months later, while in England, that Khrushchev unilaterally announced that nuclear missiles had made all other weapons obsolete. Within a year Khrushchev pushed through the approval to build an operational launch site for the R-7 in North-Western Russia even though the missile had yet to be tested.[153]

The personal visit to OKB-1 in January 1956 fundamentally changed Korolev's status.

> "... After this visit father simply fell in love with Korolev, he was prepared to talk about him without end."[154]

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[150]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 107.
[151]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 112.
[152]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 111.
[153]The decision to build Plesetsk was taken in January 1957. Khrushchev had forced this decision through in order to "economise on time" (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 292.)
[154]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 112.

Khrushchev was so taken by Korolev that he granted him virtually unlimited, direct access. After this Korolev could bypass the ministerial policymakers and oversight mechanisms and appeal directly to Khrushchev when needed.

With Khrushchev's sponsorship the ICBM programme became more politicised. This became particularly evident as the R-7 prototypes approached the testing phase. In April or May 1956 V. M. Riabikov was named head of the State Commission for the R-7 test programme.[155] This was extremely unusual. A military officer usually served as chairman of State Commissions for testing weapons prototypes, even in the missile programme.[156] Although Riabikov held the rank of General in the engineering services, he had served his entire career in the weapons building industry.[157] It is particularly striking that the military did not control the evaluation of one of the most important weapons programmes of the time. On the other hand, Riabikov's appointment may have been a compromise. His long connections with the Armaments industry may appear to predispose him to favouring the R-7, but other details of his career suggest that he was not a supporter of Korolev and his space plans.

When the R-7 prototype tests finally began in 1957 Khrushchev was under heavy political pressure. While he was pushing through the Sovnarkhoz reforms, the first R-7 arrived at NIIP-5 (Baikonur).[158] Although assembly and testing went reasonably well, Khrushchev was "impatient" for the tests to begin.[159] He claims not to have meddled in R-7 preparations, but Khrushchev had arranged for Korolev to call him directly if the R-7 tests ran into any troubles.[160] Sergei Khrushchev's memoir suggests that, despite his political troubles, the R-7 tests were at the forefront of his father's attention in May 1957.[161]

Just five days after the Supreme Soviet approved the Sovnarkhoz reforms the first R-7 was tested. The 15 May 1957 flight ended one hundred seconds after launch, when the

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[155] Konovalov, "Uroki Pervogo Sputnika."

[156] For example, Marshal Iakovlev, then Commander-in-Chief of Artillery, had been chairman for the Soviet-built V-2 tests; and later Marshal Nedelin for the R-16 (SS-7).

[157] Most weapons industry ministry leaders held military rank in the engineering services.

[158] The first launchable missile arrived in March 1957.

[159] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 112.

[160] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 287. In fact, Korolev did call Khrushchev directly to report on each test launch. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 288.)

[161] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 287-8.

missile exploded.[162] The second test launch, on 9 June, also failed.[163] After this the State Commission met in a special session to discuss the tests.[164] At this session, the programme came under heavy attack. The State Commission found a wide range of problems with the R-7.[165]

Meanwhile, in Moscow, the so-called "Anti-Party Group" was trying to oust Khrushchev.[166] Was the R-7 an issue during the fight to remove Khrushchev? It has never been mentioned as such, and it seems unlikely that a highly classified military programme would have become a subject of open debate. In fact, there were certainly plenty of other issues to use against Khrushchev. But it is possible that the problems with the R-7 were an issue in the Presidium. Khrushchev had based his legitimacy in weapons decisions on the superiority of missiles. Pervukhin, as Minister of Medium Machinebuilding, was responsible for nuclear weapons programmes which depended on the development of delivery systems like the R-7 ICBM. It seems likely that Pervukhin would have used the problems with the R-7 to attack Khrushchev's judgement on weapons policy. It is also possible that the special scrutiny of the R-7 by the State Commission (under Riabikov) was an attempt by Pervukhin, or others, to embarrass Khrushchev and undermine his authority.

Khrushchev's political victory in late June 1957 assured the continuation of Korolev's ICBM programme. Riabikov was replaced as Chairman of the State Commission by K. N. Rudnev.[167] As First Deputy Minister in charge of missile programmes at the Ministry of Defence Industry, Rudnev was guaranteed to support the R-

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162 Varfolomeyev, "Soviet Rocketry that Conquered Space," p. 261; and Lardier, L'Astronautique Sovietique, p. 93.

163 As Khrushchev noted: "...we had several unpleasant incidents. They either blew up on the pad or during liftoff." (Khrushchev, Khrushchev Remembers: The Last Testament, p. 46.)

164 Konovalov, "Uroki Pervogo Sputnika."

165 A. Zakharov, "V Nachale Puti," Aviatsiia i Kosmonavtika, No. 10, October 1987, p. 14. This scrutiny of the R-7 apparently is reflected in the 1972 Soviet film biography of Korolev, "The Taming of Fire." (James E. Oberg, "Korolev and Khrushchev and Sputnik," Spaceflight, Vol. 20, No. 4, April 1978, p. 146.)

166 The "Anti-Party Group" affair began on 18 June and ended on 29 June 1957.

167 I. D. Sergeev, et al., Khronika Osnovnykh Sobytii Istorii Raketnykh Voisk Strategicheskogo Naznacheniia, Moscow: TsIPK, 1994, p. 36 and the correction sheet. This source does not give an exact date for the change of Chairmen, but it seems highly likely that it occurred after the simultaneous attack on the R-7 and Khrushchev.

7.[168] But, after several delays, the third R-7 launch, on 12 July, also failed.[169] Nonetheless, construction of the first operational launch site (at Plesetsk) began the same month.[170] The fourth test of the R-7 finally came on 21 August 1957.[171] The missile flew as planned, but the simulated warhead disintegrated during re-entry.[172] Although the test was not a complete success the Soviet Union announced it as such less than a week later.

The unprecedented announcement of the R-7 test was aimed at both international and domestic audiences. Normally, the Soviet Union did not announce anything about weapons test programmes, especially missiles. However, in this case, there were distinct advantages in suggesting that the United States was no longer invulnerable.[173] The announcement seemed to receive more attention within the USSR than in the West. Such publicity appears to have been aimed at enhancing Khrushchev's legitimacy. After the doubts raised over the previous year, especially by the Anti-Party Group affair, the success of the R-7 underscored the "wisdom" of Khrushchev's vision and leadership. This would have been an important blow against Khrushchev's opponents, some of whom remained in the leadership and the government.

The announcement of the test was not the only thing about the R-7 to be rushed. The missile was tested again on 7 September 1957.[174] Once again, it flew perfectly, but the warhead did not survive re-entry.[175] Nonetheless, the State Commission still decided that the R-7 should be accepted into the military inventory immediately.[176] There does not appear to have been a corresponding decree by the Central Committee and Council of Ministers, so it is not clear if the State Commission's finding had any real impact. In

168 For Rudnev, see Appendix 3.

169 This failure was apparently the result of an electrical fault. Lardier, L'Astronautique Sovietique, p. 93. For the delays, see: B. Konovalov, "Ryvok k Zvezdam," Izvestiia, 1 October 1987.

170 Lardier, L'Astronautique Sovietique, pp. 94-5.

171 Iu. Mozzhorin and A. Eremenko, "Ot Pervykh Balisticheskikh do...," Aviatsiia i Kosmonavtika, No. 8, August 1991, p. 34; and Lardier, L'Astronautique Sovietique, p. 93. The date of this test has frequently been reported in the West as 3 August.

172 The warhead broke up at about eleven kilometres above the earth. (Prudnikov, "Reshenie 'Problemy No. 1'," p. 40.)

173 This was a bluff. Even if they had a warhead that would survive re-entry, the Soviet Union could not have hit the US with the R-7. The R-7 did not have sufficient range from Kazakhstan. The first launch site at Plesetsk, from which the R-7 could reach parts of the US, was not completed until 1960.

174 Lardier, L'Astronautique Sovietique, p. 93.

175 Prudnikov, "Reshenie 'Problemy No. 1'," p. 40.

176 Lardier, L'Astronautique Sovietique, p. 93.

reality, the ICBM programme appears to have been put on hold at this time. There was no further testing of the R-7 until January 1958, when a new warhead design had been completed.[177]

Although the R-7 had been declared a success by Khrushchev and the State Commission, this was not the end of the political process. There was sharp resistance to the R-7 in the military. In later years this would become painfully evident. However, for the time being, the R-7, if not its warhead, appeared to be a great success. Korolev was now able to turn his attention to his first love, spaceflight.

The Satellite (Sputnik) Programme

During the first half of the 1950s there were a number of satellite projects being developed in the Soviet Union. These included military projects and a scientific project, but all of them were rather low-priority until January 1956. After this, the scientific satellite programme piggybacked on the R-7 ICBM programme, becoming a top priority.

The first Soviet satellite projects were officially sanctioned in 1954. M. K. Tikhonravov, a scientist at NII-4 and co-founder of MosGIRD, had been working on his own satellite ideas for some time. In 1954 he took his calculations, and a collection of foreign press clippings about US satellite programmes, to an official at the Council of Ministers.[178] The seriousness of US military interest in reconnaissance satellites apparently convinced Tikhonravov's superiors to support his research.[179] After this visit, NII-4 received plenty of support to carry out official research on satellites.[180]

While Tikhonravov was winning support for military satellite projects, Korolev was pushing for approval of a scientific satellite project. The timing of Korolev's efforts suggest that it was prompted by the May 1954 deadline for International Geophysical Year

[177]Prudnikov, "Reshenie 'Problemy No. 1'," p. 40.
[178]This official was G. M. Pashkov. (N. Dombkovskii, "Oktiabr - Aprel' - Vselennaia," Sovetskaia Rossiia, 12 April 1989, p.3.) For Pashkov, see Appendix 3.
[179]The US military had been studying the idea of reconnaissance satellites since 1946. By 1954 these studies were being taken seriously. In March 1954 the RAND Corporation completed a study that argued strongly in favour of a television-based reconnaissance satellite. (Dwayne A. Day, "Corona: America's First Spy Satellite Program," Quest, Vol. 4, No. 2, Summer 1995, p. 8.)
[180]Dombkovskii, "Oktiabr - Aprel' - Vselennaia."

(IGY) satellite proposals. His overt lobbying began with a memo to the Council of Ministers on 26 May 1954.[181] In this memo he explained that the Soviet Union had "...the possibility of creating a scientific satellite of the Earth in the next few years..."[182] Korolev's memo also insisted that Tikhonravov's satellite design team be transferred from NII-4 to his own OKB-1.[183] This memo apparently received no immediate reply.

The next year, Korolev sent his space proposals to both the Academy of Sciences and the party. He advocated a major space effort in his annual report to the Academy of Sciences submitted on 25 June 1955.[184] In this report he stated that both satellites and piloted spaceflight had been proven possible and that a satellite design project could be completed by the end of 1956. Korolev also complained of the dissipation of energy caused by the two separate "space" commissions of the Academy of Sciences. He was, no doubt, referring to Blagonravov's Commission for the Investigation of the Upper Layers of the Atmosphere and the Commission on Interplanetary Communication under Sedov.[185] Korolev proposed that the Academy of Sciences should have a single commission to co-ordinate all work on space research.[186]

The day after submitting his report to the Academy of Sciences, Korolev sent a memo to the Central Committee with the same satellite and human spaceflight proposals.[187] In this memo he repeated the theme of the necessity to unify the control and management of space programmes. He proposed the creation of a special government subdivision (podrazdelenie) to concentrate on the development of satellites and work out the problems of piloted flight on rockets.[188]

Although there is no evidence that either of these reports had any direct effect, later in the summer of 1955 a scientific satellite project was approved. Exactly who approved it

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[181]Lardier, L'Astronautique Sovietique, p. 106.

[182]The memo is excerpted in: Rebrov, "Versiia Shifra 'PS'."

[183]At least one source reports that Korolev presented a much more detailed plan for the space programme to Ustinov on this date. The proposal is said to have included inhabited space stations. (M. V. Tarasenko, Voennye Aspekty Sovetskoi Kosmonavtiki, Moscow: Nikol, 1992, p. 16.)

[184]M. V. Keldysh, ed., Tvorcheskoe Nasledie Akademika S. P. Koroleva, Moscow: Nauka, 1980, p. 346.

[185]Blagonravov's Commission had been created in 1949. Sedov's Commission had just been created in 1954.

[186]Keldysh, Tvorcheskoe Nasledie Akademika S. P. Koroleva, p. 346.

[187]Rebrov, "Versiia Shifra 'PS'."

[188]V. Gor'kov, "Vestnik Kosmicheskoi Eri," Aviatsiia i Kosmonavtika, No. 10, October 1987, p. 10.

is not clear, but it must have been approved by August 1955. It seems unlikely in the extreme that Academician Sedov would have called a press conference at the IAF Congress in Copenhagen to announce the programme, if it had not been approved at higher levels. Additionally, Academician Keldysh later referred to a decision by the 'directive organs' authorising the satellite project in August 1955.[189] Since this was a relatively low-priority Academy of Sciences project, not a major weapons programme, it is quite possible that it was approved without full leadership review, or a decree from the party or government. The timing of Sedov's announcement, three days after the US satellite announcement suggests that the Soviet decision was taken in response to the US initiative. Even if the decision on the Soviet programme was not prompted by the US announcement, Sedov's public announcement surely was.

In any case, the Presidium of the Academy of Sciences met on 30 August 1955 to discuss the new scientific satellite project.[190] Chief Designers Korolev and Glushko were at the meeting. Korolev told the Presidium that the launch vehicle (the R-7) would be ready within a year and a half and that the Academy should draw up a consolidated scientific programme for space research.[191] The task of developing such a programme was handed to the two existing "space" Commissions (Blagonravov's and Sedov's). The Academy of Sciences also created a third Commission, specifically to oversee the development of the first scientific satellite. This Commission was known by a variety of names, but is identified most frequently as the Interdepartmental Commission (on Spaceflight). At the request of Korolev, Keldysh was named chairman of this commission.[192] Korolev and Tikhonravov served as his deputies.

Keldysh's commission, eventually turned out to be just the powerful co-ordinating organ that Korolev had suggested earlier in the year. It performed the same function for the

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[189] Keldysh made this comment in September 1956. Avduevskii, M. V. Keldysh, p. 235.
[190] Lardier, L'Astronautique Sovietique, p. 107.
[191] Barry S. Field, The Scent of the Future: Manned Space Travel and the Soviet Union, Garmisch, Germany: US Army Russian Institute, June 1981, p. 10.
[192] Asif Siddiqi, "Soviet Space Programme: Part 1 - Organizational Structure 1940s-1950s," Spaceflight, Vol. 36, No. 8, August 1994, p. 285.

scientific satellite programme that Korolev's Council of Chief Designers did for the R-7 programme. As one of Korolev's deputies later said, Keldysh was thus able

> "to overcome departmental barriers, and the space programme combined clear step-by-step aims, in tight co-ordination with the development of our technology."[193]

The design of the satellite was not conducted by the Academy of Sciences, or even in OKB-1. The work was actually conducted by Tikhonravov's group at NII-4, an organisation that was still part of the military.[194] Having other government agencies build hardware for Academy of Sciences projects was not unusual. For example, research versions of the R-2 and R-5 rocket were ordered by the Academy of Sciences from the Ministry of Defence Industry in June 1956.[195] The team at NII-4 designed a 1,200 kilogram "laboratory" that was known as Object D.[196]

Object D may have started out as a relatively low priority Academy of Sciences project, but this quickly changed. As with Korolev's other big project (the R-7), it was Khrushchev's January 1956 visit to OKB-1 that made all the difference. Throughout this tour of the design bureau, Korolev did not mention his space ambitions to Khrushchev. Only as the delegation reached the exit, did Korolev ask Khrushchev to take a look at another application of his rockets. He brought the group into a room full of displays about the rocket research programmes that had been conducted throughout the late 1940s and early 1950s. As the unenthusiastic audience was leaving Korolev directed Khrushchev's attention to a small display tucked discretely by the door. It was a model of Object D.

At first, Khrushchev was not impressed. Korolev unleashed his passion about the dreams of Tsiolkovskii, and the historic importance of Object D. Khrushchev was clearly uninterested, so, without skipping a beat, Korolev switched to another approach. He explained that the US had a satellite programme, but that the Soviet Union would be able to use the R-7 to launch a satellite many times heavier, and do it before the Americans. Warming to the idea of beating the Americans at their own game, Khrushchev made it clear

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[193] B. E. Chertok, quoted in a 1987 interview. (Konovalov, "Ryvok k Zvezdam.")
[194] NII-4 was subordinate to the Main Artillery Administration. See Appendix 7, sheet 2.
[195] Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 59.
[196] M. Rebrov, "Lider: Maloizvestnye Stranitsy iz Zhizni S. P. Koroleva," Krasnaia Zvezda, 1 July 1989.

that the missile programme must come first. Then he said, "If the main task doesn't suffer, do it."[197]

By the end of the month, the scientific satellite programme became a high priority - in essence it became part of the R-7 programme. Khrushchev's support for Object D was formalised in a joint decree of the Central Committee and the Council of Ministers on 30 January 1956. This document was equivalent to the design decision decree in the weapons R&D process.[198] It authorised Korolev to proceed with the R&D project as chief designer. The decree also specifically mandated the launch of Object D by the end of 1957.[199] In other words, this project was structured to beat the US into space.

Following the decree on 30 January 1956, work on Object D proceeded at a rapid pace. In March, Keldysh managed to procure time on the Soviet Union's most advanced computers to conduct calculations for the project.[200] Plans to modify the R-7 to launch the satellite were developed and verified by July.[201] Korolev signed the completed Draft Project (EP) for Object D on 25 September 1956.[202] The Academy of Sciences reviewed and approved the project on 29 September 1956.[203]

With the sponsorship of the First Secretary, OKB-1 seemed to be prospering, but the truth was that 1956 was a very difficult year. Korolev's design bureau may have been given independence from NII-88 that summer, but this caused a number of practical problems.[204] In addition, the rapidly accumulating problems of the new Five Year Plan and the weakening of oversight and control led to serious delays for the satellite project.

The problems led Keldysh to make an urgent plea for help at the meeting of the Presidium of the Academy of Sciences on 14 September 1956. Keldysh blamed the

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[197] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 111.
[198] See Appendix 9.
[199] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 113-4; and Keldysh, Tvorcheskoe Nasledie Akademika S. P. Koroleva, p. 362.
[200] See the copy of the letter he wrote requesting access to the computers in: Avduevskii, M. V. Keldysh, pp. 324-5.
[201] Lardier, L'Astronautique Sovietique, p. 107.
[202] See a copy of this in: Keldysh, Tvorcheskoe Nasledie Akademika S. P. Koroleva, p. 362.
[203] Lardier, L'Astronautique Sovietique, p. 107.
[204] For example, independence, combined with the growth of the "firm," led to an acute housing shortage for employees that summer. (M. Rebrov, "Gorod Koroleva," Rossiiskaia Gazeta, 22 September 1992, p. 5.)

problems with Object D on the lack of co-operation between the various ministries and research institutes. For example: the solar cells could not be completed because the appropriate ministry refused to supply the silicon to make them. The Department of Chemistry was not helping enough with fuel development for the upper stage of the rocket. The radio-technical industry was behind in its projects. Even the institutes of the Academy of Sciences were slow in delivering the engineering models of the instruments that were to go on the satellite. Keldysh concluded that if the Academy Presidium did not apply pressure to the lagging institutes and directors the US would launch its satellite first and steal priority from the Soviet Union.

By the end of the year some improvements were made, but Object D was still far behind schedule. In November 1956 Korolev finally got his wish to consolidate satellite and launcher design in his KB. Tikhonravov's satellite design group was moved from NII-4 to OKB-1. Unfortunately for Korolev, this did not alleviate the numerous co-ordination problems that were plaguing his project, and the rest of the economy, in late 1956.

Korolev could see that desperate action was needed to meet the deadline of a launch in late 1957, and more importantly, to beat the Americans.[205] At the end of 1956 he began to work on the idea of a "prosteishii sputnik" (PS) or "simple satellite" to replace Object D. This idea met with stiff opposition; even Korolev's close ally Keldysh did not agree with him.[206] However, by early January, Korolev had persuaded his fellow scientists that such an approach was their only hope.

On 5 January 1957 Korolev sent a memo about this idea to the leadership. Korolev's memo contained a number of detailed recommendations. First, he proposed to build 2 simple satellites (PS-1 and PS-2) between April and June. In addition, a new variant of the R-7 was to be built, specifically to carry the smaller and lighter simple satellites.[207] He also proposed (again) that a single, powerful government committee be created to supervise all work on the project. In effect, he was calling for a merger of

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[205]As noted above, the US was extremely confident about its space programme in late 1956 to early 1957.
[206]Gor'kov, "Vestnik Kosmicheskoi Eri"; and Konovalov, "Ryvok k Zvezdam."
[207]This was given the ministerial designation 8K71PS. The R-7 ICBM was known as the 8K71, and the rocket developed to launch Object D was designated 8A91. (Varfolomeyev, "Soviet Rocketry that Conquered Space," p. 262.)

Keldysh's Academy of Science Commission (the Interdepartmental Commission on Spaceflight) and the Council of Chief Designers. Korolev also requested that this programme be made a top government priority; that no expense be spared to complete it on time. Finally, he asked that the Interdepartmental Commission on Spaceflight be permitted to publicise the launch in the press. This proposal was approved, presumably by Khrushchev, on 25 January 1957.[208]

On the same day, in characteristic style, Korolev dashed off the design specifications for PS-1. In seven major points he described a simple and highly reliable device that would transmit a radio signal that could be received by the maximum number of listeners around the world.[209] Yet, Korolev intended PS-1 to pave the way for future space programmes, so it was to have two other important features - a round shape, and a pressurised interior. The round shape was to simplify calculating the effect of atmospheric drag on the satellite. This was important for the design of future spacecraft, and planning of their orbits. The pressurised interior was not only to ensure even cooling of the interior components, but also to test the ability to maintain pressure and temperature in a spacecraft - a crucial requirement for piloted flight.

Object D fell by the wayside as all efforts were shifted to making PS-1. The satellite, which was not much more than a sphere with two radio transmitters, was ready for tests in May. It arrived at Baikonur on 24 June 1957.[210] There it waited until after the first successful test of the R-7 on 21 August 1957.

Although the satellite had to wait on the R-7, there were numerous details of the project to be found in the Soviet press that summer. President of the Academy of Sciences Nesmeianov announced, at the beginning of June, that work on rockets and instruments for a satellite had already been completed.[211] Throughout June and July, magazines from Literaturnaia Gazeta, to Radio, and the Astronomical Journal of the Academy of Sciences,

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[208]Lardier, L'Astronautique Sovietique, p. 108; and Gor'kov, "Vestnik Kosmicheskoi Eri."
[209]Tikhonravov later described Korolev's requirements in a presentation at the International Astronautical Federation Congress in 1973. (Phillip Clark, The Soviet Manned Space Programme: An Illustrated History of the Men, the Missions and the Spacecraft, London: Salamander Books, Ltd., 1988, pp. 9-10.)
[210]Lardier, L'Astronautique Sovietique, p. 108.
[211]The New York Times carried this story on 2 June 1957. (Peebles, "A Traveller in the Night," p. 282.)

carried stories with details about PS-1. The frequencies on which PS-1 would broadcast were given wide distribution in July. Although this went virtually unnoticed in the West, it appears that Khrushchev's victory against the Anti-Party Group also ensured the survival of the satellite programme. In later years Korolev would say that

> "in the summer of 1957 the Central Committee finally endorsed the project."[212]

In September the satellite programme came to the fore. After the R-7 had proven itself, "all forces were hurled into the launch" of PS-1.[213] A wide variety of tests on the satellite and its launcher were conducted during September.[214] On 20 September the State Commission for the Launch of the First Scientific Satellite of the Earth met to schedule a launch date. This State Commission was identical to the State Commission that oversaw the R-7 tests, except that Riabikov returned as Chairman.[215] He approved 5 October 1957 as the launch date.[216] The State Commission also agreed to prepare a press announcement that was to be delivered to TASS after the first orbit had been confirmed.[217]

Although preparations for the launch were being made at a fevered pitch, Korolev took time off on 15 September to deliver a speech at ceremonies commemorating the centenary of Tsiolkovskii's birth.[218] The ceremony was held in the Hall of Columns in the Kremlin, and an edited version of Korolev's speech was carried in Pravda on 17 September.[219] Korolev proclaimed that Soviet scientists would soon put a satellite into orbit, and were working on putting a "parcel" on the moon, sending a probe around the moon, and also on piloted spaceflight. This speech highlighted Korolev's long-term plans. Delivered despite the pressures of the impending launch, it also indicated the depth of his dedication to Tsiolkovskii's vision.

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[212] P. Astashenkov, "Akademik Korolev," Sputnik, March 1972, p. 78.
[213] Konovalov, "Ryvok k Zvezdam." Note that the warhead failed during both the August and September launches, but the R-7 worked as planned.
[214] Lardier, L'Astronautique Sovietique, p. 109.
[215] It is unclear why Riabikov returned to this post.
[216] Gor'kov, "Vestnik Kosmicheskoi Eri."
[217] Gor'kov, "Vestnik Kosmicheskoi Eri." (See the quote at the beginning of this chapter.)
[218] Daniloff, The Kremlin and the Cosmos, p. 61.
[219] The full text of this speech can be found in: Keldysh, Tvorcheskoe Nasledie Akademika S. P. Koroleva, pp. 375-386.

Early on 4 October 1957, the launch crew began to fill the fuel tanks of the R-7. The preparations were completed earlier than expected. At 10:28 PM Moscow time (nearly midnight at Baikonur) the R-7 lifted off. Within three hundred seconds PS-1 was in orbit.[220] The launch team waited nervously in a bus near the launch site for the ninety minutes that it took the satellite to circle the globe. When they received the "beep-beep-beep" of the satellite's transmitters they "took out the vodka and champagne" and celebrated right on the launch pad.[221] The press release announcing the launch of "Sputnik" went out on the news wires as Korolev made a brief speech to his co-workers:

> "Today the dreams of the best sons of mankind, including our outstanding scientist Konstantin Eduardovich Tsiolkovskii, have come true. ... The storming of space has begun."[222]

Implications and Conclusions

With this information about the beginnings of the Soviet space programme we can now turn to the four central questions of this dissertation. What major space projects were authorised and how? Did the missile chief designers play an influential role in the promotion, selection and approval of these projects? What were the objectives and purposes of the Soviet space programme? Finally, what does this tell us about the Soviet political system?

Space Projects and the Policy Process

There were two major space-related programmes prior to the launch of Sputnik: the ICBM and satellite development. The Soviet leadership did not intend for the ICBM to be a space project, but its designer developed it with that purpose in mind, and quickly turned it to that use. There were two different types of satellite projects being developed in the early 1950s. Relatively little is known about the military satellite projects, except that they appear to have been authorised first. The scientific satellite project eventually overtook the military

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220 Clark, The Soviet Manned Space Programme, p. 11.

221 Harvey, "'I Was Last to Touch the Sputnik'," p. 17.

222 A. P. Romanov and V. S.. Gubarev, Konstruktory, Moscow: Politizdat, 1989, p. 81.

satellite as a top priority space project. The process by which these decisions were made reveals much about the Soviet space programme.

ICBMs were something that the Soviet leadership had been interested in, but the timing of the decision to build an ICBM, and the design selected for development, were driven by people below the top leadership level. Long-range ballistic missiles were clearly an option for solving the strategic asymmetry between the Soviet Union and the United States at the time of Stalin's death. However, ICBMs were not an immediate prospect, and the nuclear industry was oriented toward aircraft or winged missiles. The decision to begin an ICBM project was initiated by S. P. Korolev with the assistance of Minister D. F. Ustinov.

Thanks to changes in the political environment, this proposal was accepted by the Soviet government. Korolev, who was the only person with any real expertise on long-range ballistic missile development, mounted a convincing argument in favour of abandoning an intermediate range project in favour of his ICBM proposal. He used these technical arguments to win the support of key government and military leaders and powerful scientists in the weapons industry.[223] The elimination of tight supervision by the security forces made this sort of lobbying possible. In addition, the leadership turmoil and re-assessment of Stalinist military assumptions contributed to the authorisation of a wide array of nuclear weapons programmes - Korolev's ICBM was just one of these.

The R-7 was designed as a dual purpose rocket from the very beginning.[224] It was sold to the party leadership as an ICBM, but the R-7 was developed from Korolev's earlier ideas for a satellite launching rocket.[225] After the purge of the security forces and the shunting aside of Presidium members familiar with weapons R&D, the highest ranking political leader who understood Korolev's motives was Ustinov. There is no direct evidence that Ustinov was in favour of space exploration, but he does appear to have encouraged Korolev's efforts in this direction. It is quite possible that he supported

[223] e.g., Minister of Defence Industry Ustinov, Marshal Nedelin, and Academician Kurchatov, the chief nuclear weapons scientist.

[224] The fact that updated versions of the R-7 are still the only manned space booster in use by Russia testifies to the soundness of Korolev's design for this purpose.

[225] Korolev's work on such rockets relied on the efforts of many others, including Tikhonravov, Keldysh, and the other chief designers.

Korolev's space ambitions knowing that such an opportunity would extract the maximum effort from the chief designer. Ustinov's cultivation of Iangel' as a possible alternative, or competitor, to Korolev further suggests that he was more interested in successful projects than in space exploration, per se.

Until January 1956 the military and scientific satellite projects had a number of similarities. Unlike ICBMs, satellites were not a major weapons R&D programme at first. Military and civilian satellite projects were both initiated by the same few people - the surviving space enthusiasts. In both cases, the major argument in favour of the satellite projects appears to have been international competition. (US military satellite projects on the one hand, and IGY projects on the other.) Neither decision involved the top political leadership. Instead, these rather low priority research projects appear to have been approved at some intermediate level of government. Thus, both satellite programmes "ticked over" as a research effort, centred in NII-4, until Khrushchev's visit to OKB-1 in January 1956.

The decision to elevate the scientific satellite project (Object D) to a major, high priority programme was an entirely different sort of decision. Object D had already been approved as an Academy of Sciences project at this point. What was lacking was the sort of priority treatment needed to quickly complete the project, and the authorisation to use the R-7 to launch it into space. Such decisions could only be made by someone with political authority over weapons R&D. By January 1956, Khrushchev had acquired that power.

The decision on Object D was made with extraordinary alacrity. Once again, it was Korolev who initiated the change in policy. As he had done in the past, he bypassed the usual procedures and appealed directly to the top leadership.[226] After having impressed Khrushchev with his accomplishments, Korolev presented the satellite project as a simple addition to the ICBM programme. While there may have been other considerations, the idea of outdoing the US appears to have been the main reason that Khrushchev agreed to

[226] He had done this as early as 1931, when he approached Tukhachevskii about the GDL and MosGIRD merger. It was also evident in his successful effort to cancel the R-3A in 1953.

Korolev's request.[227] Within days, a decree effectively added the scientific satellite project to the larger ICBM programme.[228] Thus Korolev was granted the authority and resources needed to make the programme successful. Ten months later, the satellite design team that had been a part of the military, and had also been working on military satellites, became a part of Korolev's design bureau.

The 30 January 1956 decree, and the consolidation of the ICBM and space programmes under Korolev, were not sufficient to make Object D an immediate success. However, through his direct leadership access and reputation, Korolev was able to salvage the satellite project. Once again, it was Korolev who initiated, and Khrushchev who apparently decided. Although substituting PS-1 for Object D was a major change to the programme, it is likely that Khrushchev did not see it as such. After all, Khrushchev's goal had been to beat the Americans, not advance science.

Thus, the decision to launch Sputnik (PS-1) was actually a series of decisions driven by the space enthusiasts, especially Korolev. The first satellite projects were approved as research projects at a low level. However, after January 1956 the scientific satellite project became part of a high-priority weapons R&D programme sanctioned by the most powerful leader in the country. Decisions about space policy for the two years prior to the launch of Sputnik were made directly by Khrushchev, at the prompting of Korolev.

The Role of the Chief Designers

From the death of Stalin to the launch of Sputnik, one chief designer played a pivotal role in the promotion, selection and approval of space projects. The other two chief designers mentioned in contemporary accounts of the space programme, Iangel' and Chelomei, were not involved in the Sputnik decisions.[229] Korolev played a role in every decision that led to the launch of Sputnik. Without his persistence, ingenuity, and

[227]For example, it is quite possible that Khrushchev conceded to the request in order to provide Korolev with a greater incentive to finish the R-7 rapidly.

[228]This was the 30 January 1956 decree.

[229]In early 1957 Iangel' did conduct a study about using his R-12 (SS-4) as a space launcher. (Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 60.) It seems unlikely that Iangel' undertook this initiative on his own. In all likelihood, it was a case of Ustinov hedging his bets in case Korolev failed with the R-7.

leadership ability the Soviet Union might not have pursued any major satellite projects in the 1950s. Nor is it likely that the Soviet Union would have been the first country to launch an artificial satellite, had S. P. Korolev not forced the issue at every opportunity.

In effect, Korolev created, and then hijacked, the ICBM programme in order to start the space programme. Having forced the issue of building a powerful rocket, Korolev built a serviceable ballistic missile on the designs he had originally developed for a space launcher. He then turned his attention to starting a scientific satellite project. When the opportunity to merge the two projects and put them both under his own control arose in January 1956, he successfully pushed this as well. As chief designer of these high priority programmes Korolev had the resources of the state at his disposal. He used them to fulfil Tsiolkovskii's vision under the guise of building an ICBM.

How did Korolev "get away" with this? A number of seemingly unrelated circumstances and events were crucial to his success. The increased reliance on experts and leadership turmoil enhanced the influence of some designers over their projects. However, in the longer term, it was the rise of Khrushchev that made Sputnik possible. The Khrushchev-led elimination of Beriia, and the subsequent purge of the security forces oversight network facilitated Korolev's lobbying for the R-7. Later, the lack of oversight and/or protection by Ustinov allowed Korolev to devote himself to satellite projects instead of limiting his work to long-range missiles.

In his drive to establish dominance over weapons R&D policy Khrushchev turned to missiles as a way to undermine the existing weapons policymaking elite. This too aided Korolev, for the leading missile designer was a natural ally of Khrushchev against his aviation-oriented competitors. Moreover, Korolev gained the trust and respect of the First Secretary. Khrushchev was willing take Korolev's advice. With direct access to such a powerful ally Korolev's decisions would have been difficult to dispute. Thus, the traditionally strong powers of a chief designer were further enhanced by Khrushchev's unquestioning trust and patronage.

Objectives and Purposes of the Soviet Manned Space Programme

The Sputnik press releases suggest that the Soviet Union was following a peaceful, long-term plan of space exploration - this was both true and false. Tsiolkovskii's vision of the peaceful exploration of space was an article of faith among the space enthusiasts. Korolev knew that mankind's destiny in space required establishing a satellite launch capability, to be followed quickly by manned spaceflight. Once mankind had established bases in orbit these could be used as stepping stones to the colonisation of the moon and the nearby planets. This was the Tsiolkovskii vision, one that Korolev made sure to accentuate in the publicity about Sputnik.

However, Sputnik was neither a scientific, nor strictly a civilian project. Object D, the scientific satellite that was being developed in co-operation with the USSR Academy of Sciences, had been abandoned in the race to beat the Americans into space. PS-1 had relatively little scientific, or direct military value. Its primary significance to the man who authorised it (Khrushchev) was as a strategic symbol - to beat the Americans at their own game, and convince them (as the August 1957 announcement of the "successful" R-7 test had not) that the Soviet Union was a great power. Thus, Sputnik was authorised as part of a larger weapons programme.

In the United States, President Eisenhower had insisted on keeping scientific research in civilian hands - this was a crucial distinction that the Soviets never adopted. The scientists and designers who made Sputnik, and who wrote the initial press releases, had their own, peaceful, motives. But the policy-maker(s) had a very different view of the space programme. To them, it was primarily a useful adjunct to strategic policy.

Implications for the Soviet Political System

These findings suggest several interesting conclusions about the Soviet political system during the 1953-1957 period. In the first place, there were major upheavals in the R&D policymaking system. Secondly, oversight of scientists and designers was undermined by the purge of the security forces. Despite these changes the weapons R&D policymaking system eventually returned to an essentially Stalinist arrangement.

After March 1953 the policymaking system was replaced, not once, but twice. The first shift occurred immediately after Stalin's death, when missile programme policy was taken up by Beriia, and later by the remnants of his First Main Administration. The Ministry of Medium Machinebuilding under Malyshev continued to serve as the locus for policymaking in many high-technology defence programmes. This moved the control of policy from the security organs to the state structure.

The second shift was not completed until the summer of 1957. While Khrushchev was trying to assert his authority he still had limited legitimacy in weapons policy and more limited knowledge. These deficits left the executors of weapons R&D policy considerable lee-way. Ministers like Malyshev or Ustinov, could effectively make policy by the way they implemented the guidance they got from the Presidium. Control of weapons R&D policy was uncertain until Khrushchev consolidated power. After this point, control over weapons policy shifted more decisively to the party. Then, Khrushchev could choose to intervene to set policy. He did so with regard to the ICBM and Sputnik.

Between the time of Beriia's arrest and the victory of Khrushchev, oversight of scientists and designers was weak. Initially the collective leadership had to rely on ostensibly impartial experts. Although NII-88 was an important institution in the missile programme, it did not serve as a "leading NII." Despite attempts to cultivate other experts (like Iangel'), Korolev and his fellow space enthusiasts had a monopoly on ballistic missile expertise. These experts were anything but impartial - they had their own visionary agenda. Scientists in the missile and nuclear weapons programmes were able to ignore state authorities with only mild consequences.[230] While the struggle for control over weapons R&D policy went on, the scientists and designers were remarkably free from political oversight.

However, by the end of the Anti-Party Group affair, Khrushchev had established himself in a position akin to that of Stalin with regard to weapons R&D. The dynamics of Presidium politics have generally led to the emergence of a "senior colleague," and this case

[230]An obvious case of this was Korolev's blunt, and successful, rejection of Malyshev's demand (in 1953) that the R-3A programme be completed.

was no exception.[231] Once again, the First Secretary was at the centre of the weapons R&D policymaking system. Khrushchev did not have full knowledge and control over all weapons R&D programmes, but he could intervene if it suited him. He had also replaced the Beriia-style execution and oversight systems with his own. Policy was now implemented through the government VPK and State Commissions. Policy oversight became a function of the party, through the Central Committee Secretariat and its departments.

Weapons R&D policymaking was not only in the hands of the Khrushchev, but he returned to some of the techniques used by his predecessor. For example, the State Commissions were ostensibly impartial arbiters of prototype testing, but the Secretariat's control over the selection of the chairmen, and members of such commissions, made it possible to control the outcome. This is strongly reminiscent of Stalin's use of leadership subgroups to control policy.

The concentration of control over policy had one more important consequence. Khrushchev's personality was now a major factor in policymaking. As leader, Khrushchev's predilection for boldness, tendency to rely on his instincts, and desire to secure the place of the Soviet Union as a major world power were crucial in the development of events and institutions. These traits also provided the opportunity for another bold entrepreneur to advance his cause. Thus, Korolev and his space programme were launched.

[231] John Löwenhardt, The Soviet Politburo, Edinburgh: Cannongate, 1982, pp. 1-2; and Archie Brown, "Conclusions," in Archie Brown, ed., Political Leadership in the Soviet Union, Bloomington: Indiana University Press, 1989, pp. 222-223.

Chapter 5: The Beginnings of the Manned Space Programme (1957-1961)

"The new victory of the Soviet conquerors of space is a remarkable expression of the advantages of the Soviet Socialist system, a result of the great achievements of our people in the development of the economy, science, technology, culture and education. It was possible only thanks to the daily concerns of the Communist Party for scientific and technical progress, for the attentive preparation and training of cadres of Soviet scientists."

Pravda editorial
22 August 1960

Overview

In the three and one half years after Sputnik, the Soviet Union went from one stunning space accomplishment to the next. This culminated in the first human spaceflight in April 1961. Although the Soviet Union appeared to be making sure and rapid progress with its planned conquest of space, their space programme was not what it seemed. It was primarily a series of political events, and as the political circumstances changed, the types of space (and missile) projects that were approved changed dramatically. During this period, the influence of Chief Designer Korolev plummeted and the Soviet space and missile programme was more carefully harnessed to achieve the goals of the political leadership, rather than those of the space enthusiasts.[1]

Such changes were not evident from the pace and variety of Soviet space successes. While the world was still in shock from Sputnik, the Soviet Union launched a second satellite a month later.[2] On 3 November 1957, Sputnik 2 not only reached orbit, but brought the first living creature into space - a dog named Laika. The spacecraft weighed an impressive five hundred kilograms and remained attached to the spent rocket stage that had boosted it into orbit. Thus, the total weight of the satellite came to seven and one half tonnes.[3] Although the Soviet Union had not yet perfected the technology to return anything

[1]Note the difference in the quotes at the beginning of this chapter and the previous chapter. The change in tone is typical of pronouncements of the time.
[2]See Appendix 12 for a summary of all known Soviet space launch attempts from 1957-1964.
[3]Phillip Clark, The Soviet Manned Space Programme: An Illustrated History of the Men, the Missions and the Spacecraft , London: Salamander Books, Ltd., 1988, p. 11.

from orbit, Sputnik 2 did prove that living beings could survive in space.[4] It also suggested that manned spaceflight was the ultimate objective of the Soviet space programme.

The back-to-back Sputnik launches set off a panic in the West.[5] This was exacerbated when the highly publicised first US satellite attempt failed in a dramatic launch pad explosion on 6 December 1957. The US finally got a satellite into orbit on 1 February 1958. However, of the next thirteen launch attempts, ten failed to achieve orbit. These frantic efforts heightened the perception of overwhelming Soviet technological superiority. Meanwhile, the Soviet Union launched its third satellite, Sputnik 3, on 25 May 1958.

Deep in the throes of "sputnik fever," the United States committed itself to a manned space programme and created a new institution to implement it.[6] Based largely on a pre-existing scientific research organisation, the National Aeronautics and Space Administration (NASA) was a civilian organisation that was given charge of scientific space projects.[7] The mission of NASA was made clear at the highest level - to unify American space efforts so that the US could "catch up" with the USSR. One of NASA's top assignments was the man-in-space programme.[8] In April 1959, NASA presented its first seven astronaut candidates to the public.

Meanwhile, the Soviet Union stunned the world again, by aiming for the Moon in 1959. The US had been trying to launch a probe to the moon since August 1958. They were beaten on 2 January 1959, by Luna 1. The Soviet probe passed within six thousand kilometres of the moon, becoming the first manmade object to escape Earth's gravitational

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[4]The Soviet Union maintained that Laika was euthanised after seven days in orbit. Reports from early 1995 suggest that the dog died of heat prostration early in the mission due to the loss of insulation around the spacecraft during launch. The loose insulation may also have been the reason why PS-2 did not separate from the spent booster. (Colin Burgess, "Animals in Space (letter)," Spaceflight, Vol. 37, No. 4, April 1995, p. 140.)

[5]American General James Gavin referred to the Sputnik launches as a "technological Pearl Harbor." (quoted in Nicholas Daniloff, The Kremlin and the Cosmos, New York: William Morrow & Co., 1972, p. 6.)

[6]President Eisenhower signed the "Space Act" on 28 July 1958.

[7]Institutionally, NASA was primarily descended from the National Advisory Council for Aeronautics (NACA). US military and reconnaissance space projects remained under the control of the military and the Central Intelligence Agency.

[8]NASA's control of the manned space programme was spelled out in a National Security Council decision on 18 August 1958. (Giles Alston, International Prestige and the American Space Programme, Oxford University, DPhil. dissertation, 1989, p. 161.) Manned military space projects still existed, but they were not as high a priority as the NASA programme.

field.[9] In September 1959, Luna 2 became the first space probe to hit the moon. A month later, Luna 3 returned the first photographs of the hidden side of the moon.

Khrushchev reaped tremendous political benefits from the Soviet space successes. Soviet propaganda touted space supremacy as incontrovertible proof of the truth and power of communism. In East-West relations, space triumphs strengthened Khrushchev's position. Moreover, Khrushchev used his space successes to humiliate the US. During his first visit to the United States in September 1959, Khrushchev presented President Eisenhower with a replica of the "pennants" delivered to the moon just two days earlier by Luna 2.[10]

The sharp political pressure prompted a re-evaluation of US space policy. The Eisenhower administration developed a new space policy in December 1959.[11] This document did not commit the US to any manned programmes beyond the initial Mercury programme launches, but it did cite the importance of manned spaceflight for international political prestige. However, many Americans, such as Senate Majority Leader Lyndon Johnson and officials in NASA, were not satisfied with this. They saw a direct connection between Laika and the Luna probes - i.e. the Soviet Union must be planning a manned lunar expedition. Pressure for a matching US programme built up quickly.

Western suspicions that the Soviet programme was oriented toward human spaceflight appeared to be borne out in 1960. That summer the Soviets began tests of a spacecraft designed to return living creatures from space. The first such test was in May 1960 when the Soviet Union launched a new satellite that they referred to as a "korabl'-sputnik" (ship-satellite).[12] Then, in August 1960, Korabl'-Sputnik 2 carried the dogs Belka and Strelka into orbit and back again.[13] These were important scientific successes. The

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[9]A US moon probe did not succeed until the fifth attempt, Pioneer 4, launched on 3 March 1959.

[10]Luna 2 was launched on 12 September 1959, and struck the moon late on 14 September (Moscow time). Khrushchev left for Washington on 15 September and presented a replica of the pennants on his visit to the White House later that day. (Let Us Live in Peace and Friendship: The Visit of N. S. Khrushchov to the U.S.A., Moscow: Foreign Languages Publishing House, 1959, pp. 53-55; and Sergei N. Khrushchev, Nikita Khrushchev: Krizisy i Rakety, Vol. 1, Moscow: Novosti, 1994, p. 473.)

[11] This was again in the form of a National Security Council Decision; NSC 5918. (Alston, International Prestige and the American Space Programme, p. 163.)

[12]In the West this mission was more commonly known as Sputnik 4. The other korabl'-sputniks were also given sputnik designators by the West.

[13]Korabl'-Sputnik 3, in December 1960, was another test of the same spacecraft. However, the Soviets were rather silent about the results. See Appendix 12.

Soviet Union especially stressed their peaceful scientific intentions in space as a contrast to US behaviour, "typified" by the U-2 incident in May 1960.[14]

Although the United States launched many more satellites than the Soviet Union in 1960, the Soviets enhanced their "lead" in the space race in 1961.[15] In February 1961 the USSR successfully sent Venera 1 on its way toward Venus.[16] This was the world's first interplanetary probe and the first time that a spacecraft had successfully used an intermediate orbit (or "parking orbit") to leave Earth's gravitational field.[17] In March 1961, the Soviet Union also carried out two more successful orbital missions with dogs.

In April 1961, the Soviet Union scored another major coup. The United States was making its final preparations for its first manned spaceflight, a sub-orbital mission in the Mercury capsule.[18] But on 12 April 1961 the USSR not only put a man into space, but sent him into orbit around the Earth. After his one hour and forty eight minute flight, Major Iurii Gagarin was treated to a hero's welcome in Moscow and became an international celebrity.[19] Once again the Soviets embarrassed the US both technologically and politically. Gagarin's orbital flight came immediately on the heels of the aborted US-sponsored invasion of Cuba at the Bay of Pigs.

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[14]The US had not only violated Soviet airspace during the U-2 overflight, but initially President Eisenhower had lied about US involvement and intentions. Only after Khrushchev produced wreckage, and the captured pilot, did Eisenhower admit that the US was conducting "spy flights."

[15]In 1960 the Soviets only managed to put three satellites into orbit. The US put sixteen satellites into orbit, including a missile detection satellite (Midas), the Samos observation satellite, a navigation satellite (Transit), a weather satellite (Tiros), and two communications satellites (Echo and Courier). Since the Soviet Union never publicised its space launch failures it was extraordinarily difficult to make useful comparisons with their space programme.

[16]Unfortunately, the Soviet Union lost radio contact with Venera 1 two weeks later.

[17]The only previous Soviet missions to leave earth orbit, the Luna probes, had used a "direct ascent" trajectory. This means that they were launched directly from the surface of the earth at their target. The direct ascent method is much less demanding in terms of creating rocket engines for use in space, however, it is less efficient and considerably more demanding in initial launch accuracy. (It requires split second timing because your aim is determined by the rotation of the Earth.)

[18]In other words, this was to be a brief ballistic flight from Florida to the middle of the Atlantic Ocean. It did not actually take place until 5 May 1961.

[19]For Gagarin, see Appendix 3.

Institutions and the Policymaking Environment

The Party

The Presidium of the Central Committee

After the "Anti-Party Group" affair, Khrushchev moved slowly, but relentlessly, against potential adversaries and his remaining opponents. In December 1957 Marshal Zhukov was removed from the Presidium and from his post as Minister of Defence. He was replaced on the Presidium by, yet another Secretary of the Central Committee, N. A. Mukhitdinov. Early in 1958, Khrushchev also moved against the most senior of his remaining opponents from the "Anti-Party Group." In March, Bulganin lost his post as Chairman of the Council of Ministers. Then, in September 1958 he was removed from the Presidium.[20]

Completely dominated by Khrushchev and his entourage, the Presidium of the Central Committee was fairly stable until May 1960.[21] The Central Committee Plenum, held just three days after the U-2 incident and on the eve of a planned US-Soviet summit in Paris, made major changes to the Presidium. The changes reflected a dramatic shift in Khrushchev's assessment of the domestic and international political situation.[22] Far from being a political defeat for Khrushchev, the sweeping changes demonstrated his continued dominance of Soviet politics.[23] Kirichenko, who had been Second Secretary, and four of the nine people elected to the Presidium in June 1957 were removed from, or demoted in, the Presidium.[24] F. R. Kozlov moved up to de facto Second Secretary and Podgornyi, Polianskii, and Kosygin all became members of the Presidium.

Shortly thereafter, Brezhnev was transferred from Central Committee Secretary for Heavy Industry, Defence and Space to Chairman of the Presidium of the Supreme Soviet.

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20 Bulganin was not officially accused of being part of the "Anti-Party Group" until November 1958. (Jerry F. Hough and Merle Fainsod, How the Soviet Union is Governed, Cambridge: Harvard University Press, 1979, p. 219.)
21 The only change not mentioned above was the addition of two new candidate members in June 1958.
22 S. N. Khrushchev, Krizisy i Rakety, Vol. 2, p. 30. Sergei Khrushchev has since suggested that his father took the 1 May 1960 U-2 mission as a personal insult, intended to ruin his May Day holiday. ("Khrushchev, Powers Sons Meet," Associated Press news wire story, 7 October 1995.)
23 This assessment is confirmed by developments in space policy. See below.
24 Kirichenko and Beliaev were removed, while Aristov, Furtseva, and Ignatov were demoted. (Archie Brown, ed., The Soviet Union: A Biographical Dictionary, London: Weidenfeld and Nicolson, 1990, p. 186.)

Although technically head of state, this was a largely ceremonial post. The industrious Frol Kozlov took on Brezhnev's Secretariat portfolio of Heavy Industry, Defence and Space.

The Party Leadership and Missile / Space Policy

Following the "Anti-Party Group" affair Khrushchev personally controlled weapons R&D policy, and could thereby dominate missile and space policy decisions. The were no full members of the Presidium with weapons R&D leadership experience that pre-dated Khrushchev's.[25] From 1957-1960 the Presidium member with formal responsibility for weapons R&D programmes was Brezhnev.[26] He had little experience in this field prior to 1957 and is reported to have had a distaste for the weapons industry.[27] Given Khrushchev's close identification with the missile industry it seems unlikely that Brezhnev had any significant, independent influence on missile and space policy.

The degree of Khrushchev's dominance in these matter was evident during the 21st Party Congress in early 1959.[28] In tones reminiscent of Stalinist times, Khrushchev was praised effusively by delegates for his "personal guidance and initiative...in every sector," including, of course, missile and space accomplishments.[29] Leading nuclear scientist I. V. Kurchatov addressed the Congress on 3 February 1959, stressing the effectiveness of Soviet nuclear-rocket weapons.[30] Minister Ustinov's Congress speech focused on the successes of innovation in the space programme and Khrushchev's personal leadership in this area.[31] The Party Congress succeeded in underlining three things: first, missiles were a revolutionary new weapon; second, space spectaculars had won the Soviet Union the respect of the world; third, Khrushchev was personally responsible for both of these accomplishments.

[25]Pervukhin had more experience than Khrushchev, but he had been demoted to candidate member and was "exiled" to East Germany.

[26]This was a result of his post as TsK Secretary for Heavy Industry, Defence and Space.

[27]Andrei D. Sakharov, Memoirs, trans. Richard Lourie, London: Hutchinson, 1990, p. 214.

[28]The Congress was held between 27 January and 5 February 1959, less than a month after the Luna 1 mission.

[29]Hough and Fainsod, How the Soviet Union is Governed, pp. 221-2.

[30]Matthew Evangelista, Innovation and the Arms Race: How the United States and the Soviet Union Develop New Military Technologies, London: Cornell University Press, 1988, p. 210.

[31]David Holloway, "Innovation in the defence sector," in Ronald Amann, and Julian Cooper, eds., Industrial Innovation in the Soviet Union, London: Yale University Press, 1982, p. 333 fn.

After the leadership shake-up in May 1960 missile and space policy came under more effective control. Khrushchev maintained his personal authority in this field but he was now assisted by the more able F. R. Kozlov. Kozlov had substantially more experience as an engineer than Brezhnev, and had also been a party leader in regions with a high concentration of defence industry.[32] Not only was Kozlov more experienced than Brezhnev, but he was substantially more powerful. He served as Second Secretary, as well as Secretary for Heavy Industry, Defence and Space.

The Government

The Council of Ministers and the Ministry Structure

With the Sovnarkhoz reforms in 1957 Khrushchev had substantially weakened the Council of Ministers and the central ministerial structure. In 1958 he completed the job. The remainder of the industrial ministries (with the notable exception of the Ministry of Medium (nuclear) Machinebuilding) were disbanded.[33] When Bulganin was removed as Chairman of the Council of Ministers on 27 March 1958, Khrushchev named himself as the new Chairman. Like Stalin before him, Khrushchev was now head of the party and head of the government.

In taking over the Council of Ministers, and the remnants of the central government, Khrushchev brought along his most trusted followers. In 1957 F. R. Kozlov had been named Chairman of the Russian Federation (RSFSR) Council of Ministers. The next year Kozlov was transferred to the USSR Council of Ministers as one of Khrushchev's First Deputy Chairmen.[34] Kozlov held this post until his promotion in May 1960. He was replaced as First Deputy Chairman of the USSR Council of Ministers by A. N. Kosygin.[35] Throughout this period D. F. Ustinov served as a Deputy Chairman of the USSR Council

[32] i.e. Kuibyshev and Leningrad.
[33] The changes were completed by June 1958. V. A. Tsikulin, Istoriia Gosurdarstvennykh Uchrezhdenii SSSR 1936 -1965, (Uchebnoe posobie), Moscow: Ministerstvo Vyschego i Srednego Spetsial'nogo Obrazovaniia RSFSR/ Moskovskii Gosudarstvennyi Istoriko-arkhivnyi Institut, 1966, p. 56. (My particular thanks to Dr. G. Walker of the Bodleian Library for uncovering this invaluable, but obscure work.)
[34] The other First Deputy Chairman was long-time Khrushchev ally, A. I. Mikoian.
[35] Kosygin was promoted from the dual post of Deputy Chairman of the Council of Ministers and head of Gosplan. (See Appendix 10.) Interestingly, Kosygin had served as First Deputy Head of Gosekonomkom from 1956-57 under Pervukhin.

of Ministers and supervisor of the defence industry as Chairman of the Council of Ministers' Military-Industrial Commission (VPK).

The Defence Industrial Ministries

Although the defence industrial ministries were formally disbanded in the first half of 1958, the reforms actually left them substantially intact. Control over planning and supervising the work of defence plants was supposed to be shifted to the appropriate regional Sovnarkhoz. Many R&D institutions were decentralised or subordinated to other agencies like Gosplan.[36] However, the most important parts of the defence industrial ministries remained intact in the form of State Committees to co-ordinate weapons R&D. For example, the Ministry of Defence Industry (MOP) became the State Committee for Defence Technology (GKOT), and the Ministry of Aviation Industry was re-named the State Committee for Aviation Technology (GKAT).[37] For the missile and space programmes this meant that the design bureaux and institutes remained under the control of the same administrators they had always known.

In fact, defence industry leaders, especially those associated with Ustinov and Kozlov, became a more significant part of what remained of the USSR central government. Ustinov was responsible for the defence industry as head of the VPK. The heads of the State Committees for military technology (GKOT, GKAT, etc...) under him retained the rank of Minister of the Soviet Union. Ustinov's replacement at the GKOT was his long-time deputy for missiles, K. N. Rudnev. Moreover, defence industry leaders were promoted into other important posts. For example, in May 1960 a defence industry leader associated with both Ustinov and Kozlov became head of Gosplan.[38] It has been noted in previous studies that the military industrialists were in "virtual control" of the Soviet economy in the early 1960s.[39] Now, it is clear that by 1961 it wasn't simply military industrialists, but missile industrialists who were in "control."

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[36]US Central Intelligence Agency, National Intelligence Estimate Number 11-6-59: Soviet Science and Technology, (Secret) Washington DC, 21 July 1959, as declassified 9 August 1993 by CIA Historical Review Program, p. 6.
[37]Other significant conversions included the State Committees for: Shipbuilding, Radio-electronics, Automation and Machinebuilding, and Chemistry. See Appendix 4, sheet 2.
[38]When Kosygin was promoted he was replaced by V. N. Novikov. For Novikov, see Appendix 3.
[39]Arthur J. Alexander, Decision Making in Soviet Weapons Procurement, Adelphi Paper no 147/8, London: International Institute for Strategic Studies, Winter 1978/79, p. 20.

The aviation industry (GKAT) was in a much weaker position than the missile industry (GKOT). Its only hope for improving its fortunes was to win control of part of the missile business. Many leaders in the aviation industry weren't keen on ballistic missiles, but they believed that their own designers and factories were better suited to producing such aerospace products than those of the armaments industry.[40] However, until the middle of 1960, Ustinov's old ministry (now called the GKOT) monopolised the ballistic missile industry.

Within the GKOT, the role of the leading missile research institute was changing, but not in ways that the political leadership appears to have intended. In 1959 the Central Committee created new procedures meant to improve the control of scientific research in the Academy of Sciences and industry.[41] Having spun off the major design bureaux in 1956 and 1957, NII-88 was supposed to have become the "brain centre" of the missile programme rather than its chief administrator.[42] Yet, NII-88's function as the "lead institution" was undermined by two important changes. First, chief designers like Korolev, Glushko, and Iangel', increasingly bypassed NII-88 review by presenting their proposals directly to Khrushchev.[43] Second, the new leader appointed as head of NII-88 in 1959 was a close personal friend of Korolev.[44] G. A. Tiulin, formerly the deputy head of the military's missile institute (NII-4), probably appeared to be a perfect choice to ensure a more effective military voice in missile design.[45] However, what it really meant was that Korolev could depend on favourable treatment from the "experts" in the GKOT.

The Military

Although military industry played an important role in space policymaking, the military itself had limited influence. Shortly after Sputnik 2, Marshal Zhukov was removed

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[40]For comments in this vein see: S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 377.

[41]The July 1959 Central Committee Plenum approved the use of "lead institutions" and Scientific Councils to: "raise the role of science in technical progress, improve the organization of research and experimental work, and step up the introduction of scientific achievements." (CIA, National Intelligence Estimate Number 11-6-59, p. 7.)

[42]See Appendix 7, sheet 3.

[43]Far from reviewing Korolev's work, parts of NII-88 worked for him on the R-7 project. NII-88 was responsible for developing the tracking and control network used for R-7 launches.

[44]M. Rebrov, "Versiia Shifra 'PS'," Delovoi Mir, 10 October 1992, p. 10.

[45]For Tiulin, see Appendix 3.

from all of his posts. The new Minister of Defence, Marshal Malinovskii did not become a member of the Presidium, so the military no longer had formal representation in the highest party body.[46] In addition, Khrushchev's power, and divisions of opinion within the military, limited the policymaking role of the military leadership.

Within the military there was resistance to Khrushchev's emphasis on missiles. This opposition was reflected in the extended debates over military doctrine and training that raged in the Soviet military throughout this period.[47] This opposition also included specific objections to the space programme; particularly Korolev's vision of a grand, glorious, and scientific colonisation of space. Doubtless aware of the often extravagant US military proposals for space,[48] and knowing that the top US priority in space had long been the development of a reconnaissance satellite, some military leaders wanted a matching military space programme.[49] But Khrushchev was not looking for new ways to spend money on the military.

Since 1956 Khrushchev had been pushing for a smaller, more effective, less expensive military based on nuclear missiles. Following the first successes of the R-7, Khrushchev called for a further one-third cut in the size of the Soviet Army.[50] Khrushchev also undercut the Soviet Air Force by converting aircraft plants to missile production. Nonetheless, change came slowly to the huge military bureaucracy.

Khrushchev saw that one way to accelerate the change in doctrine, and ensure its permanence, was through institutional change. In 1959, Khrushchev told Marshal Nedelin to develop plans for a new branch of the armed services, specifically devoted to long range missiles.[51] This proposal was not particularly welcome in the Ministry of Defence, but

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[46] For Malinovskii, see Appendix 3.
[47] For a brief overview of this issue see: David Holloway, The Soviet Union and the Arms Race, 2nd ed., New Haven: Yale University Press, 1984, pp. 35-39.
[48] These included stationing nuclear missiles on the moon, and a variety of anti-satellite programmes. (William Burrows, "Securing the High Ground," Air & Space/Smithsonian, Vol. 8, No. 5, December 1993/January 1994, pp. 64-69.)
[49] At this point the United States had two major reconnaissance satellite programmes, one under the US Air Force, and another under the Central Intelligence Agency. (Dwayne A. Day, "Corona: America's First Spy Satellite Program," Quest, Vol. 4, No. 2, Summer 1995, p. 10.)
[50] Troop strength had already been cut by thirty seven percent between 1955 and 1958.
[51] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 434-6.

there was no open resistance to it.[52] Decrees by the Central Committee and Council of Minister on 17 December 1959 created the Strategic Rocket Forces (RVSN) and appointed Marshal Nedelin as its first Commander-in-Chief.[53]

In January 1960 the relatively small, new service became the centrepiece of a newly announced military doctrine. The RVSN had a central staff of just over one thousand and an armoury initially limited to one type of missile, Iangel"s R-12.[54] Yet, in a speeches to the Supreme Soviet on 14 January 1960, Khrushchev and Defence Minister Malinovskii announced that any future world conflict would be a long-range nuclear missile war.[55] The RVSN, it was declared, now took precedence over all other branches of the Soviet military. Several major changes to the leadership of the Soviet military followed shortly thereafter.[56]

The RVSN was mainly created out of parts of the Main Artillery Administration (GAU).[57] Nedelin took the rocket units and the missile acquisition structure with him to the new service. As in the other branches of the military, weapons acquisition was controlled by a Main Administration. This organisation became known as the Main Administration for Missile Armaments (GURVO).[58] Among other things GURVO was responsible for writing the Tactical-Technical Requirements (TTT) for strategic missile weapons[59] and developing the technical documentation for the preparation and use of the weapon once it was accepted into the inventory.[60] GURVO also oversaw the test ranges (Kapustin Iar and Baikonur) and NII-4. It appears that NII-4 functioned primarily as a "think tank" for the missile

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[52]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 436.

[53]The decrees are reproduced in: I. D. Sergeev, et al., Khronika Osnovnykh Sobytii Istorii Raketnykh Voisk Strategicheskogo Naznacheniia, Moscow: TsIPK, 1994, pp. 236-9. For a summary of known decrees see Appendix 6 of this dissertation.

[54]The R-7 was not formally accepted into the inventory until 20 January 1960. (Sergeev, et al., Khronika Osnovnykh..., p. 37.)

[55]James Sherr, Soviet Power: The Continuing Challenge, 2nd ed., London: Macmillan, 1991, p. 125.

[56]Long-standing Chief of the General Staff, Marshal Sokolovskii, and Commander-in-Chief of the Ground Forces, Marshal Grechko, were moved to new, less influential posts in 1960. For Grechko, see Appendix 3.

[57]See Appendix 7, sheet 3.

[58]"O Nauchno-tekhnicheskoi deiatel'nosti Iu. A. Mozzhorina (k 70-letiiu so dnia rozhdeniia)," Iz Istorii Aviatsii i Kosmonavtiki, Vol. 60, 1990, p.6; and Iu. Mozzhorin and A. Eremenko, "Ot Pervykh Balisticheskikh do...," Aviatsiia i Kosmonavtika, No. 7, July 1991, pp. 40-41; and No. 8, August 1991, pp. 34-35.

[59]The TTT establishes the military need and sets the basic performance requirements for proposed weapons.

[60]Oral History of N. N. Smirnitskii in Iu. A. Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, Moscow: MAI Press, 1992, p. 142.

directorate with departments for ballistics, space research, calculations, and combat utilisation.[61]

Unfortunately for the new service, disaster struck the RVSN on 24 October 1960. During preparations for the test of a new ICBM, Marshal Nedelin, and many others, were killed when the missile exploded. There was no one else with Nedelin's knowledge of, and commitment to missiles in the Soviet military. He was replaced as Commander-in-Chief of the RVSN by an old associate of Khrushchev, Marshal K. S. Moskalenko.[62]

The USSR Academy of Sciences

The Academy of Sciences played an extremely important role in the early development of the Soviet space programme. One of the reasons that the Academy played this role is because it became the alternative institutional home for most of the space enthusiasts. This was particularly apparent in the June 1958 elections to the Academy. Following the stunning success of the first three Sputniks, virtually all of the technical leaders of the space programme became corresponding or full members of the Academy of Sciences.[63] Of the thirty four Academicians (full members) elected in 1958, at least three, Korolev, Glushko, and G. I. Petrov, were leaders of the space programme.[64] At least five of the eighty two new corresponding members were also directly involved with the Sputnik launches. These included: V. P. Barmin, V. I. Kuznetsov, M. S. Riazanskii, N. A. Piliugin, and Korolev's top assistant at OKB-1, V. P. Mishin. At this point all of the original members of the Council of Chief Designers were members of the Academy of Sciences. They now had an institutional "home" outside of the defence industrial ministry structure.

During this period the political leadership became increasingly disenchanted with the "expert" advice it got from the Academy of Sciences. In 1959 scientists were criticised for their "isolation from life," and steps were taken to increase control over them.[65] With

[61]Until 1956 M. K. Tikhonravov headed the space research department at NII-4. (One of his assignments was to develop a reconnaissance satellite.) There were other departments and an aerodynamics laboratory. ("O Nauchno-tekhnicheskoi Deiatel'nosti Iu. A. Mozzhorina," Iz Istorii Aviatsii i Kosmonavtiki, pp. 6-7.)
[62]For Moskalenko, see Appendix 3.
[63]This was the first election to the Academy of Sciences since 1953. See Appendix 5.
[64]For G. I. Petrov, see Appendix 3.
[65]CIA, National Intelligence Estimate Number 11-6-59, p. 4.

regard to the space programme, these efforts appear to have had little effect. This is because space enthusiasts held key posts and controlled crucial commissions. Of primary importance in this regard was Academician M. V. Keldysh. As head of the Mathematical Institute of the Academy of Sciences (MIAN) and NII-1, Keldysh was supposed to be providing impartial analysis of both scientific and weapons projects. However, from 1948 on, Keldysh had discreetly, but systematically, thrown his support behind Korolev and his space ambitions. As a member of the Presidium of the Academy of Sciences and also Chairman of the Interdepartmental Commission on Spaceflight, Keldysh ensured that Korolev's proposals had the support of the scientific "experts."

The Academy of Sciences' Interdepartmental Commission on Spaceflight was especially important. When it came to developing satellites, it took on the responsibilities that would have been the duty of a Scientific-Technical Council in Stalin's time.[66] In those days, the Scientific-Technical Council under Special Commission 2 reviewed new proposals from missile designers and made recommendations on whether to approve their development.[67] The Academy of Sciences set up a body of its own to review proposals for instruments and the design of the first scientific satellite. It was not unreasonable for this Interdepartmental Commission on Spaceflight to assume responsibility for the scientific satellite programme as a whole after the success of Sputnik. This appears to be precisely what it did for the first few years of the space programme.

The space enthusiasts continued to gain power and influence in the Academy of Sciences as the institution was coming under increasing political pressure to contribute more to the development of the economy. In 1960 Keldysh was promoted to Vice President and Korolev won a position on the Presidium of the Academy of Sciences.[68] It is not clear if the political leadership intended these promotions to serve as an example, but Keldysh and Korolev had both made direct, tangible contributions to the Soviet Union, and Khrushchev.

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[66] See Appendix 7, sheet 1.

[67] In reality this authority was often usurped by higher political authorities, like Stalin. Yet this Scientific-Technical Council, along with Scientific-Technical Councils in the Ministries, did exercise its authority over numerous lower priority projects.

[68] Skriabin, Akademiia Nauk SSSR, Book 2, p. 61; and Bol'shaia Sovetskaia Entsiklopediia: Ezhegodnik 1961, Moscow: Sovetskaia Entsiklopediia, 1961, p. 68.

The State Commission for Spaceflight

The State Commission that had supervised the tests of the R-7 and launch of the first satellites underwent several remarkable changes during the first years of the space programme. Rather than representing the military "customer," this body became the co-ordinator and executor for satellite launches. This was a significant change of function for a weapons programme state commission. An institution originally intended as a tool to evaluate military research and development, it became the executor of space policy.

With the completion of the first satellite launches in early 1958 a new type of State Commission was created.[69] V. M. Riabikov remained a member of this organisation but, once again, he was demoted from the position of Chairman.[70] The Chairman of this "State Commission for Spaceflight" was Minister K. N. Rudnev, Chairman of the State Committee for Defence Technology (GKOT).[71] The State Commission for Spaceflight still included the chief designers, and representatives of the military. However, the defence industry was now represented by the Chairmen of the other defence industrial ministries/committees.[72] On the old State Commission for Spaceflight the defence industries had been represented primarily by deputy ministers. This was a significant increase in the governmental level of participant on the State Commission.

The reason for this change appears to lie in the broadening of the functions of the State Commission. One of the later Chairmen has stated that the State Commission took on "a range of co-ordination-directional functions" in its early years.[73] The context of this comment suggests that these functions had to be taken on because of the destruction of the

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[69]Asif Siddiqi, "Soviet Space Programme: Part 1 - Organisational Structure 1940s-1950s," Spaceflight, Vol. 36, No. 8, August 1994, p. 286.

[70]In 1958 Riabikov became a Deputy Chairman of the Council of Ministers of the RSFSR. Perhaps this explains the reduction of his duties on the State Commission for Spaceflight. (Bol'shaia Sovetskaia Entsiklopediia: Ezhegodnik 1966, Moscow: Sovetskaia Entsiklopediia, 1966, p. 610.)

[71]For the sake of clarity I have decided to refer to this institution as the State Commission for Spaceflight. This is a title, and distinction, not normally used by Soviet and Russian sources.

[72]These included: B. E. Butoma - Chairman, State Committee for Shipbuilding; P. V. Dementev - Chairman, State Committee for Aviation Technology; and V. D. Kalmykov - Chairman, State Committee for Radio and Electronics.

[73]B. Pokrovskii, "Tovarishch Predsedatel' Gosudarstvennoi Komissii!...'," Aviatsiia i Kosmonavtika, No. 11, November 1988, p. 43. The quote is attributed to K. A. Kerimov. For Kerimov, see Appendix 3.

ministerial system.[74] Numerous memoirs from the early period of the Soviet space programme also mention the role of the State Commission for Spaceflight in co-ordinating, creating and vetting proposals that were subsequently approved by the VPK.[75] This was an ad hoc solution to dealing with the problems caused by the Sovnarkhoz reforms and the creation of an industry that crossed bureaucratic boundaries. The bulk of the early space industry was concentrated in the GKOT, specifically in Korolev's design bureau, but the success of the space programme required the co-ordinated efforts of many other parts of Soviet society. Rather than creating a permanent, new, civilian institution as the Americans had, the Soviets relied on the State Commission for Spaceflight to run the space programme.

Design Bureaux and Policy

The Council of Chief Designers

As in the early years of the ballistic missile programme, the Council of Chief Designers played a significant role in the first years of the space programme. Since it held a monopoly on space expertise, just as it had a monopoly on missile expertise, the Council of Chief Designers was an effective way to control the space programme agenda. Working in concert with the Academy of Sciences' Interdepartmental Commission on Spaceflight (under Keldysh), Korolev was effectively able to propose and ratify his own ideas. After the launch of Sputnik, the Council was granted special rights to manage and develop the space programme.[76]

> "Its decisions practically determined the development of the technology of long range ballistic rockets and the opening of space at the beginning stage. The basic decisions of the Soviet government on these questions were a result of proposals, carefully thought out by the Council (of Chief Designers)."[77]

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[74]In the full quotation Kerimov comments that in 1965 the State Commission was "freed from a range of co-ordination-directional functions, which it took on itself, as it needed to, and were restored to branch ministries." Pokrovskii, "'Tovarishch Predsedatel' Gosudarstvennoi Komissii!...'," p. 43.

[75]This procedure is mentioned in General N. P. Kamanin's diaries. For example, see: N. P. Kamanin, "Takoe Bosl'she Nikogda ne Dolzhno Povtorit'sia!", Vozdushnyi Transport, No. 24, 1993, p. 12.

[76]G. Vetrov, "Trudnaia Sud'ba Rakety N-1," Nauka i Zhizn, No. 5, May 1994, p. 25.

[77]B. Chertok, "Lider," Aviatsiia i Kosmonavtika, No. 1, January 1988, p. 31.

However, the cleavages that had become evident in the missile programme during the mid-1950s came back to haunt the Council of Chief Designers after the first few successes.

OKB-1: Korolev

In late 1957 Soviet missile design was still dominated by one bureau: Korolev's OKB-1. This bureau had been directly responsible for the development of every Soviet ballistic missile, except Iangel"s R-14 (SS-4).[78] In fact, the entire missile industry, including Iangel"s design bureau, could trace its origins back to OKB-1. Yet Korolev had learned from the creation of Iangel"s design bureau that his personal monopoly over missile design was not likely to last. In the mid-1950s he had begun his own organisational "perestroika."[79] He set up new design bureaux under his junior subordinates, and created semi-independent subdivisions of OKB-1; giving them control of missile projects that were peripheral to his personal interests.[80] The most notable example of this is when he handed submarine-launched ballistic missiles (SLBMs) and the R-11 (SS-1B) design to the young V. P. Makeev.[81] As his missile programme grew, Korolev established a number of other branches throughout the Soviet Union, thus creating a huge, regionally diverse industry centred on his design bureau.[82]

As the missile "empire" around OKB-1 grew in the late 1950s, the design bureau itself took on more space work. Korolev had long been pushing for full control over all aspects of the satellite programme. The problems and delays in developing Object D (Sputnik 3) re-emphasised that spacecraft required as much design effort and co-ordination as the rockets that launched them. The long-range development of the space programme would require design teams dedicated to spacecraft as well as rockets. Korolev aimed to keep both of these essential functions of the space programme under his control.

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[78]The R-14 had only just begun tests in 1957.

[79]Chertok, "Lider," p. 41.

[80]B. Konovalov, "Ryvok k Zvezdam," Izvestiia, No. 274, 1 October 1987. See also Appendix 11, sheet 1.

[81]Makeev, barely 30 years old when his design bureau was established in Miias in 1955, was known at OKB-1 as "Pioneer." (A reference to the children's youth group.) (Ia. K. Golovanov, "Raketnyi Neptun," Nauka v Rossii, No. 4, July-August 1992, pp. 58-63.) For Makeev, see Appendix 3.

[82]It is not clear how much of this was a result of Khrushchev's order to Ustinov to disperse the weapons production industry.

In 1959 OKB-1 lost, or shed, three of its major missile projects. The development and production of Korolev's second generation ICBM, the R-9 (SS-10), was handed over to a new subsidiary set up in Krasnoiarsk-26.[83] This organisation, later known as OKB-10, was headed by a young Korolev protégé named M. F. Reshetnev.[84] Another affiliate of OKB-1 was set up in Kuibyshev, when the aircraft plant there was absorbed by OKB-1 to produce the R-7.[85] This Filial No. 3 was also assigned the task of modernising and improving the R-7.[86] Finally, Korolev's new solid fuel missile project was given to a special institute.

Thus, within two years of Sputnik, OKB-1 had basically become a space design bureau, rather than a missile design bureau. Design work at OKB-1 concentrated on the development of satellites, space probes, spacecraft, upper stages for the R-7, and more advanced manned spaceflight projects. While it is not clear that Korolev was personally responsible for this change, it is clear that this is what he wanted. Korolev had consistently lavished his energies on space projects, while missile work was shunted off to subordinates or other organisations. Although technically still a part of the defence industry (i.e. subordinate to the GKOT), OKB-1 devoted most of its attention to "Academy of Sciences" space research projects.

OKB-586: Iangel'

For a while, Korolev's pre-eminent place in missile design was assumed by M. K. Iangel'. With his very first independent missile project Iangel' displayed an ability to join new technology with operational considerations in a way that delighted his military customers. The R-12 (SS-4), first tested on 22 June 1957, was a huge hit with the

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[83]V. Khokhlov, "Interview with NPO PM Director Reshetnev," Vozdushnyi Transport, No. 40, 1994, p. 6, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-94-008, 28 December 1994, pp. 37-39; and S. Golotyuk, "After Thirty Years and Thousand Satellites," Russian Space News (in English), No. 17, August 13-26 1994, pp. 27-28.
[84]Sergei V. Golotyuk, "Academician Mikhail F. Reshetnev, Director General of the Research and Production Association of Applied Mechanics," Space Bulletin, Vol. 1, No. 1, 1993, pp. 27-29.
[85]Christian Lardier, L'Astronautique Sovietique, Paris: Armand Colin, 1992, p. 103. It is worth noting that Kuibyshev (now once again known as Samara) was Ustinov's home town.
[86]Mozzhorin and Eremenko, "Ot Pervykh Balisticheskikh do...," August 1991, p. 34.

military.[87] Most importantly, the R-12 used storable hypergolic propellants which, although highly toxic, did away with the need for liquid oxygen.[88] This meant that the bulky equipment and slow fuelling times associated with Korolev's missiles were a thing of the past. Not only could the R-12 be driven to a launch site and prepared for launch in four to six hours[89], but it could then stay fuelled and ready for an extended period.[90] From the military commander's point of view this type of missile was infinitely superior to Korolev's current project; the huge, immobile, slow, and highly vulnerable R-7.

Iangel''s missiles also won the approval of industrial and political leaders. The R-12 (SS-4) tests were so successful that it was accepted into the inventory within a year of the first test, by March 1958.[91] In July 1958, the R-14 (SS-5), formally got under way with a Council of Ministers decree.[92] The draft project (EP) on this improved missile was completed by the end of the year. Iangel' also continued missile work for the Navy.[93] But, more importantly, Iangel''s ICBM design came to Khrushchev's attention in mid-1958. On 28 August 1958, a new government decree was issued calling for the completion of the R-16 (SS-7) "in the shortest possible period."[94]

By mid 1959, Iangel' had displaced Korolev as Khrushchev's favourite missile designer. After the success with the R-12 (SS-4) Khrushchev came "to believe decisively in Iangel'."[95] The 19 May 1959 decrees on Korolev's R-9 (SS-10) and Iangel''s R-16 (SS-7) appear to have formally made OKB-1 and OKB-586 competitors to produce the second

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[87]Not much bigger Korolev's R-2 (SS-2), the R-12 had nearly three times the range and was designed to carry a nuclear warhead (unlike the R-2).

[88]Hypergolic propellants ignite spontaneously when mixed together.

[89]American analysts pointed out that such mobility was "a basic Soviet design consideration" for missiles. (US Central Intelligence Agency, National Intelligence Estimate Number 11-5-59: Soviet Capabilities in Guided Missiles and Space Vehicles, (Top Secret) Washington DC, 3 November 1959, as declassified by the CIA Historical Review Program, (date of declassification not shown), p. 18.)

[90]The R-12 was not exactly unobtrusive, requiring some 20 vehicles and trailers, but it was mobile.

[91]V. Pappo-Korystin, V. Platonov, and V. Pashchenko, Dneprovskii Raketno-Kosmicheskii Tsentr, Dnepropetrovsk: PO Iuzhnyi mashinstroitel'nyi zavod and KB Iuzhnoe, 1994. The R-12 became the basic intermediate range (2000 km) missile in the Soviet inventory. In 1963, it was the primary weapon planned for deployment to Cuba.

[92]The 2 July 1958 decree called for the R-14 to have twice the range of the R-12 (i.e. 4000 km), and be ready for flight-design tests by April 1960. (Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 61.)

[93]The R-15 naval missile was supplanted by the R-21 (possibly SS-N-6) in December 1958. (Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 62.)

[94]Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 62.

[95]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 432

generation of ICBM.[96] Khrushchev paid a personal visit to Dnepropetrovsk in summer 1959.[97] As with the January 1956 visit to OKB-1, Khrushchev's visit to Iangel''s bureau made a huge impression. In 1960 work on Korolev's R-9 (SS-10) was curtailed and the facility that was to produce it was directed to switch its efforts to production of Iangel''s R-14 (SS-5).[98] Iangel' also challenged Korolev's early solid fuel missile project by beginning research on his own solid fuel missile in November 1960.[99]

In 1960 Iangel' also began work on space projects. A Central Committee and Council of Ministers decree dated 8 August 1960 authorised Iangel' to convert his R-12 (SS-4) missile into a space booster and also to develop ten small satellites.[100]

> "When it became evident that small satellites would have advantages over large satellites for solving many scientific and defence problems and that it would be wasteful to launch them with the R-7, planning-design development work for them was transferred from OKB-1 to OKB-586."[101]

However, it does not appear that Iangel' initiated this project.[102]

Although Iangel' was a favourite of the military he never developed the type of close relationship with Khrushchev that Korolev had enjoyed. This appears to be the result of a number of factors. One of these was simply physical proximity. Iangel''s design bureau was located in Dnepropetrovsk, far from Moscow. His poor health probably restricted his ability to travel.[103] However, a more basic factor appears to be that Iangel' and Khrushchev did not "hit it off." This may have been a result of Iangel''s closeness with the military, or it could simply have been something personal.[104]

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[96]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 431.
[97]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 431-2.
[98]The facility in question was Korolev's Filial No. 2 in Krasnoiarsk. (Golotyuk, "After Thirty Years and Thousand Satellites," p. 28.)
[99]Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 66.
[100]Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 65.
[101]Iu. V. Biriukov, "Vladimir Fedorovich Utkin: k70 letiiu so dnia rozhdeniia," Zemlia i Vselennaia, No. 3, May-June 1994, pp. 45-50, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-94-007, 5 October 1994, pp. 13-16.
[102]The circumstances suggest that this project was advocated by Ustinov, or other leaders associated with the GKOT.
[103]Iangel''s widow noted that he was hospitalised for heart trouble in February 1958, and even Khrushchev mentioned Iangel''s poor health in his memoirs. (Irina V. Strazheva, Tiul'pani s Kosmodroma, Irkutsk: Vostochno-Sibirskoe Knizhnoe Izdatel'stvo, 1986, p. 258; and Nikita S. Khrushchev, Khrushchev Remembers: The Last Testament, ed. and trans. by Strobe Talbott, Boston: Little, Brown & Co., 1974, p. 50.)
[104]Iangel' was a chain smoker and Sergei Khrushchev hints that this may have been a point of irritation for his father (who did not smoke). (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 391.)

Another factor that hampered Iangel''s advancement later in this period was the missile disaster that killed Marshal Nedelin on 24 October 1960. It was Iangel''s R-16 (SS-7) that exploded on Baikonur pad Number 41, killing Marshall Nedelin and over one hundred other technicians and engineers.[105] Iangel' himself was saved only because he, and several others, had stepped into a specially shielded smoker's chamber to have a cigarette.[106] Whether this disaster had a direct effect on Iangel''s relationship with Khrushchev is not known. However, beside killing the military's most ardent supporter of missiles (Nedelin), the disaster had at least two direct effects on Iangel'. First, Iangel' was troubled by guilty feelings about the accident for the rest of his life.[107] Second, the accident raised questions about the wisdom of using hypergolic propellants like nitric acid. This made Korolev's objections to using "the devil's brew" seem almost prophetic.

OKB-52: Chelomei

By mid-1960 Khrushchev was cultivating a new favourite missile designer - V. N. Chelomei. Chelomei had already won Khrushchev's favour once, in 1955, but in 1958 he managed to open a permanent channel of communication to the leader. After learning that Khrushchev's son Sergei was about to graduate from an engineering programme, Chelomei wooed him with promises of opportunities to work on revolutionary new projects.[108] The younger Khrushchev began to work for Chelomei as a guidance and control specialist on 8 March 1958.[109]

After hiring Sergei Khrushchev, Chelomei made a spectacular climb out of obscurity. He was one of the only aviation designers to advance into the Academy of Sciences in the June 1958 elections, becoming a corresponding member.[110] In the first half

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[105] M. Rebrov, "The Difficult Path to April 1961, or Why We're Not Finding Out the Entire Truth About the Flight of Iu Gagarin Until Today," Krasnaia Zvezda, 28 March 1992, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-92-004, 10 June 1992, p. 8.

[106] Chief Designers Iangel' and V. I. Kuznetsov (gyroscopes), and deputy head of military administration for missiles (GURVO) General A. G. Mrykin were among those so protected from the flames. (Khrushchev, Khrushchev Remembers: The Last Testament, p. 51; and Lardier, L'Astronautique Sovietique, p. 96.) For Mrykin, see Appendix 3.

[107] S. N. Khrushchev, Krizisy i Rakety, Vol. 2, p. 87.

[108] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 362

[109] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 373.

[110] Skriabin, Akademiia Nauk SSSR, Book 2, p. 96.

of 1959 his P-5 missile was accepted into the inventory and he won the Hero of Socialist Labour and the Lenin Prize for it.[111] Later in the year he was awarded the title of General Designer of Aviation Technology.[112]

Suddenly Chelomei's projects extended well beyond naval missiles. One of his first new assignments was to develop an anti-ballistic missile (ABM).[113] First Secretary Khrushchev not only mentions Chelomei's involvement in ABM design in his memoirs, but admits to favouring him over his competitor.[114] Chelomei's pre-eminence in the GKAT was now such that he was able to impose a pet project of his own on two other aviation design bureaux (Miasishchev and Sukhoi) even though this project turned out to be "completely infeasible."[115]

Chelomei's ambitions led him directly to the fields that were growing most rapidly; ballistic missiles and space. It appears that Chelomei began preliminary design work on a series of ballistic missiles around 1958. Sergei Khrushchev suggests that Chelomei's interest in space projects began in earnest in 1959. More specifically, he states that it was his father's presentation of the Luna "pennants" to Eisenhower in September 1959 that precipitated Chelomei's interest in space projects.[116] Chelomei tried to get an audience with Khrushchev to talk about his space and missile proposals, but was unsuccessful.[117] In early April 1960, Chelomei and a number of others met with Khrushchev to discuss naval weapons and how to improve their accuracy.[118] Chelomei took this opportunity to make his space and missile proposals.

Chelomei's proposals at the April 1960 meeting served as the beginning of a number of new space and missile projects. According to Sergei Khrushchev, Chelomei's primary

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[111] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 459.
[112] N. N. Bogoliubov, et al., eds., V. N. Chelomei: Izbrannye Trudy, Moscow: Mashinstroenie, 1989, p. 13.
[113] Lardier, L'Astronautique Sovietique, pp. 92 & 158.
[114] Nikita S. Khrushchev, Khrushchev Remembers: The Glasnost Tapes, ed. and trans. by Jerrold L. Schecter, London: Little, Brown and Company, 1990, p. 188. (Khrushchev identifies the competitor as Kisunko.)
[115] Lardier, L'Astronautique Sovietique, p. 152. Miasishchev refused to work with Chelomei after this.
[116] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 474.
[117] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 484-5.
[118] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 485-94.

goal was to get authorisation to build a manned "space-plane."[119] But, during the April meeting Chelomei made three proposals for immediate projects.[120] First, he proposed the creation of a space-based ocean reconnaissance satellite.[121] Second, he proposed building a manoeuvrable satellite called "Polet." Chelomei intended this as a step toward building his "space-plane." Finally he proposed the development of his own series of "Universal Rockets," that could be used as both missiles and as launchers for his space projects. The "Universal Rocket" name was even incorporated into the designations of his rocket designs; all of which were known as "UR" followed by a numerical designator.[122] Khrushchev was wary of the "space-plane" idea, but apparently agreed to "Polet" as an anti-satellite system.[123] Khrushchev also sanctioned the other systems.

In order to design and build his "Universal Rockets" Chelomei needed more designers and facilities. With the backing of Minister P. V. Dement'ev, head of the GKAT, Chelomei annexed Miasishchev's design bureau and its associated factory as Filial No. 1 in 1960.[124] The entry of Chelomei and the aviation industry (GKAT) into the missile business was strongly opposed by some military leaders, (notably Marshal Nedelin) and the existing missile industry (GKOT), (especially its "founder" D. F. Ustinov).[125] Khrushchev overruled the objections and deliberately set up Chelomei as a competitor to the existing missile and space industry.[126] These decisions were implemented by a joint decree of the Central Committee and Council of Ministers dated 23 June 1960.[127]

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119 S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 481.

120 He also made proposals on a number of longer-term projects.

121 This was what is now known as a RORSAT, Radar Ocean Reconnaissance SATellite.

122 Theoretically his family of rockets would be easier and cheaper to develop since each was to be the building block for the next. (Dmitri Khrapovitskii, "Absolutely Unclassified: The Ground Waves of Space Politics," Soiuz, No. 15, April 1990, p. 15, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-90-005, 26 November 1990, pp. 85-7.)

123 This project appears to have been developed in parallel with a US programme known as SAINT, a SAtellite INTerceptor, which was discussed by the US leadership in early 1960 and approved later in the year.

124 S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 493. This move resulted in the cancellation of all of Miasishchev's aircraft projects. (See Appendix 11, sheet 1.) For Dement'ev, see Appendix 3.

125 S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 495.

126 See N. S. Khrushchev's comments about the advantages of competition in the missile industry in S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 486 and 492.

127 G. Vetrov, "Trudnaia Sud'ba Rakety N-1," May, p. 23.

The Anonymity of the Space Designers

Before moving on to the details about policymaking in specific space and missile programmes it is necessary to review one other aspect about the chief designers involved in the space programme - their anonymity. It is interesting to note that Korolev was a fairly public figure prior to Sputnik. He had published a number of articles and books, and even as late as September 1957, his name appeared in Pravda.[128] Yet, his first Pravda article after Sputnik appeared under the pseudonym Professor K. Sergeev.[129]

After Sputnik all of the key technical leaders of the space programme disappeared behind a veil of grand titles and pseudonyms. Publicly, Korolev was known only as "The Chief Designer of Spacecraft." V. P. Glushko was only identified as "Chief Designer of Rocket Engines," although he too was allowed to publish articles under a pseudonym - Professor G. V. Petrovich. M. V. Keldysh was too well-known a figure to disappear, but his role was obscured by the title "Chief Theoretician of Spaceflight." In fact Keldysh was so successful in concealing his direct involvement in the space programme that for many years no one suspected that he and the "Chief Theoretician of Spaceflight" were one and the same.[130]

Khrushchev bluntly asserted, both at the time and in his memoirs, that the reason for this secrecy was to protect the designers from Western governments.[131] Yet the threat of Western agents had not prevented Khrushchev from allowing the names of prominent aircraft designers from being known. Nor had this fear prevented him from bringing I. V. Kurchatov, the chief scientist in the Soviet nuclear programme and close collaborator of

[128] His speech at the Tsiolkovskii Centennial on 17 September 1957 was published in Pravda. (M. V. Keldysh, ed., Tvorcheskoe Nasledia Akademika S. P. Koroleva, Moscow: Nauka, 1980, p. 375.)
[129] Professor K. Sergeev, "Issledovanie Kosmicheskogo Prostranstvo," Pravda, 10 December 1957. (Reproduced in Keldysh, Tvorcheskoe Nasledia Akademika S. P. Koroleva, p. 387.)
[130] Even after the identities of the other two Chief Designers had been correctly established by Western correspondents in Moscow in 1963, the identity of the Chief Theoretician eluded them. In his otherwise remarkably accurate 1972 book, Nicholas Daniloff speculates that the Chief Theoretician might be M. K. Tikhonravov. (See: Daniloff, The Kremlin and the Cosmos, p. 82.)
[131] For example see: Khrushchev, Khrushchev Remembers: The Last Testament, pp. 59-60; and his July 1958 speech in Germany as cited in Albert Parry, The New Class Divided: Russian Science and Technology Versus Communism, London: Collier-Macmillan Ltd., 1966, pp. 112-113.

Korolev, to Britain with him in 1956.[132] Clearly there was more to the secrecy, than fear of Western kidnapping or assassination.

The secrecy policy probably served a number of purposes. From Khrushchev's perspective, it was an excellent way to focus the credit for space spectaculars on himself. However, the traditional secrecy practices in the defence industry were certainly another factor in favour of this policy. Although aviation designers had been long been identified with their aircraft, this was the exception in the Soviet weapons industry. Even the most basic facts about the weapons business, like the names of factories and their locations, were highly classified secrets. The space programme was part of the missile industry, and no other missile industry designers had been publicly identified. To allow the leaders of one of the most important defence industries to become public figures was something the security organs would have strongly protested.[133]

Another important advantage of the anonymity policy was that it allowed the government to disassociate the visionary dreams of the space advocates from the national space programme. It was acceptable to have the unknown Professors Sergeev and Petrovich call for manned missions to Mars and the colonisation of the solar system. To allow the leading figures of the space programme to publicly advocate such a highly controversial policy was apparently unacceptable. Thus, secrecy for the designers was a double-edged sword. On the one hand it kept them from earning the public acclaim that they would have liked, and certainly deserved. On the other hand, it gave them the opportunity to advocate their long-range plans publicly, albeit under pseudonyms.

The Early Unmanned Space Programme

A great mythology has grown up around early Soviet space programme decisions that has yet to be fully dispelled by revelations from the participants or archives.

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[132]Kurchatov not only accompanied Khrushchev to London, but was allowed to visit various British research facilities with minimal escort. In addition, the legendary aviation designer A. N. Tupolev and his daughter also accompanied Khrushchev on this trip. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 134-150.)

[133]In this respect, Kurchatov's unusual visit to Britain in 1956 may well have contributed to the tightening of restrictions on other weapons scientists. Kurchatov went well beyond his brief and unilaterally "de-classified" Soviet fusion research on his visit to the British nuclear research site at Harwell. (David Holloway, Stalin and The Bomb, New Haven: Yale University Press, 1994, pp. 360-2.)

Nonetheless, it is possible to piece together Soviet space policy with the evidence that is now available. The decisions to launch Sputniks 2 and 3, and the moon and planetary probes, reveal that the early Soviet space programme was actually a series of discrete, limited projects. The development of these projects sheds considerable light on the beginning of the manned space programme.

It was no surprise that Korolev had other satellite projects in mind after Sputnik, and the authorisation to carry out at least one of them, but making Sputnik 2 a crash project was an unexpected development. The Central Committee and Council of Ministers decree of January 1956, calling for the launch of Object D (later Sputnik 3), was still in effect. In January 1957 Korolev had also been allocated two R-7s and the authority to develop his two "simple satellites." However, it appears that the second "simple satellite" was primarily considered as insurance against the failure of the first. Although Korolev had laid the groundwork for PS-2 during the summer of 1957, it was far from ready for immediate spaceflight.[134] There does not appear to have been any clear launch schedule for PS-2 and the leadership of OKB-1 was not expecting an immediate effort. Korolev's top deputies had gone directly on holiday after Sputnik.[135] They were stunned to have their long-overdue rest cut short by orders to return to Moscow for another crash programme.[136]

> "It was done in so much of a hurry that there was never any time to design Sputnik 2. It was built from sketches alone."[137]

It has long been speculated that Khrushchev was so taken by the world-wide reaction to the first Sputnik that he demanded an even bigger spectacle to celebrate the anniversary of the Revolution the next month. However, Sputnik 2 was Korolev's idea.[138] Korolev certainly had more to gain from a quick, successful launch than Khrushchev. The first Sputnik had been more than sufficient to prove the point that the Soviets had extremely

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[134]David Easton Potts, Soviet Man in Space: Politics and Technology from Stalin to Gorbachev, Volume 1, Ph.D. dissertation, Georgetown University, June 1992, p. 126.
[135]Brian Harvey, "'I Was Last to Touch the Sputnik'," Spaceflight, Vol. 33, No. 1, January 1991, p. 17.
[136]A. Tarasov, "Polety vo Sne i Naiavu," Pravda, 20 October, 1989. (In this interview, Korolev's deputy, Vasilii Mishin, says that Korolev called his deputies back to Moscow five days after they had arrived at Bulganin's dacha in the Crimea.)
[137]Harvey, "'I Was Last to Touch the Sputnik'," p. 17.
[138]S. A. Afanas'ev, later Minister of the missile and space industry, says categorically that Sputnik 2 was Korolev's idea - not Khrushchev's. (N. Tarasenko, "Ekonomika Kosmosa: Dostizheniia, Problem, Perspektivy," Ekonomika i Zhizn, No. 16, April 1991, pp. 6-7.)

powerful missiles with the ability to loft large payloads over substantial distances. Thus the Soviet Union stood to earn only marginal strategic gains from the rapid launch of a second satellite.

Korolev, however, had everything to gain. If he succeeded, it would not only boost his prestige and authority, but would imply that the Soviet Union had a robust, well-developed space programme, oriented toward human spaceflight. It might then be more difficult for Khrushchev to reject his further space launch proposals for fear of appearing to abandon the programme. The press releases for the first Sputnik (written at the behest of Korolev) already implied that it was not a "one-off" spectacular; a quick second launch would give the programme even more momentum.[139] It appears that Korolev himself volunteered to quickly produce another space miracle and won Khrushchev's support.

There was a relatively long pause before the third Soviet satellite, but this was the result of technical difficulties rather than any specific leadership decision. The launch of this satellite had been authorised two years earlier in the 30 January 1956 decree. Object D, the original "orbital laboratory" was not ready for launch until April 1958. The first attempt to launch it, on 27 April 1958, failed.[140] Finally, on 15 May 1958, the backup copy of Object D was successfully launched as Sputnik 3. The satellite was apparently not a complete success.[141] After this, the Soviet Union abandoned non-manned programme earth-orbital satellites.

The new direction for the unmanned programme was again initiated by Korolev. In December 1957 he had finished the draft project (EP) for a three stage version of the R-7 that could be used to send a probe to the moon.[142] On the basis of this design he made a

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[139]Andrei Sakharov noted that Korolev was not only devoted to Tsiolkovskii's dreams of spaceflight, but that he was "...possibly a bit more cunning, ruthless, and cynical than Kurchatov" (the chief nuclear scientist). (Sakharov, Memoirs, p. 177.)

[140]Timothy Varfolomeyev, "Soviet Rocketry that Conquered Space: Part 1: From the First ICBM to Sputnik Launcher," Spaceflight, Vol. 37, No. 8, August 1995, p. 262.

[141]According to Roald Sagdeev, the tape recorder system, designed to store the instrument measurements and then transmit them when the satellite passed over the Soviet receiving station, malfunctioned. This meant that the Soviets could only get readings from the satellite as it passed overhead. (Roald Z. Sagdeev, The Making of a Soviet Scientist: My Adventures in Nuclear Fusion and Space from Stalin to Star Wars, New York: John Wiley & Sons, 1994, pp. 156-8.)

[142]T. Varfolomeev, (untitled letter to editor), Novosti Kosmonavtika, No. 26, 18-31 December 1993. On the R-7, the strap-on side boosters were considered the first stage, the core booster (the part that remained attached to Sputnik 2) was called the second stage. The third stage was placed atop the second stage.

presentation to the government in January 1958 about his programme for exploring the moon.[143] This proposal was met with "long and heated fights."[144] Subsequent events suggest that the objections came primarily from Khrushchev's remaining opponents and, perhaps, the military.[145] In the end Korolev's lunar proposal was accepted.[146]

The personal support of Khrushchev was undoubtedly the key to winning approval for the Luna programme, but there were other contributing factors. The Luna programme had the solid support of the experts. There may have been opposition within the defence industry, but the head of the VPK (Ustinov) and the new leader of the GKOT (Rudnev) stood to gain from the programme and were allies of Korolev. All of the leading designers of the R-7, as members of the Council of Chief Designers, also supported the proposal. A similar situation held in the Academy of Sciences. There might have been objections to the Luna programme within the Academy, but the Interdepartmental Commission on Spaceflight, under Academician Keldysh, was full of believers in Tsiolkovskii's vision of spaceflight. Even if some of them would have preferred more emphasis on science over theatrics, they probably found the Moon an enticing target. From Khrushchev's perspective, the solid expert support for the proposal would have made it easier to override the objections to a (still) modest programme that promised yet more spectacular international political gains.

Once the Luna programme was approved, construction work began immediately. In January 1958, Korolev requested two different engine designers, V. P. Glushko and S. A. Kosberg, to build the engine for the new R-7 third stage.[147] The Luna probes themselves were built in OKB-1 during the first half of the year. The probes came in two major varieties.[148] One was a fairly simple instrument package designed to hit the moon and

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[143] M. Rudenko, "'Malen'kii Shag Odnogo Cheloveka...' Khronika Neizvestnoi Kosmicheskoi Zhizni," Vozdushnyi Transport, No. 29, 1994, p. 8. Unfortunately this source does not identify the group that Korolev was speaking to, only "pravitel'stvu" (to the government).
[144] M. Rebrov, "Gorod Koroleva," Rossiiskaia Gazeta, 22 September 1992.
[145] e.g., at the time, Bulganin was still Chairman of the Council of Ministers and a member of the Presidium.
[146] It is not clear which, if any, other spaceflight proposals were discussed or approved at this time.
[147] Asif Siddiqi, "Soviet Space Programme: Part 2 - Organisational Structure in the 1960s," Spaceflight, Vol. 36, No. 9, September 1994, p. 317. For Kosberg, see Appendix 3. The third stage for the R-7 may have begun as a military project, to make the missile meet its original range requirement.
[148] Lardier, L'Astronautique Sovietique, p. 113.

scatter a number of metal "pennants" on the lunar surface. The other was a much more complex device designed to provide the first photographs of the moon's hidden side.

As 1958 wore on, the Luna programme took on added significance. Despite the perception of American incompetence in space, the US programme was much broader and more robust than its Soviet counterpart. Although unable to match the sheer size of Soviet satellites, the US launched a much wider variety of them, on a number of different booster rockets.[149] After Sputnik 3, the Soviet unmanned programme consisted solely of the modified R-7 and the two types of Luna probe. In order not to be outdone by the US, the Luna programme had to succeed, quickly.

Launch attempts for the Luna programme began in September 1958.[150] After three launch failures the fourth attempt made it into space.[151] However, Luna 1, launched on 2 January 1959, failed to deliver the "pennants" to the moon.[152] Luna 2, timed to support Khrushchev's first visit to the United States, finally succeeded with this mission in September.[153] The second variety of moon probe was successfully launched a month later as Luna 3. This provided spectacular photographs of the unseen face of the moon.

After having achieved its initial political and scientific objectives the Luna programme fell on hard times. At a meeting in December 1959 the early Luna programme failures were blamed on Korolev.[154] In March 1960, Korolev's request for approval of a new series of Luna probes was rejected by the Central Committee.[155] In his request Korolev had cited the threat of the proposed US Ranger moon probes as an incentive to accelerate his effort, but this time the use competition with the West was ineffective. The

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[149]By the end of 1958 the US had launched satellites for four separate programmes: Explorer, Vanguard, Pioneer (lunar), and Score (communications). These were launched on five rockets: The Jupiter C (Explorer), Vanguard (Vanguard), Thor-Able (Pioneer), Juno II (Pioneer), and Atlas B (Score).

[150]Some Western sources have suggested that the first Luna attempts came as early as May 1958. However, the upper stage needed for the Luna mission was not ready until September. (A. Poluektov, "A 'Hunt' for the Moon," Selskaia Zhizn, 5 April 1991, p. 4, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-91-004, 20 September 1991, p. 77.)

[151]See Appendix 12.

[152]The probe missed the moon by 5,500 kilometres. Sergei Khrushchev points out that Luna 1 was considered a failure at the time. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 473.)

[153]Sergei Khrushchev states that the launch was delayed to have a greater political impact, but claims that this was not the usual practice at the time. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 473.)

[154]M. Rudenko, "'Mne Pokazalos', Chto Nachalas' Tret'ia Mirovaia...'," Moskovskii Komsomolets, 15 July 1994, p. 4.

[155]Korolev's letter to the Central Committee was dated 23 March 1960. (Lardier, L'Astronautique Sovietique, p. 116.)

failure of the next two Luna launches, on 15 and 16 April 1960, was the death knell for this programme.[156] After this the Soviet unmanned space programme abandoned lunar exploration until 1963. Instead, they turned to a series of even more spectacular flight attempts to Mars and Venus.

Although unknown at the time, the Soviet planetary programme began in 1960. Whether this was one of Korolev's ideas, or whether it originated elsewhere, is not known. However, this turned into another crash programme. It was timed to take advantage of a "launch window" to Mars during Khrushchev's 1960 visit to the United Nations.[157] The first launch was scheduled for 26 September 1960 but had to be postponed because the spacecraft was not ready.[158] Two attempts to launch the Mars probe, on 10 and 14 October, both failed to reach earth orbit.[159]

Shortly after the "launch window" to Mars closed, a "window" to Venus opened. Two more of the same type of spacecraft were readied.[160] The first Venus probe, launched on 4 February 1961, got stuck in earth orbit and was called a "heavy satellite" (Sputnik 7 in the West). The second launch, on 12 February, was slightly more successful. Venera 1 left earth orbit and eventually passed by Venus.[161] However, the Soviet Union lost radio contact with the probe long before it reached its target. Korolev's planetary programme was not off to an auspicious start. In any case, the planetary programme would have to wait until the end of 1961 for the next launch window (to Mars) to open.

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[156] It has been reported that these Luna probes were to have marked Khrushchev's birthday (17 April). (Lardier, L'Astronautique Sovietique, p. 116.)

[157] Since the planets of the solar system orbit the sun at different speeds, they are only closely aligned for relatively short periods. Launching during these "windows" allows for a much more efficient and speedier trip to our neighbouring planets. There is a launch window to Venus approximately every 19 months, and to Mars every 13 months.

[158] Lardier, L'Astronautique Sovietique, p. 118.

[159] Khrushchev had reportedly brought models of the Mars probes with him to the UN. (Walter A. McDougall, ...The Heavens and the Earth: A Political History of the Space Age , New York: Basic Books, 1985, p. 242.) McDougall suggests that Khrushchev's frustration with these failures contributed to the infamous shoe-banging incident at the UN.

[160] Lardier, L'Astronautique Sovietique, p. 118.

[161] Part of the booster rocket was left in earth orbit. The Soviet Union called this another "heavy satellite." In the West it was known as Sputnik 8.

The ICBM Programme

Developments in the ICBM programme immediately after Sputnik had a huge impact on the course of the Soviet space programme, especially for Korolev. Plans for a major deployment of R-7 ICBMs went ahead rapidly until mid-1958. Then, two events undermined Khrushchev's trust in the missile industry in general, and Korolev in particular.

The first event began in mid-1958 when the R-7 ICBM programme came to a sudden halt. That spring, Ustinov and Nedelin had finalised plans to install "tens" of R-7 launch sites around the Soviet Union.[162] Shortly after this R-7 ICBM flight tests were completely stopped and work on the first operational launch site at Plesetsk was halted.[163] Plans for the third launch site, reportedly near Krasnoiarsk, were cancelled before work even began.[164] Although tests of the R-7 ICBM resumed in March 1959, the planned deployment was sharply curtailed. The missile was not formally accepted into the inventory until January 1960. Instead of "tens" of launch sites, only the site at Plesetsk (with two launch pads) was put into service.[165]

There were a number of reasons why the R-7 ICBM programme was so stunningly curtailed - one of these was resistance by governmental opponents to the programme. A major problems with the R-7 was finding someone to build it. OKB-1 did not have the facilities to mass-produce the missile. It made the most sense to build a missile like the R-7 in aviation factories.[166] But Ustinov realised that, even as head of the VPK, he would have a hard time getting the aviation industry to agree to build "his" missile. He insisted that Khrushchev personally initiate the conversion of aviation factories to R-7 production.[167] Brushing aside the objections of the Chairman of the GKAT, Khrushchev ordered the Kuibyshev Aviation Factory be converted to R-7 production.[168] However, this change led Khrushchev to an unpleasant confrontation with aviation designer A. N. Tupolev, whose

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[162] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 380.
[163] Lardier, L'Astronautique Sovietique, pp. 94-5.
[164] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 384.
[165] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 384. The first launch pad at Plesetsk was completed in 1959 and the second in 1961.
[166] The large cylindrical shape of the R-7 had much more in common with aircraft than with artillery or tanks.
[167] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 380.
[168] The Chairman of the GKAT at the time was Minister P. V. Dement'ev.

bombers were being produced at this factory.[169] Although Khrushchev held his ground, it was painfully apparent that the aviation industry was opposed to the R-7, and Ustinov's monopoly on the missile industry.

The military added to these problems by insisting that the R-7 meet certain operational requirements. The General Staff successfully asserted that the lengthy fuelling and preparation process of the R-7 was unacceptable. They set the condition that such a missile would have to be continuously fuelled at all times, so that it could be launched before the enemy could destroy it.[170] However, the guidance system of the R-7 was not designed to be kept in such a constant state of readiness. Even if this problem could be overcome, the missile would require a liquid oxygen production and pumping plant nearby each launch site in order to continuously replenish the oxidiser as it boiled away.[171] Military leaders also objected to the limited range of the R-7.[172] Even if all of the proposed launch sites had been built, only the northern and coastal parts of the United States could have been targeted.[173] However, the military was overruled on this latter point.

Khrushchev was less concerned with the limited number of targets than he was with the tremendous costs now involved in the deployment.[174] Ustinov and Nedelin had taken the military objections into account when they developed the R-7 deployment plan. When Khrushchev was presented with this plan, in early May 1958, he was stunned. He had thought the R-7 would be a cheap deterrent.[175] To deploy it, even on a small scale, while satisfying military criticisms turned out to be outrageously expensive.

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[169] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 380.

[170] Given the proximity of Western air and missile forces in Europe, this was an important consideration.

[171] Petr Kapitsa, the physicist renowned for his lack of involvement in the nuclear weapons programme, proposed a design for just such liquid oxygen plants to Khrushchev. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 381.)

[172] Korolev had promised Khrushchev that the R-7 would have a range of 8,000 km. The first models did not achieve this goal.

[173] Sergei Khrushchev states that the main targets were to be large population centres: New York, Washington DC, Chicago, and Los Angeles (the latter two to be targeted from launch sites yet to be built). (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 384.)

[174] His son Sergei insists that Khrushchev was a lifelong believer in minimal deterrence - that only a few ICBMs would be sufficient to dissuade the US from attacking the USSR. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 384.)

[175] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 380.

Having based much of his legitimacy in weapons decisions on the remarkable successes of Korolev's missile designs, Khrushchev now hoped that the designer could provide an easy solution to the problems with the R-7. Recalling that Korolev's R-11 (SS-1B) missile had been converted from liquid oxygen and kerosene to hypergolic propellants, Khrushchev asked him to do the same with the R-7.[176] Korolev categorically refused. Claiming that it was not possible to make a sufficiently powerful engine using nitric acid, Korolev reportedly said: "It is impossible to imagine anything better now."[177]

Korolev offered two alternatives: his R-9 (SS-10) and solid fuel ICBMs. The R-9 would be significantly lighter and more capable than the R-7, but it still relied on liquid oxygen and would not be ready for a number of years.[178] Solid fuel missiles, such as the Americans were developing, would take even longer, since they would require the creation of a whole new chemical industry. According to Korolev there was no easy alternative to the R-7. With characteristic bluster he added that Chief Designer Glushko would confirm his opinion that a powerful engine based on hypergolic propellants like nitric acid was impossible.

Unfortunately for Korolev, Khrushchev decided to check with Glushko. He found out that the engine designer believed precisely the opposite. Having been continually frustrated by attempts to build high-thrust liquid oxygen/kerosene engines, Glushko had already turned his attentions to more exotic fuels.[179] He told Khrushchev that a hypergolic ICBM was not only possible, but that Iangel' had already designed one.[180] This was Iangel''s R-16 (SS-7), which had been authorised by the Council of Ministers in December 1956.[181] The draft project (EP) for Iangel''s ICBM had subsequently been approved by a "special governmental expert commission" under the chairmanship of M. V. Keldysh in January 1958.[182]

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[176]The R-11 conversion had been done in 1953 or 1954, while Iangel' was head of NII-88. See Chapter 4.
[177]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 382.
[178]Due to engine development problems the R-9 was never deployed.
[179]G. Vetrov, "Trudnaia Sud'ba Rakety N-1," April, pp. 79-80. According to Vetrov, Glushko believed that hypergolic fuels were the wave of the future and that the Soviet Union must develop them to maintain its lead in large engine design.
[180]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 385.
[181]i.e. before Khrushchev became Chairman of the Council of Ministers.
[182]Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 61.

Khrushchev met with Iangel' and Glushko to talk about the R-16. Iangel' assured Khrushchev that with enough resources the development problems could be overcome quickly, and his missiles could be turned out on a production line "like sausages."[183] Khrushchev told Ustinov to prepare a government decree allocating to Iangel' the buildings, laboratories and housing that he said would be needed.[184] A decree accelerating work on the R-16 was issued on 28 August 1958.[185]

Yet, Khrushchev was wary of these new demands from the relatively unknown Iangel'. At some later point, perhaps in Spring 1959, he decided to check again with Korolev.[186] Unexpectedly, Korolev did not attack Iangel's proposal. He suggested instead, that if the government wanted to build such a missile, OKB-1 could do it better and faster than Iangel''s bureau. According to Sergei Khrushchev, his father was stunned, by this reversal. He answered Korolev by saying:

> "Let's do it this way: since the acid-fueled project is his idea and he developed it in his design bureau, let him solve that problem and you solve yours. Let it be a competition. You will do your missile of instant readiness with oxygen [the R-9], and he will do his with acid [the R-16]."[187]

However, when Korolev insisted on taking over the R-16 project Khrushchev became angry:

> "I can't transfer the acid-fueled missile to you. The concept was his and he would be insulted. You have to understand that you turned this down, while Iangel' took it upon himself. Now you want to take everything into your own hands and shove Iangel' aside. That is more than an insult, it is impossible."[188]

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183 S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 383.
184 S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 383.
185 Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 62.
186 The Spring 1959 period is suggested by the timing of dual decrees on the R-9 and R-16 - on 19 May 1959.
187 S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 387. This quote is actually taken from Khrushchev, Khrushchev Remembers: The Glasnost Tapes, p. 185. The notes in brackets were added by this author. Both sources mention that Khrushchev was the Chairman of the Council of Ministers at the time of this conversation.
188 Khrushchev, Khrushchev Remembers: The Glasnost Tapes, p. 185. (The "quotes" of Khrushchev in both of The Glasnost Tapes, and Krizisy i Rakety match closely except on one key point - the order of the conversation. In the former book these quotes are reversed giving the impression that the competition was the solution to the dilemma. In Sergei Khrushchev's book, the emphasis is on Korolev's attempt to monopolise missile design and his father's increasing disillusion with Korolev. I have chosen to use the quotes from what are purported to be transcripts of Nikita Khrushchev's own taped reminiscences. However, since the more recent work (Krizisy i Rakety) seems to better fit with other known facts I have accepted the interpretation therein.)

Korolev's behaviour during this incident had huge repercussions for the missile and space programmes. Of first importance, it seriously undermined his close relationship with Khrushchev. In addition, the incident destroyed the unity of the Council of Chief Designers. Korolev knew exactly who had "betrayed" him and had a spectacular fight with the Chief Designer of Rocket Engines. For his part, Glushko questioned Korolev's mantle as the leader of rocket and space technology, pointing out that the engines were the crucial technology in rocketbuilding. Korolev called Glushko a "traitor" and swore never to put another Glushko engine on one of his rockets again.[189] A number of designers and officials attempted to patch-up relations, but to no avail. At some point, Khrushchev also tried; inviting Korolev, Glushko, and their wives to his dacha to achieve a reconciliation.[190] However, the meeting only led to even more harsh words. The "fuel dispute" set off a bitter rivalry that afflicted the space and missile programmes for years to come.

Another incident, in 1958, had a widespread effect on the entire weapons policymaking process, not just the space and missile programmes. Although Khrushchev's political power and personal interest in missile design allowed him to direct missile R&D policy, he had depended on, and usually deferred to, his chief designers on technical and engineering questions. However, this deferential attitude changed in the fall of 1958. This change was precipitated by Khrushchev's proposal to put Soviet missiles in underground silos.

In mid-1958 Khrushchev suggested to Korolev that Soviet ICBMs should be put in underground silos to protect them from attack.[191] In his memoirs Khrushchev claims that this idea was inspired by his earlier work as a coal-miner, and leader in the building of the Moscow Metro.[192] However, it possible that this idea was actually inspired by intelligence information from the US.[193] Korolev replied that such an idea would not work.[194]

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[189]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 388-9.

[190]See both: Khrushchev, Khrushchev Remembers: The Glasnost Tapes, pp. 185-6; and Khrushchev, Khrushchev Remembers: The Last Testament, pp. 46-7.

[191]Khrushchev, Khrushchev Remembers: The Last Testament, pp. 48-9; and S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 390-407.

[192]Khrushchev, Khrushchev Remembers: The Last Testament, p. 48.

[193]It is now known that some of the "insights" long attributed to I. V. Kurchatov, the scientific leader of the nuclear weapons programme, were actually the result of highly classified intelligence reports. Kurchatov had access to these reports, but they were considered too sensitive to be shown to anyone below him. (David

Khrushchev was remarkably persistent about his silo idea. Over the course of the summer of 1958 he had further discussions with missile designer Iangel', and launch site designer V. P. Barmin.[195] They too rejected their leader's proposal as impractical. Khrushchev was disappointed:

> "always mindful of my political status - I realized I had no right to force the idea down their throats. I assumed these people knew their own professions, so I let the matter drop."[196]

Unfortunately for the designers, events conspired to prove them spectacularly wrong. Here, Khrushchev's son Sergei played a direct role. As an engineer at Chelomei's OKB-52, the young Khrushchev had direct access to translations of the Western aerospace press. Upon returning from a summer holiday with his father in Crimea in 1958, Sergei happened across an article, complete with drawings, describing American plans to put their missiles in underground silos.[197] Knowing of his father's recent disappointment in proposing the same idea, he showed the article to him.

Armed with this information from his son, Khrushchev waited to publicly humiliate the designers who had dismissed his idea. In September 1958, at a display of missile technology arranged for senior military and political leaders at Kapustin Iar, Khrushchev produced the article and drawing. He called Barmin forward and "reprimanded him for not following the technical journals."[198] "Under pressure from the announcement from the USA," the designers changed their tune and supported Khrushchev's silo proposal.[199] Within a year Iangel''s R-12 (SS-4) missile was test launched from a silo, and thereafter virtually all military missiles were designed, or adapted, for silo launch.[200]

Holloway, "Soviet Nuclear History: Sources for Stalin and the Bomb," Cold War International History Project Bulletin, Issue 4, Fall 1994, p. 4.) Khrushchev undoubtedly had privileged access to KGB intelligence and may have been trying to pass off the silo idea as his own.

[194] In the case of the R-7 this was certainly true, since this ICBM was extremely wide at the base and would have required a very large silo and a way to disperse the huge quantity of exhaust gasses produced by the numerous engines.

[195] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p 391. Khrushchev also mentions these consultations in The Last Testament, however, Barmin is misidentified as I. P. Bardin, an academician not involved with the missile programme. (Khrushchev, Khrushchev Remembers: The Last Testament, p. 48.)

[196] Khrushchev, Khrushchev Remembers: The Last Testament, p. 49.

[197] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 391

[198] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 406.

[199] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 406.

[200] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 391.

Khrushchev's victory on this technical question had two important effects. In the first place, it enhanced his authority on military questions at a time when his judgement was coming under increasing pressure from the military and the defence industry.[201] More importantly, it led to an important change of Khrushchev's attitude toward the missile "experts." He was:

> "upset and disappointed with our own engineers... I'd been careful not to push them around; I'd simply proposed the plan as part of a free exchange of opinions. But now I felt justified in giving some orders."[202]

Khrushchev no longer trusted his "experts." He accepted the R-7, but only as an interim solution. Iangel' became the leading missile designer, but never enjoyed the confidence that Korolev had previously. Even before the first (disastrous) test of Iangel''s R-16 (SS-7), Khrushchev had set up a competitor in a different "ministry" (the GKAT). The approval of Chelomei's proposals was specifically designed to put pressure on both Korolev (in space) and Iangel' (in missiles).[203]

The Manned Space Programme

As with Sputnik, the Soviet manned space programme was largely a creation of Korolev, made possible by support from Khrushchev. However, gaining authorisation for the first human spaceflight was much more difficult than for Sputnik. By the time the decision to launch Vostok was made, Korolev was no longer Khrushchev's favourite. But, a number of domestic, and international political factors helped to tip the balance in favour of launching the first manned spaceflight.

Manned spaceflight had been Tsiolkovskii's dream before the turn of the century, but in the mid-1950s Korolev started to take concrete steps to realise the dream. In 1955 Korolev publicly proposed five different manned spacecraft designs.[204] M. K.

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[201] They were particularly keen to end the unilateral moratorium on nuclear tests. Khrushchev did end the unilateral test ban shortly thereafter, but apparently on his own terms. For Khrushchev's version of why testing was resumed just as the West was offering a bi-lateral ban see: S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 410-11.

[202] Khrushchev, Khrushchev Remembers: The Last Testament, p. 49.

[203] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 492. Note that the secrecy surrounding the identities of the chief designers made such a political strategy easier.

[204] This was in his speech at the 125th anniversary celebration for the Moscow Higher Technical School (MVTU). (M. Rebrov, "Lider: Maloizvestnye Stranitsy iz Zhizni S. P. Koroleva," Krasnaia Zvezda, 1 July 1989.)

Tikhonravov later noted that by November 1956, OKB-1 designers were already working on preliminary designs for manned spacecraft and were looking at lunar expedition requirements.[205] These designs were far enough advanced that the Council of Chief Designers discussed piloted spaceflight the same year.[206]

In 1957 Korolev's spaceflight plans were solidified. While some supporters of manned spaceflight argued that the programme should begin with sub-orbital tests, Korolev decided that such a step was unnecessary.[207] He proposed that the Soviet Union move vigorously, and directly, to orbital spaceflight.[208] The technical leadership abandoned the idea of testing the spacecraft on sub-orbital flights sometime during 1957.[209] By December 1957, a new group was formed in the planning section of OKB-1 to begin studies of manned orbital spacecraft.

Korolev's plans appear to have been based directly on Tsiolkovskii's vision of space development. Korolev advanced this vision in his articles and speeches throughout this period. At the Tsiolkovskii Centennial in September 1957, and even his more guarded December 1957 article (under the pseudonym K. Sergeev), he proposed the same basic steps - the rapid establishment of a manned spaceflight capability, the development of nuclear and liquid hydrogen rocket engines, the assembly of manned orbital stations, and then the use of these stations to mount exploratory missions around the moon. After this, larger boosters and spacecraft would be used to carry out lunar exploration and flights around the nearby planets. These steps in the colonisation of the solar system could all be traced to Tsiolkovskii's works.

Design work on Korolev's first manned spacecraft was carried out at a fevered pitch in 1958. Between March and November, the design of the Vostok capsule was

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[205]M. K. Tikhonravov, "The Creation of the First Artificial Earth Satellite: Some Historical Details," Paper presented to the International Astronautical Federation Congress, 1973, as cited in Clark, The Soviet Manned Space Programme, p. 14.
[206]Rebrov, "Lider;" and Rebrov, "Gorod Koroleva."
[207]V. Svergun and V. Ageev, "Put' k 'Vostoku'," Aviatsiia i Kosmonavtika, No. 3-4, April-May 1994, pp. 42-43.
[208]Clark, The Soviet Manned Space Program, p. 14.
[209]Lardier, L'Astronautique Sovietique, p. 243. Note that the United States did not follow this design path, but first tested its Mercury capsule with manned sub-orbital flights.

finalised.[210] After much discussion, a spherical re-entry capsule atop instrument and engine modules was adopted. This had the distinct advantage of simplifying numerous technical problems.[211] It also expedited work since this was the same design that Tikhonravov had been working on for a reconnaissance satellite (Object OD).[212] The Vostok design was discussed, and adopted, by the Council of Chief Designers in November 1958.[213] Work on building Vostok got underway by December.

Despite the rapid pace of work on Vostok, it is not clear that a manned spaceflight programme had been authorised. There were at least two opportunities in 1958 for Korolev to present manned spaceflight proposals. The first of these was the January 1958 meeting, which was noted for its "heated fights." Korolev also had the opportunity to lay out his long range plans during the summer of 1958. He is known to have written a detailed space "plan" on 5 July 1958.[214] This proposal was in response to a government call for alternative spaceflight proposals, probably as a result of the January disagreements. However, a decree authorising the manned spaceflight programme after these proposals has not come to light. Korolev was building a manned spacecraft, but it does not appear that the government had agreed to use it.[215]

The slowness, or unwillingness, to respond to Korolev's manned spaceflight proposals reflected the decline in his influence. Although Korolev had strong support from Ustinov, much of the missile industry, and the Academy of Sciences, the support of such experts was not enough to guarantee approval of a manned space programme. After the "silo incident" Khrushchev was no longer so deferential to experts. He had other priorities, especially the quick construction of an effective ICBM. By mid-1958 it was apparent that

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[210] Lardier, L'Astronautique Sovietique, p. 121.

[211] The spherical re-entry capsule was particularly noteworthy since it could be weighted to be self-stabilising on re-entry. This meant that complicated and critical re-entry orientation and control systems were not needed. Once the capsule was slowed down by the retro-rocket it would follow a simple ballistic path to the earth's surface.

[212] Work on Object OD began in 1956. On the connection between Vostok and the Zenit reconnaissance satellite (Object OD) see: Iu. M. Frumkin, "Pervyi Sputnik-razvedchik," Aviatsiia i Kosmonavtika, No. 3, March 1993, pp. 41- 42.

[213] Lardier, L'Astronautique Sovietique, p. 121; and Clark, The Soviet Manned Space Program, p. 14.

[214] Lardier, L'Astronautique Sovietique, p. 119.

[215] It is possible that Korolev was once again redirecting a military programme (the reconnaissance satellite) to his own ends. The reconnaissance satellite and Vostok were identical in many features.

Korolev was uninterested in missiles, he wanted to concentrate on space projects. But, in 1958, his space programme was largely unsuccessful.[216]

The Soviet space programme continued despite these problems. One reason for this was international political competition. The Soviet lead in space had been a stunning ideological and propaganda boon that they had used to great effect.[217] At the time, Soviet foreign and security policy rested on the facade of strength generated by the Sputniks. Despite his irritation at Korolev, Khrushchev recognised that space was now "no less important" than the development of ICBMs.[218] By early 1959, Korolev's relationship with Khrushchev had improved somewhat, as the leader enjoyed the international impression that Luna 1 made.[219]

Manned spaceflight preparations appear to have been driven by this same force - international competition. One of the centrepieces of the US response to the Sputniks was a manned space programme. This decision was based on the belief that manned spaceflight was an integral part of Soviet space policy.[220] By October 1958 the United States had enshrined manned spaceflight as national policy. Although Korolev had started work on his manned spacecraft long before the US, in terms of policy decisions the US appears to have seized the initiative.

The pattern of acting after the United States in the manned programme was reflected in the selection of cosmonauts in 1959. Only after the United States announced the selection of its first seven astronaut candidates in April, did the Soviet Union formally begin the process of selecting cosmonauts.[221] However, selection of the final twenty cosmonaut candidates was not completed until March 1960.[222]

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[216]In five attempts, only one object made it into space. See Appendix 12.
[217]e.g., after the public failure of the first US Vanguard launch attempt (in December 1957), the Soviet Ambassador at the UN asked if the US wanted to be included in the USSR's aid programme for backward countries. (C. Peebles, "A Traveller in the Night," Journal of the British Interplanetary Society, Vol. 33, No. 8, August 1980, p. 285.)
[218]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 407.
[219]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 473.
[220]A belief not only encouraged by the Sputnik 2 dog flight, but also by the rhetoric surrounding the Soviet space programme. Whether it was intentional or not, Korolev doubtlessly contributed to this perception. His December 1957 article in Pravda is a perfect example.
[221]In May 1959 a special commission chaired by Keldysh, determined that Soviet cosmonauts should be selected from military pilots.
[222]Lardier, L'Astronautique Sovietique, p. 125-7

While the selection and screening of cosmonaut candidates was going on, the Soviet leadership finally agreed to its first "Comprehensive Decree on Space Research" in December 1959.[223] Although the only references to this decree are oblique and rather unrevealing, it appears from the context, that the decree ratified the two existing programmes: the planetary probe and the manned spaceflight programmes. Based on the projects under development during this period, it appears that the manned programme consisted solely of Korolev's Tsiolkovskii-inspired plans.

Regardless of what had been authorised, as early as January 1960, Khrushchev began to express his doubts about the adequacy of the December 1959 decree. He is reported to have told his chief designers that more urgent measures would be needed to meet the US challenge to Soviet supremacy in space. Officially, the US manned programme did not extend beyond a handful of earth-orbital Mercury flights. Yet, Khrushchev was no doubt concerned about the breadth of US space efforts.[224] He was also known to be troubled by the trend in American opinion toward manned space missions, especially the lunar landing proposals of US Senator Lyndon Johnson.[225] Several months later (in May), the first test of Vostok, Korabl'-Sputnik 1, failed.[226]

Following Khrushchev's adoption of a more confrontational attitude toward the West and the changes to the political leadership in May 1960, Soviet space policy underwent a major change. A new decree by the Central Committee and Council of Ministers, "About the creation of powerful rocket launchers, satellites, spaceships and the opening of space in 1960-1967," was signed on 23 June 1960.[227] Although the full contents of this decree are not known, the emphasis in the Soviet space programme clearly shifted toward military projects. This was the same decree that allowed Chelomei to expand into the space and missile business, and begin two military satellite projects. Subsequent events suggest that,

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223Vetrov, "Trudnaia Sud'ba Rakety N-1," April, p. 78.

224In 1959 the Soviet Union had only successfully carried out the three Luna missions. The US, although not notably successful, had a lunar probe project and numerous earth-orbital satellite projects.

225Vetrov, "Trudnaia Sud'ba Rakety N-1," April, p. 78. Johnson was then the US Senate Majority Leader. Later in 1960 he would be elected Vice President of the US.

226Instead of returning to Earth when commanded on 18 May, Korabl'-Sputnik 1 was accidentally boosted into a higher orbit. For a summary of all known Soviet manned space launch attempts (1960-1970) see Appendix 13.

227Vetrov, "Trudnaia Sud'ba Rakety N-1;" Rebrov, "Gorod Koroleva," p. 5; and S. Kriukov, "Blesk i Zatmenie Lunnoi Programmy," Nauka i Zhizn, No. 4, April 1994, pp. 81-85.

if Korolev's manned space plans had been adopted by the December 1959 decree, then the June 1960 decree may have revoked this authorisation.

The apparent lack of authorisation for a manned spaceflight became evident after the first successful test of the Vostok spacecraft in August 1960. The records show that VPK Chairman Ustinov sent a memo advocating approval of a manned flight to the Central Committee on 19 September 1960.[228] Citing the success of the Vostok test with the dogs Belka and Strelka (known publicly as Korabl'-Sputnik 2), the memo stated that it would be possible to send a man into space by December 1960.[229] Although Ustinov's name came at the top, the memo was also signed by all of the members of the State Commission for Spaceflight.[230] The response to this proposal came in the form of a Central Committee and Council of Ministers decree dated 11 October 1960. The decree said that the proposal was "approved, because it is a task of great importance."[231] At this time there appears to have been little opposition to the desire to beat the Americans, who were planning their first spaceflight for Spring 1961.

The optimistic schedule for a flight by the end of the year was not to be fulfilled. The Vostok programme was delayed by the unsuccessful rush to launch two probes to Mars in October 1960. The programme was further set back by the tragic R-16 (Nedelin) disaster on 24 October. Vostok tests did resume in December, but both tests were failures. Korabl'-Sputnik 3 put the dogs Mushka and Pchelka into orbit on 1 December. However, they re-entered at too steep an angle the next day, and burned up. The test on 22 December

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[228]Rebrov, "The Difficult Path to April 1961," p.7; and V. Belianov, et al., "Tomorrow is Space Program Day: The Classified Documents on Gagarin's Spaceflight: The First and Only," Rabochaia Tribuna, 11 April 1991, pp. 1,4, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-91-004, 20 September 1991, p. 72.

[229]Rebrov, "The Difficult Path to April 1961," p.7; and Belianov, et al. "Tomorrow is Space Program Day," p. 72. Other sources say that Korolev also requested approval for four more test flights (one in October, two in November and one in December) before conducting a manned flight in December. (Lardier, L'Astronautique Sovietique, p. 124.)

[230]These included all of the Chairmen of the State Committees for defence industries, Minister of Defence Malinovskii, Marshall Nedelin, Marshal Rudenko (deputy chief of the Soviet Air Force), Academician Keldysh, and the members of the Council of Chief Designers. (For lists see: Rebrov, "The Difficult Path to April 1961," p.7; and Belianov, et al. "Tomorrow is Space Program Day," p. 72.) For Marshal Rudenko, see Appendix 3.

[231]Rebrov, "The Difficult Path to April 1961," p.7; and Belianov, et al. "Tomorrow is Space Program Day," p. 72.

also had mixed results; the R-7 failed after lift off, but the escape system worked perfectly.[232] Around this time Korolev suffered a heart attack.[233]

After the (initially) successful Venera 1 launch (4 February 1961), Korolev turned his attention back to the manned programme. In March two flawless tests of the Vostok spacecraft were carried out under the names Korabl'-Sputnik 4 and 5. Although these tests were a success, the joy was tempered by the first Soviet cosmonaut death. On the same date as the Korabl'-Sputnik 5 test, V. V. Bondarenko was burned to death when a fire broke out in test chamber filled with pure oxygen. This training accident rattled many involved in the manned programme, but had no major effect on the Vostok plans.

On 30 March 1961 Ustinov sent a memo to the Central Committee, again requesting approval of a manned spaceflight. The memo emphasised the high reliability of the booster and spacecraft. It also pointed out that even in the event of failure of the retro-rocket system the cosmonaut was in little danger, since Vostok would orbit at a low enough altitude that drag from the atmosphere would slow it to re-entry speed within ten days. The Vostok was equipped with a ten day supply of food, water, and air.[234]

The attention to the safety of the cosmonaut in this memo is striking. Rumours have long circulated about cosmonauts who were killed in pre-Gagarin launch attempts.[235] The implication was that the Soviet Union was bent on maintaining its priority in space regardless of the risk to the lives of its cosmonauts. This was certainly not the case with the first Vostok. In fact, Khrushchev may have been especially sensitive to this issue since he and Bulganin had been blamed for the deaths in a "technological stunt" in the 1930s - the crash of the Maxim Gorkii.[236] The recent Nedelin disaster and the Korabl'-Sputnik failures in December, may also have heightened the leadership's sensitivity to the risks of the mission.

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[232]The two dogs were safely recovered in their capsule in the Altai Mountains. (Lardier, L'Astronautique Sovietique, p. 124.)

[233]Potts, Soviet Man in Space, Vol. 1, p. 152.

[234]Belianov, et al. "Tomorrow is Space Program Day," p. 72.

[235]e.g., Oleg Penkovskiy, The Penkovskiy Papers, trans. Peter Deriabin, New York: Doubleday and Co. Inc., 1965, p. 342.

[236]The Maxim Gorkii was the biggest aircraft in the world. During a flight display, on 18 May 1935, the Maxim Gorkii crashed - killing the crew and all thirty six passengers. Stalin blamed Khrushchev and Bulganin. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 341.)

Ustinov's March 1961 memo requesting authorisation to launch a manned space mission is also notable for two anomalies. First, why was additional authorisation for the launch needed after the 11 October 1960 decree? The only obvious explanation is that the earlier decree was technically invalidated by the failure to carry out the mission by the December 1960 deadline.[237] Second, the list of signatures attached to this memo differs significantly from the first (September 1960) Vostok launch proposal. There were several minor changes and additions to the signatories, but most striking are the omissions.

The signatures missing on the March Vostok proposal included Minister of Defence Malinovskii, former head of the State Commission V. M. Riabikov, and all of the Chief Designers except Korolev.[238] It is likely that Korolev signed for the other designers as head of the Council of Chief Designers. However, it appears that Malinovskii and Riabikov may have refused to endorse the proposal. This is corroborated by the fact that only two of the known members of the State Commission for Spaceflight were <u>not</u> awarded the Hero of Socialist Labour following Vostok; Malinovskii and Riabikov.

Nevertheless, on 3 April 1961, a Central Committee Presidium decree entitled "The Launch of the Satellite/Spacecraft," approved the proposals in the 30 March memo.[239] The decree differed from the one in October 1960 in that it was apparently not a joint decree with the Council of Ministers. Whether this was simply an oversight or a significant change is not clear. Nevertheless, it seems evident that Khrushchev had to override or ignore opposition to the launch of Vostok. When presented with the opportunity to beat the US in space again, he could not resist.

Following the decree in favour of Vostok, the State Commission was charged with execution of the mission. This included approving the flight and work programme for the

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[237] There are a number of other possible explanations, including: an unrevealed requirement in the first decree to get final approval, or changes in procedure after the Nedelin disaster. There is, as yet, no evidence to support these explanations for this anomaly.

[238] Rebrov, "The Difficult Path to April 1961," p. 8. It is possible that this these were oversights on the part of the author of the cited article. But given that he lists all of the signatories of the September 1960 memo on the previous page, and twice lists the signatories of the 30 March 1961 memo, this seems unlikely.

[239] Rebrov, "The Difficult Path to April 1961," p. 8.

flight, supervising all aspects of preparation, and the selection of the crew.[240] On 10 April 1961, the State Commission for Spaceflight met at Baikonur to announce that Lieutenant Iurii Gagarin was their choice to make the first flight.[241] Two days later, on 12 April 1961, Gagarin became the first man in space.[242]

The Manned Lunar Programme

Despite US fears to the contrary, prior to 1961 the Soviet Union did not have official plans to conduct a manned lunar mission. Manned exploration of the moon was one of Korolev's long-term objectives, but it does not appear that this was ever formally approved. Khrushchev may have informally sanctioned such a proposal in the first few months after Sputnik. However, by 1960, it is clear that Korolev's long-term spaceflight plans, particularly manned exploration of the moon, were not accepted as state policy.

As early as September 1956, Korolev explicitly pointed to exploration of the moon as one of his primary objectives.[243] Two months later he was known to have assigned designers in OKB-1 to examine the requirements for a lunar expedition.[244] These studies indicated the need for two major new projects: a more powerful booster rocket and spacecraft capable of carrying cosmonauts to and from the moon.[245]

Early authorisation of a more powerful rocket was essential to manned lunar exploration. Carrying out a moon mission using the R-7 was simply not feasible. Even before the first successful test of the R-7, Korolev had been pushing his plans for

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[240]Iu. A. Skopinskiy, "State Acceptance of the Space Program: 30 years of work - from the history of science," Zemlia i Vselennaia, No. 5, September-October 1988, pp. 73-79, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-89-005, 15 March 1989, p. 61.

[241]S. Shamsutdinov, "K Shestidesiatiletiiu Iu. A. Gagarina," Novosti Kosmonavtiki, No. 5, 1994, p. 7.

[242]Until the late 1970s Soviet officials insisted that Gagarin had landed inside the Vostok capsule. This was to ensure that Vostok was credited by the International Aeronautical Federation (FAI) as a successful first flight. FAI rules require record flights to be completed in the craft. However, Vostok was not designed for manned landing - the capsule was too heavy to be adequately slowed by its parachute. Gagarin, as the mannequins and dogs before him, and all subsequent Vostok cosmonauts, ejected from the capsule at around 7 kilometres altitude and landed separately.

[243]Rudenko, "'Mne Pokazalos', Chto Nachalas' Tret'ia Mirovaia...'," p. 4.

[244]M. K. Tikhonravov, "The Creation of the First Artificial Earth Satellite," as cited in Clark, The Soviet Manned Space Program, p. 14.

[245]The Vostok design could not have been used for a lunar mission. In addition to its limited size, its spherical shape was not suitable for re-entry at post-lunar mission velocities. The conical shape of later spacecraft allowed for some aerodynamic control, and thus the dissipation of velocity over a longer re-entry path.

substantially larger rockets.[246] An early start was needed because of the length of time it would take to design, build and test such a huge booster. In fact, a larger booster project was finally included in the OKB-1 annual planning documents for 1959-1960.[247]

In 1960 Korolev completed the draft design (EP) for a pair of big boosters: the N-1 and N-2. The "N" series was the first Soviet rocket project of the post-war era not specifically intended as a ballistic missile.[248] The N-1 was designed to launch a forty five tonne payload into earth orbit and would be used for a manned circumlunar mission.[249] This would be followed by the N-2, which would carry around 70 tonnes into orbit, and serve as the basic launcher for both a lunar landing and a circum-Mars expedition.[250]

Korolev also developed a spacecraft to go with the "N" series booster rockets. The spacecraft, known as the L-1, was planned as the successor to the Vostok capsule. According to Soviet cosmonaut Alexei Leonov, Korolev briefed the cosmonauts about the L-1 in May 1960.[251] It was apparently intended as an all-purpose design that would serve as the basic spacecraft for many future missions. In May 1960 Korolev presented his new rocket and spacecraft proposals directly to the political leadership. The new spacecraft design was rejected.[252]

However, the new booster rocket designs were accepted as part of the 23 June 1960 decree on space policy. The decree called for the completion of the N-1 by 1963 and the N-2 by 1967.[253] The justification given in the decree for the N-1 was extremely vague. It "was intended to resolve a range of military tasks in near-earth space" but these tasks were not specified.[254] In fact, the decree required the military to create a mission for the N-1.[255]

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[246]According to Georgii Vetrov, the NPO Energiia archives hold records of early plans dated 14 September 1956, and notes of a discussion of these proposals at a meeting with the Chairman of the VPK (Ustinov) on 15 July 1957. (Vetrov, "Trudnaia Sud'ba Rakety N-1," April, p. 80.)
[247]Vetrov, "Trudnaia Sud'ba Rakety N-1," April, p. 80.
[248]Notably other projects had all been designated as "R" for "raketa" (rocket or missile). This project was designated "N" for "nositel" (carrier). In Russian, space boosters are usually designated "raket-nositel" (carrier rocket).
[249]Kriukov, "Blesk i Zatmenie Lunnoi Programmy," p. 81; and A. Iasinskii, "Lunnyi Nositel," Propeller, No. 54-55, 11 October 1991, p. 8.
[250]Iasinskii, "Lunnyi Nositel," p. 8; and Lardier, L'Astronautique Sovietique, p. 155.
[251]Rudenko, "'Mne Pokazalos, Chto Nachalas Tret'ia Mirovaia...'," p. 4.
[252]Lardier, L'Astronautique Sovietique, p. 155.
[253]Iasinskii, "Lunnyi Nositel," p. 8.
[254]Kriukov, "Blesk i Zatmenie Lunnoi Programmy," p. 81. (Emphasis added.)
[255]Vetrov, "Trudnaia Sud'ba Rakety N-1," May, p. 23. Vetrov appears to mean that the military was told to develop a TTT for the N-1.

The decree also suggested five non-military uses for the N-1; only the last of which was "manned research and exploration of the moon."[256] For Korolev, this was enough to keep his hopes for the "N" series alive.

The question is, how did Korolev get the "N" boosters approved at all? There appear to have been at least three things working in his favour. First there were future military missions that would require a very-large booster; for example, putting large observation or bombardment systems in orbit, or launching numerous small satellites with one booster. Neither the R-7, nor the R-16, would be capable of carrying such large loads into orbit, and even Chelomei's ambitious plans would not provide such a capability until the late 1960s. The N-1 could fulfil these missions much earlier.

A second factor in favour of the N-1 was the need to be ready to counter US plans. With the transfer of Wernher Von Braun to NASA in 1960, the United States had a space programme technical leader of the same calibre and enthusiasm of Korolev.[257] President Eisenhower may have continued to resist a lunar programme, but he would no longer be in office after January 1961.[258] Like Eisenhower, Khrushchev recognised that a lunar expedition would be phenomenally expensive. But he was unwilling to cede Soviet "superiority" in space. He was also unwilling to take the chance that the US space effort might have been a military programme in disguise. Permitting development of the "N" rockets would keep Khrushchev's options open without committing him to an expensive manned space programme.

The third factor in favour of the N-1 was the formidable array of Korolev allies in the right places. Ustinov was the most important. As Chairman of the VPK, Ustinov showed considerable favouritism toward his old associates in the missile programme. In addition, Korolev could count on the support of other recently promoted missile programme

[256]Kriukov, "Blesk i Zatmenie Lunnoi Programmy," p. 81. After the military assignment the other tasks are listed as: observation of the Earth and Sun, creation of global communications, collecting meteorological information, the launch of unmanned probes to the distant planets, and manned lunar exploration.

[257]Von Braun's original plan for using the Saturn rocket was strikingly similar to Korolev's plan for the "N" series boosters. At one point it included assembly of the lunar craft in earth orbit through multiple Saturn launches. This is not surprising, since both men were students of the same theoretical works studied by rocket societies in the 1920s and 1930s.

[258]Having served two terms, Eisenhower was constitutionally prohibited from running in the 1960 Presidential election. His Vice President, Richard M. Nixon was the Republican candidate.

alumni, like GKOT Chairman Rudnev and Gosplan Chief Novikov. In addition, key personnel in the RVSN had long been associated with Korolev and were sympathetic to his space ambitions.[259] Support from the Academy of Sciences may not have been an advantage since the "N" series was authorised primarily for military purposes, but Korolev had certainly solidified his position in this body by mid-1960.[260] Scientific support for the design may have been helpful. Ultimately, military needs, and the possibility that the US might begin a manned lunar programme, gave Korolev's allies plenty of reasons to cite in favour of the "N" boosters. It is not clear which of these reasons were most important, but they all would have been useful in countering opposition to the rocket project.

A highly significant source of opposition to Korolev's "N" series was one of the members of the Council of Chief Designers. The very same issue that had fractured the Council of Chief Designers in 1958, returned to haunt the N-1. Glushko refused to build large liquid oxygen/kerosene engines. Korolev refused to consider the use of the exotic, and toxic propellants. Unfortunately for Korolev, Glushko had a monopoly on the development of the large, liquid fuel rocket engines like those needed for the N-1. Korolev either had to swallow his pride and use Glushko's designs or find a way to break Glushko's monopoly.

Although the "N" series boosters had been formally authorised, Glushko was still a significant threat to the success of the project. Oddly enough, Glushko and Korolev agreed on the ultimate aim of a manned exploration of space, but they disagreed over the best means to achieve that end, and who should get the credit for it. In words attributed to Korolev:

> "Glushko thinks that he is the chief successor and descendant of Tsiolkovskii, and we are only making tin cans..."[261]

Korolev desperately wanted to keep Glushko out of his moon rocket programme. Thus, one of the major design specifications of the N-1, the use of numerous modest-sized

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[259]In early 1960 the RVSN was headed by Marshal Nedelin. There were also a number of close associates of Korolev at NII-4, and the Main Administration for Rocket Weapons (GURVO) at this time.

[260]Keldysh was now Vice President, Korolev was on the Presidium, and all of the members of the Council of Chief Designers were full or corresponding members of the Academy of Sciences.

[261]L. N. Kamanin, "Dnevnika N. P. Kamanina," Ogonek, No. 7, 9-16 February 1991, p. 30.

engines using liquid oxygen and kerosene on the first stage, appears to have been explicitly aimed at undercutting Glushko's claim for involvement in the N-1 project.

After personally securing permission from Khrushchev to make greater use of the, now under-utilised, aviation engine design bureaux, Korolev went looking for a replacement for Glushko.[262] He found one virtually next door to the OKB-1 filial in Kuibyshev. OKB-276, under Chief Designer N. D. Kuznetsov, was an aviation engine design bureau that had been producing engines for the Tu-95 bomber.[263] Since the plant that had been building the Tu-95 had been converted to building the R-7, Kuznetsov's design bureau was without any major assignments. Kuznetsov had neither the experience, nor the equipment to develop rocket engines for the N-1.[264] Nonetheless, by March 1961, Kuznetsov agreed to take on the development of engines for the first stage of the Korolev's new rocket.

At the time of Gagarin's flight in Vostok, the prospect of a serious Soviet lunar programme was fairly slim. There was no formal policy to pursue any long-term manned spaceflight programme, let alone a manned lunar programme. Unmanned lunar reconnaissance missions, a necessary precursor to manned exploration of the moon, had been abandoned in 1960. The Soviets did have a design for lunar-capable spacecraft and rockets (and a dedicated advocate of those projects), but the spacecraft project had been rejected. The rocket had been approved, but primarily for military purposes. In addition, the "N" rockets had a number of committed opponents - including one of the Soviet Union's top rocket experts.

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[262] Igor Afanas'ev, "N-1: Sovershenno Sekretno," Kryl'ia Rodiny, No. 9, September 1993, p. 14.

[263] R. Dolgopiatov, B. Dorofeev, and S. Kriukov, "Proekt N-1," Aviatsiia i Kosmonavtika, No. 9, September 1992, p. 34. For Kuznetsov's involvement with the Tu-95 see: S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 450. For N. D. Kuznetsov, see Appendix 3.

[264] Kriukov, "Blesk i Zatmenie Lunnoi Programmy," p. 83; and Afanas'ev, "N-1: Sovershenno Sekretno," p. 14.

Implications and Conclusions

Space Projects and the Policy Process

The question of what space projects the Soviet Union had approved between 1957 and 1961 is still clouded by the limitations of the available evidence. If there were any formal decrees about space projects between the 30 January 1956 decree authorising Object D (Sputnik 3) and the December 1959 "Comprehensive Decree on Space Research," they have not yet come to light. As for the latter decree, its content can only be surmised from what happened afterward. In any case, this decree appears to have been superseded in June 1960, when a new decree re-oriented the space programme.

However, based on the projects that were being developed by the missile design bureaux and on the launches that were accomplished or attempted, it is clear that the Soviet space programme was a very limited undertaking. The first three Sputniks were all outgrowths of the original scientific satellite project authorised in January 1956. After this OKB-1 pursued two programmes, unmanned planetary exploration, and a manned orbital mission. These programmes might have been authorised in January 1958. However, it is quite possible that both of these (limited) programmes were begun only on Khrushchev's personal authorisation, as appears to be the case with the first two Sputniks (PS-1 and PS-2).

The planetary programme consisted of a series of spectacular projects. The probes were first directed at the moon, but about the time that Chelomei made his military space proposals, lunar exploration was abandoned. After this the unmanned programme turned its attention to more spectacular Mars and Venus missions, as the opportunities arose. The limited nature of the planetary effort is further suggested by the fact that preparations for the Mars launches in late 1960 seriously hindered the on-going manned programme.

The manned space programme was not a major priority for the political leadership. Preparations for a manned spaceflight had begun in earnest in 1958 with the design of the Vostok spacecraft. However, there appears to have been considerable reluctance to proceed with, or opposition to, the programme. It is not clear that a manned spaceflight was ever formally authorised until October 1960. In March 1961, the authorisation to launch Vostok had to be re-issued. There are no indications that government policy extended beyond the achievement of the first manned orbital mission. The manned lunar programme existed only in the hopes of the space enthusiasts - it was not an official programme.

The 23 June 1960 decree re-oriented the Soviet space programme toward military projects. In particular, Korolev's lunar designs only survived as military launchers. At least two other military space projects were authorised in a new "space" design bureau: Chelomei's OKB-52. But, the re-orientation had little immediate effect. The only spacecraft ready for launch through 1961 were those already under development by Korolev in OKB-1.

The Role of the Chief Designers

Korolev's monopoly of expertise on spaceflight meant that he retained considerable influence over the space programme. He was the "idea man," if not the initiator of every Soviet space success through Gagarin's mission. As Khrushchev's expert on space, he determined what was possible for the first two and a half years of the Soviet space programme. Korolev also attempted to create an institutional basis for the space programme. He not only redefined OKB-1 as a "space" design bureau, but was remarkably successful in moving the locus of space expertise into the Academy of Sciences.[265] Weak oversight and political turmoil had allowed Korolev to "hijack" the R-7 programme in the mid-1950s, but in the late 1950s the story was different. This time, he got away with establishing a space programme, perhaps before the leadership had considered the implications, through the patronage of Khrushchev.

By mid-1960 that patronage had largely vanished. Korolev was still influential in space decisions, but Khrushchev had lost faith in his "magician."[266] For Khrushchev, space had always been a <u>means</u> to an end, while for Korolev, space <u>was</u> the end. This difference became painfully apparent to Khrushchev by 1959. Korolev's attempt to maintain full control over the missile programme, while diverting it toward his space ends

[265]Given the rupture in the Council of Chief Designers, Korolev needed a new source of legitimacy. His strong position in the Academy of Sciences gave him precisely that.
[266]S. N. Khrushchev, <u>Krizisy i Rakety</u>, Vol. 1, p. 486.

was so blatant that even Khrushchev could not miss it. The bickering between Korolev and Glushko that followed further undermined Khrushchev's confidence in Korolev. In 1960, when Khrushchev turned toward military hardware, rather than bluster to deal with the West, he lavished his patronage on another designer.[267] Korolev's proposals now had to go through the full R&D review process and met with more rigorous, and hostile, scrutiny. Some of his ideas were approved, but only when they appeared to serve Khrushchev's ends. Projects crucial to Korolev's long term plans, like continued unmanned lunar exploration and more advanced manned spacecraft, were rejected.

Chief Designer Mikhail Kuz'mich Iangel' was a late entrant into space projects. Iangel''s involvement in space only began in August 1960 with a fairly limited unmanned project. The timing of this assignment, and Iangel''s general lack of interest in space, suggests that he was being advanced by Ustinov and/or the missile industry "mafia" (GKOT) as an alternative to Chelomei (whose KB was under the GKAT). OKB-586 remained, primarily, a highly effective military missile design organisation. Iangel' himself appears to have had little interest, or influence, in space policy.

Chelomei's April 1960 proposal to develop a military-oriented missile and space programme meshed precisely with Khrushchev's interests at just the right time. Even though Chelomei had no practical experience in ballistic missiles or space, he was extremely bright, ambitious and interested in space as a means to project Soviet power - not to colonise the stars. Even if his designs did not come to fruition, he could serve Khrushchev's purpose if the competition made Korolev more pliable.

Sergei Khrushchev played an important role in Chelomei's success, but not merely because of nepotism. The family connection also worked in the other direction, for the son was a reliable channel of information to his father. Thus, the elder Khrushchev could be sure that Chelomei was not attempting to do what Korolev had done.

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[267] In a summer 1960 ICBM competition, Khrushchev rejected Korolev's designs (the R-9A, and the solid fuel RT-1). In fact, he apparently did not want to deal with Korolev at all during this competition. (M. Rebrov, "Takaia Vot Tragikomediia," Krasnaia Zvezda, 24 June 1995.) (This source also suggests that one of Khrushchev's primary complaints at the time was that all of the new missiles (especially the solid fuel missiles) were too small to give an impression of great Soviet power.)

Just as the manned programme Korolev had dreamed about was getting under way, his dominance of the field was eroding. Iangel' had begun to take his place in missile design, and Chelomei was a potential threat to both missile and space programmes. Yet, even after the decision to divert much of the space programme to Chelomei in June 1960, Korolev still played the central role in devising and executing the Soviet space programme. Perhaps the role of the designers is best summed up by a saying that was popular in the Soviet Ministry of Defence at this time:

> "Korolev works for TASS,
> Iangel' for us,
> And Chelomei, on the toilet."[268]

Objectives and Purposes of the Soviet Manned Space Programme

It is now evident that the early Soviet space "programme" was actually a string of spectacular projects that were authorised in an ad hoc manner. The reasons for authorising these projects were highly complex. Domestic and international factors interacted with one another to propel the Soviet Union from one project to the next. The results did serve the interests of the space enthusiasts, but did not reflect a coherent government policy.

Domestically, the early space programme was a useful tool for Khrushchev and the party. Khrushchev had identified himself with missiles in order to defeat his political opponents (especially, those in the Soviet government). The first space successes reinforced Khrushchev's authority just when he needed it - i.e. in the wake of the "Anti-Party Group" affair. Space accomplishments were not only valuable in legitimising Khrushchev's control of weapons R&D and the military, but they had important ideological ramifications. Space spectaculars reinforced the leading role of the party and the correctness of Marxist-Leninist ideology. It appears that the sputniks contributed to Khrushchev's ebullient sense that the victory of socialism was at hand. This confidence was manifested in both domestic and international policy.

Khrushchev's confidence was not long lived. Space successes were not easy, or cheap. In fact, the space programme came at a high cost to Khrushchev's other priorities.

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[268] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 495.

He especially wanted to "deliver" useful missiles that would close the strategic nuclear gap and enable him to assert a new military doctrine. But, the long-awaited R-7 ICBM (SS-6) was only useful as a space booster. By 1960 it was evident that his favourite missile designer would not, and probably could not, produce both missiles and space spectaculars.

At precisely the same time, the need for effective ICBMs became particularly acute. Not only had Khrushchev based his security policy on ICBMs that had yet to enter the inventory, but the West was beginning to acquire hard evidence that his strategy was based on a bluff. The 1960 U-2 missions were evidence that the US was taking a more aggressive approach to learning about Soviet capabilities. Although shooting down a U-2 in May 1960 bought the Soviet Union some time, the US was already launching reconnaissance satellites that would lay the Soviet bluff bare.[269] Deployment of an ICBM was a political essential for both Khrushchev and the Soviet Union.

However, the space programme had also acquired an international dynamic of its own. It was a major political coup, not only for the Soviet Union, but for the world socialist movement - an unparalleled "expression of the advantages of the Soviet Socialist system."[270] Having staked this claim, the Soviet Union could not let the US surpass its accomplishments. Therefore, the US "overreaction" to Sputnik quickly began to influence the selection of space projects in the Soviet Union. The spectacular planetary launches and the manned programme were primarily aimed at maintaining the appearance of Soviet supremacy in space. The Soviet Union abandoned orbital application and science satellites in favour of space theatre. The purpose of the programme had not changed since Object D had been authorised in January 1956 - Soviet space projects were intended primarily to undermine the dominant position of the US in the world.

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[269]US reconnaissance satellite attempts began in February 1959. The first successful US reconnaissance satellite mission came in August 1960, just four months after the U-2 incident. Flown under the cover name Discoverer XIV, it returned "more coverage of the USSR than all U-2 overflights put together." (J. McDowell, "US Reconnaissance Satellite Programs, Part 1: Photoreconnaissance," Quest, Vol. 4, No. 2, Summer 1995, p. 23.)
[270]Pravda, 22 August 1960.

Implications for the Soviet Political System

The history of Soviet space policy suggests that surprisingly little had changed in Soviet politics since Stalin's death. After consolidating power in 1957, Khrushchev became the central figure in space policymaking. He also turned to classical Stalinist techniques to gain and maintain control. The major difference was that Khrushchev used "his own" institutions (especially the TsK Secretariat) to carry out these policies. The reliance on these new institutions and individuals had ramifications, but they had not become a significant problem prior to April 1961.

The party, and its leader, were in control of space policy throughout this period. As noted above, Khrushchev and the party used success in space to enhance their power and legitimacy in other fields. The evidence in this field sharply contradicts the findings of the "conflict school," which suggested that Khrushchev was weakened by hard-liners in the May 1960 Presidium shake-up.[271] The changes in 1960 appear to be primarily the result of a change of heart on the part of Khrushchev. There was conflict, but it occurred at the ministry level, and Khrushchev was able to use it to his own ends.

Khrushchev used control over cadres to manipulate policy in the direction he wanted. This control was evident in both formal and informal ways. In formal appointments Khrushchev tried to ensure that the appointees would serve his ends. For example, when asserting his personal control over weapons policy he promoted Brezhnev, a protégé with no military industry experience, to TsK Secretary. Three years later, when Khrushchev wanted a more effective leader to control the defence industry, Brezhnev was moved aside in favour of the more experienced F. R. Kozlov. When Khrushchev wanted to assert greater control, he also created new institutions. Once again, these were populated with supporters of his positions (e.g., the creation of the RVSN and appointment of Nedelin as its first commander). Khrushchev also made effective use of informal appointments; creating ad hoc scientific commissions to legitimise projects prior to leadership approval. The State Commission for Spaceflight was another example of an ad hoc institution, this

[271]e.g., Carl A. Linden, Khrushchev and the Soviet Leadership: 1957-1964, Baltimore: Johns Hopkins University Press, 1966, p. 116.

one used to implement policy. By manipulating the membership, and chairmanship, of these bodies Khrushchev and his party apparat were able to get what they wanted out of the space programme.

Khrushchev used the party, rather than the state, to implement his objectives. The Central Committee came to serve as the oversight and control mechanism rather than the secret police. This may not have been quite so ruthlessly effective as Stalin's approach, but it did become effective in missile and space policy. With cadre control and political oversight again located in one body, it was possible to have a potent effect on other political actors. Khrushchev had relatively little problem in implementing space and missile initiatives that he was committed to, whether it be the creation of the RVSN or the "replacement" of Korolev with Chelomei.[272]

However, the techniques and institutions used by Khrushchev and the party elite to implement policy did have unintended consequences. The reliance on the "experts" of the Academy of Sciences had enhanced the power and independence of this institution. Korolev and other missile and space advocates had been able to use their strong presence in the Academy of Sciences to put their pet projects on the agenda.

Of more importance in the long term, Khrushchev's preference for missiles had led to the promotion of a clique of leaders associated with Ustinov. As a result of the military doctrine battle, and the methods Khrushchev used to win it, the defence industry (especially the missile industry) came to control a variety of powerful government posts. The military may have been divided, and lacking in formal representation in the party and government, but the defence industry was in the opposite position. For the space programme this was particularly important, because Ustinov did his best to maintain personal control over the nascent space industry.

[272]This was also evident in other fields. For example, the return to political favour of biologist Trofim Lysenko. (CIA, National Intelligence Estimate Number 11-6-59, p. 4.)

Chapter 6: The Emergence of Competition in the Manned Space Programme (1961-1964)

"[The Polet] spaceship is really new... The fact that we have launched such a ship bears testimony that human ingenuity has reached a higher stage. Now man in space is no longer a prisoner of his ship."

Nikita Sergeevich Khrushchev
Pravda, 2 November 1963

Overview

From April 1961 until Khrushchev's ouster in October 1964, the Soviet Union launched a great number of unmanned spacecraft, but the crown jewel of the programme was manned spaceflight. As in previous years, and in other programmes, there was a substantial gap between the Western perception and the Soviet reality. The Vostok and Voskhod programmes were not logical steps forward in a coherent plan. The manned lunar programme, thought by many in the West as the main objective of the manned programme since 1957, was not even authorised until mid-1964. However, the steady stream of spectacular missions created a different perception for those outside the Soviet leadership.

In the United States, Gagarin's flight had an effect similar to Sputnik. It was the catalyst for a major change in US space policy. The new US President, John Kennedy, wanted to defuse the effects of the Soviet lead in manned spaceflight, and asked his advisors to develop a plan.[1] On 25 May 1961, shortly after the first successful American manned spaceflight, Kennedy proposed that the US carry out a manned lunar expedition. The explicit goal was a lunar landing before the end of the decade, but the implicit goal was to beat the Soviets to the Moon.[2] It was a bold move that sharply raised the international political stakes of manned space programmes. By putting the focus on a long-term goal, Kennedy also hoped to limit the short-term political damage of future Soviet space spectaculars.

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[1]The seminal work on Kennedy's decision is John Logsdon's The Decision to Go to the Moon: Project Apollo and the National Interest, Cambridge: MIT Press, 1970.
[2]The lunar expedition was the one programme that Kennedy's advisors were reasonably sure the Soviets would not be able to accomplish before them.

At first it was not clear whether the United States had the will to carry out such a task, but the manned lunar programme quickly became a top American priority. Soon, the US was pursuing three civil manned space projects simultaneously. While the one-man Mercury missions continued through 1963, the Gemini project and the Apollo lunar landing project were developed in parallel. The Gemini programme was scheduled to begin flight tests by the end of 1964 in order to perfect the techniques and equipment needed for the lunar expedition.[3] Meanwhile, the basic plan for the Apollo moon missions was finalised and contracts to design and build the equipment were completed by the end of 1962. As far as the West was concerned the "moon race" was on.

The Soviet Union appeared to take up the challenge. As with the first two Sputniks, the Soviet Union did not wait long to launch its second, more spectacular manned spaceflight. Little over three months after Gagarin's one orbit flight, German Titov spent a "day" in space in August 1961.[4] This mission took place just days prior to the erection of the Berlin Wall and proved useful in deflecting world attention from the Soviet action in Germany.

After Titov's flight there was a long pause in all Soviet space launches (manned and unmanned) until 1962. Beginning in March 1962, the Soviet Union launched a new unmanned series of satellites under the name of "Kosmos." A TASS press release said that the Kosmos series marked "the beginning of a new vast programme of space research."[5] There were suggestions in the Soviet press and hints from Khrushchev that the purpose of Kosmos satellites was to pave the way for a manned circumlunar flight.[6]

After a flurry of seven successful Kosmos launches in four months, the Soviets launched another spectacular manned spaceflight. In August 1962, cosmonauts Nikolaev and Popovich were launched on the first "dual" spaceflight. Their separate spacecraft (Vostoks 3 and 4) were launched a day apart, but into the same orbit. The spacecraft closely

[3]The first Gemini mission was actually flown in March 1965.
[4]Titov orbited the Earth seventeen times, spending just less than twenty three hours in space.
[5]As quoted in US Congress, Senate Committee on Aeronautical and Space Sciences, Soviet Space Programs: Organization, Plans, Goals and International Implications, 87th Congress, 2nd session, 31 May 1962, p. 225.
[6]US Congress, Soviet Space Programs, 1962, p. 225.

followed each around the Earth for three days. This was an impressive contrast to the US Mercury programme, which had only begun short orbital flights in 1962.[7]

Although Soviet international prestige may have been diminished by the Cuban Missile Crisis in October 1962, the space programme did its part to repair the damage. On 1 November 1962 the Soviet Union succeeded in launching the first space probe to the planet Mars.[8] Not only did the Kosmos series continue unabated, but in April 1963 the Soviet Union launched a new probe in the Luna series (Luna 4) toward the moon.

After the sixth, and final, US manned Mercury mission in May 1963, the Soviet manned programme scored yet another propaganda coup. The June flights of Vostoks 5 and 6 were similar to the previous year's "dual" mission, but this time one of the cosmonauts was a woman - Valentina Vladimirovna Tereshkova.[9] Tereshkova returned to earth to be the guest of honour at an International Women's Conference in Moscow and an example of the equality of women under socialism. The Soviet press was also quick to point out that a Soviet woman now had more time in space than all of the US astronauts combined.[10]

The blatantly political nature of the Tereshkova flight appears to have contributed to a re-evaluation of the Soviet manned programme in the West. Speculation that the Soviets had dropped plans for a lunar landing was fuelled by a number of other events. A respected Western scientist, who had met with leading figures at the USSR Academy of Sciences, reported that the manned lunar effort was not a priority in the Soviet Union.[11] When President Kennedy proposed a joint US-Soviet moon landing programme in September 1963, his offer was met with complete silence, rather than the usual derision.[12]

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[7]Two Mercury missions were sent into orbit in the first half of 1962. Both of them lasted under five hours (3 orbits) each.

[8]This was identified as Mars 1. Like Venera 1, the Soviets eventually lost contact with Mars 1 while it was enroute to the planet.

[9]The other cosmonaut was V. F. Bykovskii.

[10]Nicholas L. Johnson, Handbook of Soviet Manned Space Flight, San Diego: Univelt Inc., 1988, p. 51.

[11]British astronomer, Sir Bernard Lovell, met with Academy of Sciences President Keldysh and others during his visit to the Soviet Union. (US Congress, Senate Committee on Aeronautical and Space Sciences, Soviet Space Programs, 1962-1965: Goals and Purposes, Achievements, Plans, and International Implications, 89th Congress, 2nd session, 30 December 1966, pp. 375-6.)

[12]Kennedy made the proposal in his speech at the opening of the UN General Assembly. (Arthur M. Schlesinger, Jr., A Thousand Days: John F. Kennedy in the White House, London: Andre Deutsch, 1965, p. 785.)

Finally, when pressed by reporters in late October 1963, Khrushchev denied earlier Soviet manned lunar claims.

> "We are not at present planning flights by cosmonauts to the moon. Soviet scientists are working on this problem...We do not want to compete in the sending of people to the moon without careful preparation. It is clear that no benefits would be derived from such a competition."[13]

In the Western press this was widely reported as "dropping out of the moon race." However, Khrushchev was quick to point out that: "We never said we are giving up our lunar project."[14] Emphasising the technical difficulties, he pointed out that once a lunar mission could be safely accomplished, it would be "quiet feasible."

The appearance of yet another new spacecraft immediately after this incident helped to end the Western debate over the aims of the Soviet space programme.[15] Launched in honour of the anniversary of the Revolution, "Polet," was obviously an important new programme.[16] Although Polet was not manned, it did have new capabilities important to the manned programme. Unlike Vostok, it was able to change its orbit. Khrushchev himself, hailed it as a major step forward for the manned space programme.[17] The importance of Polet, and its connection to the manned programme, was further underscored when the second Polet was launched on the third anniversary of Gagarin's flight. This day, 12 April (1964), was a national holiday, "Cosmonautics Day." By June 1964 an analyst for the RAND Corporation could confidently state that:

> "It is evident that the Soviet man-in-space program is not only well planned and well handled, but also enjoys a high priority as well as a high degree of success."[18]

This opinion was confirmed by the next Soviet manned spaceflight in October 1964. Once again, the Soviet Union beat the United States, and stunned the world, by launching the first multi-person spacecraft. Voskhod not only came first, but it surpassed the yet-to-

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[13]As quoted in US Congress, Soviet Space Programs, 1962-1965, pp. 106-7.

[14]As quoted in Nicholas Daniloff, The Kremlin and the Cosmos, New York: William Morrow & Co., 1972, p. 143.

[15]The assassination of President Kennedy in November 1963 was also critical to the end of the debate. The new President, Johnson, was an unabashed supporter of the US lunar programme. He helped to define the US manned lunar programme as a tribute to the slain president.

[16]Polet was launched on 1 November 1963.

[17]See the quote at the beginning of this chapter.

[18]F. J. Krieger, Soviet Astronautics: 1957-1963.33, RAND Memorandum RM-3595-1-PR, Santa Monica, California: RAND Corporation, June 1964, p. 3.

be-launched American Gemini spacecraft. Gemini was to have a crew of two, but Voskhod had carried three men into orbit for a day. Whether the Soviet Union actually had an active manned lunar programme may not have been clear, but it seemed certain that the manned space programme was a top leadership priority.

Institutions and the Policymaking Environment

The Party

The Presidium of the Central Committee

Throughout the tumultuous political events of the early 1960s, the party's top organ, the Presidium of the Central Committee (TsK), had a fairly stable membership. The only large scale changes occurred when new elections were held at the end of the Twenty Second Party Congress in October 1961.[19] Compared to the membership installed during the "Anti-Party Group" affair in 1957, the Presidium was now smaller and included significantly fewer Central Committee Secretaries.[20] These changes were not as significant as they might appear, for they largely ratified previous adjustments in Presidium membership. Most of those dropped from the Presidium in 1961 were either remnants of the Anti-Party Group (like Pervukhin) or people who had already been diverted to other posts at the May 1960 Plenum.

The removal of many of the Central Committee Secretaries has frequently been interpreted as a major political blow to Khrushchev.[21] However, Khrushchev had already widened the base of his power from the party to state institutions. Not only was he Chairman of the USSR Council of Ministers, but he had also spread his supporters into state positions.[22] It seems likely that trimming the number of Central Committee Secretaries

[19]The Twenty Second Party Congress was held 17-31 October 1961.

[20]After the Party Congress in 1961 the Presidium consisted of eleven full members and five candidates, versus fifteen full, and nine candidate, members in July 1957. There were now only four Central Committee Secretaries as full members, versus ten in July 1957.

[21]e.g., Carl A. Linden, Khrushchev and the Soviet Leadership: 1957-1964, Baltimore: Johns Hopkins Press, 1966.

[22]For example, the five Central Committee Secretaries "lost" from the Presidium at the Party Congress in 1961 were: Brezhnev, who remained on the Presidium, although now as Chairman of the Presidium of the Supreme Soviet; Aristov and Pospelov, who had moved to the TsK Bureau for the RSFSR; Ignatov, who was appointed a deputy chairman of the USSR Council of Ministers; and Furtseva, who became Minister of Culture. (Sergei N. Khrushchev, Nikita Khrushchev: Krizisy i Rakety, Vol. 2, Moscow: Novosti, 1994, p. 30.)

and broadening institutional representation would actually have enhanced Khrushchev's authority, and that of the Presidium.[23]

After the 1961 Party Congress there were few formal changes to the Presidium. In April 1962, Kirilenko returned to the Presidium as a voting member.[24] Although F. R. Kozlov was incapacitated by a stroke in April 1963, he was not removed from the Presidium until after Khrushchev's downfall.[25] The only other changes were when Shelest replaced Shcherbitskii in December 1963, and when Kuusinen died in May 1964. The Presidium that removed Khrushchev in October 1964 was largely the same one that he had established during the May 1960 Plenum.

Analysts of the "conflict school" have argued that Frol Kozlov represented a conservative faction in the Presidium and that his efforts to oust Khrushchev can be traced back to 1960. As Second Secretary, Kozlov had control over personnel issues from that time. It seems probable that he could have used this power to appoint like-minded individuals. However, while it may be true that Kozlov favoured people that he knew and trusted, it is not clear that he had turned against his sponsor.[26] Sergei Khrushchev holds that Kozlov followed his father's policy line "step for step" in 1960, and did not begin to deviate from it until early 1963.[27] Even then, he states that the disagreements between the two men did not completely sour relations between them.[28] Although others in the party and state may have objected to Khrushchev and his policies, the membership of the

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[23] T. H. Rigby, "The Soviet Political Executive, 1917-1986," in Archie Brown, ed., Political Leadership in the Soviet Union, Bloomington: Indiana University Press, 1989, p. 40.

[24] Kirilenko had been a candidate member of the Presidium from 1957 until the Twenty Second Party Congress. It is not clear why he was dropped from, and then re-entered, the Presidium within the span of six months. For Kirilenko, see Appendix 3.

[25] John Löwenhardt, James R. Ozinga, and Erik van Ree, The Rise and Fall of the Soviet Politburo, London: UCL Press, 1992, p. 194.

[26] It is important to note that Kozlov had been one of the key organisers of Khrushchev's victory over the "Anti-Party Group." It is not clear what would have compelled him to part company with his patron between 1957 and 1960. The assumption that he did so is critical to most of the "conflict" explanations of the Twenty Second Party Congress.

[27] S. N. Khrushchev, Krizisy i Rakety, Vol. 2, pp. 28 and 431.

[28] Khrushchev's failure to remove Kozlov from the Presidium, when he had a perfectly good medical excuse to do so in April 1963, tends to support Sergei Khrushchev's testimony.

Presidium had every reason to support him until the multiple failures of later years exposed the flaws in his leadership and vision.[29]

For Khrushchev, the political crisis appears to have come in late 1962. By then it was obvious that the Sovnarkhoz reforms had caused more problems than they had solved. "Departmentalism" had been replaced by rampant "localism" that made the economy all but uncontrollable. This required further reforms. Khrushchev's early 1962 attempt, splitting the party into agricultural and industrial branches, only served to increase the level of chaos. As if all of these domestic problems were not bad enough, Khrushchev's risky strategic policy also failed spectacularly in October 1962. His central strategic assumption, that the appearance of Soviet nuclear missile strength would prevent America from risking war, was proven wrong during the Cuban Missile Crisis.[30] The Crisis appears to have precipitated a split in the Presidium.

Apparently, Kozlov began trying to limit Khrushchev's freedom of action and reverse his more radical doctrinal changes. At the November 1962 TsK Plenum, Khrushchev publicly acknowledged the primacy of the heavy industry.[31] His emphasis on missiles appears to have been replaced by a broader military build-up. In February 1963, he formally postponed his consumer programme; a central element of the Third Party Programme that he had pushed through at the Twenty Second Party Congress. He stated that this "belt-tightening" was necessitated by the needs of heavy industry and defence. In an interesting contrast of views, Kozlov did not depict this as a reversal of policy. He stated that everything was fine with the consumer sector.[32]

Kozlov's stroke in April 1963 took the pressure off Khrushchev. He began attacking defence industrialists who, he claimed, were making poor use of resources and

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[29]If we assume that Kozlov was loyal, the members of the Presidium owed their selection and advancement to Khrushchev. The Presidium tradition of deference to the party leader combined with Khrushchev's remarkable record of policy successes (e.g., in the missile and space fields) would have mitigated against the development of opposition. I do not suggest that the "conflict school" was entirely wrong, just that Presidium conflict did not begin before late 1962. Thus, Kozlov was not laying the basis for a conservative coup in his earlier personnel selections.

[30]The reason for putting missiles in Cuba in the first place was to "close the gap" between Soviet missile rhetoric and its military capability.

[31]Herbert L. Sawyer, The Soviet Space Controversy, 1961-63, Fletcher School of Law and Diplomacy, Tufts University, Massachusetts, Ph.D. dissertation, 1969, p. 229.

[32]As quoted in Sawyer, The Soviet Space Controversy, p. 230.

had tried to make themselves immune to criticism. At the December 1963 Plenum, Khrushchev made cuts to the ground forces and a small cut in the military budget.[33] These criticisms and cuts all appear to have been targeted against efforts to undermine his doctrinal emphasis on nuclear missiles. Thus, he could simultaneously cut the ground forces while claiming, in his concluding remarks to the December Plenum, that defence was not being neglected.[34]

Although Khrushchev appeared to have recovered his authority by the middle of 1964, the Presidium ousted him in October. His removal coincided precisely with the flight of Voskhod. While the spacecraft was in orbit on the evening of 12 October 1964, Khrushchev was called at his summer home. On the pretext of an urgent agricultural problem, he was asked to return to Moscow. Upon arrival the next morning, he found the Presidium meeting in the Kremlin to replace him. The following evening, 14 October 1964, a Plenum of the Central Committee accepted Khrushchev's "request" for retirement "in view of his advanced age and deteriorating health."[35]

The Party Leadership and Missile / Space Policy

For most of this period, successes in the missile and space programmes helped Khrushchev to dominate the party and policymaking. The Twenty Second Party Congress is an excellent example. With the first two manned space flights to boast about, the space programme was a major feature of the Twenty Second Party Congress. Cosmonauts Titov and Gagarin prominently served as delegates.[36] In keeping with the overall tone of this Congress, Titov gave a glowing speech referring to Khrushchev as the cosmonauts' "space father."[37] Although such statements have been criticised as manifestations of a new "cult of

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[33]Sawyer, The Soviet Space Controversy, pp. 230-2.

[34] As quoted in Roman Kolkowicz, The Soviet Military and the Communist Party, Princeton: Princeton University Press, 1967, p. 293.

[35]Pravda, 16 October 1964. Khrushchev was indirectly attacked for his "hare-brained schemes," "subjectivism," and other sins in the next edition (17 October) of Pravda.

[36]There were no new space launches to mark the Congress. However, the one launch attempt of the Fall of 1961 did occur during the Party Congress. The launch was to have been the first of the new Kosmos series, but it failed before reaching orbit. See Appendix 12.

[37]As quoted in David Easton Potts, Soviet Man in Space: Politics and Technology from Stalin to Gorbachev, Vol. 1, Ph.D. dissertation, Georgetown University, June 1992, p. 168. This paternal image was frequently invoked. It reached a bizarre peak in late 1963 when Khrushchev gave away his space daughter-bride, V. V. Tereshkova, when she married fellow cosmonaut A. G. Nikolaev.

personality," they were not simply a case of egregious self-promotion on the part of the First Secretary. Khrushchev's point was that he, personally, was responsible for the missile and space programmes that were now reaping huge international political rewards. He used his success in these areas to advance his political agenda at the Party Congress. Of particular note was the passage of the Third Party Programme,[38] which was intended to enshrine the idea of a communist victory over the West through ideological and economic competition.[39]

Khrushchev's particular dominance in missile and space policy was due in large part to the limited number of political leaders involved in these matters. Khrushchev himself took personal charge of policy decisions in this field. The only other party leader with significant policy responsibilities was the Central Committee Secretary for Heavy Industry, Defence, and Space. This post was always held by the number two leader of the party during this period. From 1960, until his incapacitation in 1963, Kozlov had this responsibility.

Kozlov's replacement was an indication of Khrushchev's desire for unchallenged authority over missile and space policy. Brezhnev, who returned to the Secretariat in June 1963, had held the post of TsK Secretary for Heavy Industry, Defence, and Space from 1957 to 1960. The circumstances of Brezhnev's return suggest that Khrushchev was not as interested in someone with experience, as he was in someone who would be unlikely to challenge his personal authority in this field.[40] Moreover, Brezhnev's retention of the post of Chairman of the Presidium of the Supreme Soviet (head of state) and the division of Kozlov's Secretariat responsibilities, also suggest that Khrushchev did not want to give the

[38]The First Party Programme was adopted at the 2nd Party Congress in 1903. The Second Party Programme had been adopted at the 8th Party Congress in 1919. The emphasis of the Second Party Programme had been on building socialist society.

[39]In September 1962 Khrushchev was both explicit and innovative in legitimising this change. Citing previously unpublished parts of an article by Lenin, he announced that the decisive element in the battle against capitalism would be "economic competition, economic competition, economic competition!" (Sawyer, The Soviet Space Controversy, p. 229.)

[40]Brezhnev had limited experience with the defence industry prior to 1957. His weaknesses in this regard appear to have contributed to his appointment in 1957 (when Khrushchev was asserting his authority) as well as his demotion in 1960 (when Khrushchev wanted a more effective supervisor).

new Second Secretary the opportunity to challenge his judgement in defence and space policy.[41]

Although they had no detectable influence on missile and space policy during this period, there were changes in the Central Committee that had important ramifications. At the Twenty Second Party Congress in 1961 there was a substantial overhaul of the membership of the Central Committee. Over sixty three percent of the full members elected in 1961 were new to the Central Committee.[42] By default, if not design, the defence industry was a major source of the new TsK members.[43] The missile industry and the space programme were especially well represented. In fact, after October 1961, the heads of all the planning and executive agencies for missile and space programmes were members of the Central Committee.[44] Overall, the changes to the Central Committee represented a significant co-optation of government leaders into the party hierarchy. In terms of missile and space policy, the changes highlight the remarkable penetration of state and party institutions by the armaments industry clique associated with Ustinov.

The Government

The Council of Ministers and the Ministry Structure

From 1961 until his ouster, Khrushchev exercised fairly tight control over the Soviet central government.[45] The only substantial changes affecting missile and space policy

[41]Brezhnev remained Chairman of the Presidium of the Supreme Soviet for another year. Podgornyi also came into the Secretariat in June 1963 and took on Kozlov's personnel duties. (Jerry F. Hough and Merle Fainsod, How the Soviet Union is Governed, Cambridge: Harvard University Press, 1979, p. 245.)

[42]Hough and Fainsod, How the Soviet Union is Governed, p. 232; and Robert V. Daniels, "Political Processes and Generational Change," in Brown, ed., Political Leadership in the Soviet Union, p. 100. (The numbers in these two sources differ slightly.)

[43]The Sovnarkhoz reforms had eliminated many government posts and Khrushchev had filled many of the remaining ones with defence industrialists. Defence industry ministers had traditionally been members of the Central Committee. The change was that many more defence industrialists became Central Committee members, presumably on the basis of their new positions.

[44]The new TsK members included: Rudnev (Chairman of the GKKNIR), Smirnov (Chairman of the GKOT), Novikov (Chairman of Gosplan), Riabikov (Deputy Chairman of Gosplan), Kalmykov (Chairman of the State Committee for Radio-Electronics), and Keldysh (President of the Academy of Sciences). They joined Ustinov (Chairman of the VPK) and the remainder of the Defence Industrial Ministers as full members of the Central Committee. I. D. Serbin (head of the Defence Industry Department of the TsK) also became a non-voting member of the Central Committee at the Twenty Second Party Congress.

[45]Control over regional governments (e.g. Sovnarkhozes) appears to have been more problematic.

occurred in 1962 when Khrushchev's leadership was questioned in the Presidium. As before, the attempt to curb his powers was played out through the planning organs.

After the Cuban Missile Crisis, at the November 1962 TsK Plenum, another re-organisation of the planning organs was announced. The State Scientific Economic Council (GN-ES) was abolished and Gosplan assumed its duties for long-term plans.[46] Gosplan's previous function, implementing yearly plans, was handed over to the newly created Council of the National Economy (SNKh or National Sovnarkhoz). The SNKh came into existence in December 1962 to ensure the fulfilment of industrial production and material-technical supply plans.[47]

In March 1963 the SNKh was superseded by an ostensibly more powerful Supreme Council of the National Economy (VSNKh).[48] The task of the VSNKh was to supervise and co-ordinate all aspects of the Soviet economy. This super-co-ordinator was to direct Gosplan, the Sovnarkhozes, the GKKNIR, and all of the various State Committees.[49] The VSNKh appears to have had the potential to re-centralise economic control, while keeping that control out of the hands of the Council of Ministers. Despite this sweeping mandate, the VSNKh "seems to have achieved little in its short life."[50]

The apparent weakness of the VSNKh is, perhaps, explained by the identity of its leader. Khrushchev succeeded in promoting D. F. Ustinov from Chairman of the Military Industrial Commission (VPK) to Chairman of the VSNKh.[51] It appears that the reason the

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[46]See Appendix 10.

[47]V. A. Tsikulin, Istoriia Gosurdarstvennykh Uchrezhdenii SSSR 1936 -1965. (Uchebnoe posobie), Moscow: Ministerstvo Vyschego i Srednego Spetsial'nogo Obrazovaniia RSFSR/ Moskovskii Gosudarstvennyi Istoriko-arkhivnyi Institut, 1966, p. 176. This is a remarkable parallel to what had happened exactly 6 years earlier when Gosekonomkom had been elevated in importance by taking on the same functions in December 1956.

[48]An organisation with the same name controlled industry of "All-Union significance" from 1917 to 1932. Notably, it was the basis of the industrial ministry system that developed in the 1930s. (Alec Nove, An Economic History of the USSR 1917-1991, 3rd ed., London: Penguin, 1992, pp. 91-97.) See Appendix 4, sheet 1.

[49]Tsikulin, Istoriia Gosurdarstvennykh Uchrezhdenii SSSR, p. 176.

[50]Nove, An Economic History of the USSR, p. 370. The VSNKh existed from March 1963 until October 1965.

[51]S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 433. Some analysts have suggested that Kozlov created the VSNKh and put Ustinov in place to frustrate Khrushchev. The former conclusion may be true, but the latter is less convincing. If Ustinov had made common cause with Kozlov, he appears to have changed his allegiance quickly after Kozlov's incapacitation. Sergei Khrushchev claims that his father wanted Ustinov to head the VSNKh. It is, of course, possible that the elder Khrushchev was trying to promote Ustinov out of the way for some reason. However, the limited evidence does not support this conclusion.

VSNKh was so little noted for its accomplishments (at least by Western analysts), is that Ustinov simply carried on with the same basic functions he had been doing as Chairman of the VPK. Now, however, he had more formal authority to co-ordinate, execute, and oversee the re-equipment of the Soviet military with missiles. It appears that this promotion left Ustinov in a better position to protect his interests in the space programme.

The Defence Industrial Ministries

The most notable aspect of defence industry leadership during this period was the ripple effect of personnel promotions. These changes of leadership highlight the rise of Ustinov and his missile industry associates. The promotions from 1961 to 1964 also reflected Khrushchev's priorities and preferences. The personnel changes came in two major waves; 1961 and 1963.

In June 1961 Minister K. N. Rudnev was moved from Chairman of the GKOT to head of the new science planning organ (GKKNIR).[52] This left open the dual post: Chairman of the GKOT and head of the State Commission for Spaceflight. These positions were filled by L. V. Smirnov on 10 June 1961.[53] Although Smirnov had been Deputy Chairman of the GKOT for missiles since February 1961, he had not been a member of the State Commission for Spaceflight before this point. In fact, his career had been tied to Iangel', not Korolev.[54]

The effect of Smirnov's promotion carried down to the leading research institution for the missile and space industry, NII-88. Smirnov's replacement as Deputy Chairman of the GKOT, G. A. Tiulin, had been the head of NII-88. While Tiulin's promotion may have seemed like good news for his old friend Korolev, his replacement at NII-88 posed a major problem. Iu. A. Mozzhorin was not close to Korolev. In his own reminiscences, Mozzhorin makes note of this, and dwells on long-remembered mistreatment by the Chief Designer in post-war Germany.[55]

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[52] See the Academy of Sciences section below and Appendix 10. For Rudnev, see Appendix 3.
[53] V. Pappo-Korystin, V. Platonov and V. Pashchenko, Dneprovskii Raketno-Kosmicheskii Tsentr, Dnepropetrovsk: PO Iuzhnyi mashinstroitel'nyi zavod and KB Iuzhnoe, 1994, p. 67. For Smirnov, see Appendix 3.
[54] Smirnov had attracted Khrushchev's attention in 1959, when he was serving as director of the missile plant in Dnepropetrovsk. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 423.)
[55] Oral History of Iu. A. Mozzhorin in Iu. A. Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, Moscow: MAI Press, 1992, pp. 132-40. For Mozzhorin, see Appendix 3.

The weakness of Korolev's relationship with the new head of NII-88 became important. Under Tiulin, NII-88 had been a dependable supporter of Korolev's proposals. Mozzhorin, however, seriously and energetically undertook the task of transforming NII-88 into an impartial "lead" research institution.[56] Instead of serving merely as a repository of special equipment and expertise for the design bureaux, NII-88 tried to return to its former position as the head institute in the missile, and now, space field. For Mozzhorin this meant that his organisation had two main tasks; to evaluate proposed programmes and projects, and to ensure that they fit with the long-range plans for the development of the missile-space industry.[57] When NII-88 began to assert itself as the evaluator of new proposals, it was bound to come into collision with the chief designers it was judging.

The cumulative effects of the 1961 personnel changes were bad for Korolev and his space aspirations. Some of his supporters had been promoted to higher positions, but his primary supervisors were no longer his allies. Both Smirnov and Mozzhorin had professional and personal reasons to rein-in Korolev. This appears to be one of the reasons that they were promoted to these posts.

The second wave of changes in the defence industry leadership came after Ustinov was promoted from head of the VPK to Chairman of the VSNKh in March 1963. Following in Ustinov's footsteps, L. V. Smirnov moved from Chairman of the GKOT to Chairman of the VPK. These latter promotions not only maintained the same basic relationship between missile industry leaders, but apparently allowed them to maintain much of their previous responsibilities for the space and missile programmes. Ustinov was still the top supervisor of the defence industries, with Riabikov, his deputy at VSNKh, in charge of planning, and Smirnov in charge of execution.[58]

This upward shift in responsibility for the space and missile programme is further suggested by the selection of a missile "outsider" to lead the GKOT in 1963. Smirnov's

[56] This had been the intent of new rules on science management issued by the Central Committee in 1959.
[57] "O Nauchno-tekhnicheskoi Deiatel'nosti Iu. A. Mozzhorina (k 70-letiiu so dnia rozhdeniia)," Iz Istorii Aviatsii i Kosmonavtiki, Vol. 60, 1990, pp. 9-10.
[58] On Ustinov's continuing control over defence industry see Kamanin's diaries and Archie Brown, ed., The Soviet Union: A Biographical Dictionary, London: Weidenfeld and Nicolson, 1990, p. 409.

replacement as Chairman of the GKOT was S. A. Zverev.[59] Zverev was not previously associated with the missile programme. He had a background in more conventional armaments.[60] Although Zverev was still formally in the chain of command,[61] Ustinov appears to have maintained personal control over space and missile decisions.

The Military

Leadership turnover and inter-service rivalry over space policy served to limit military influence in space policymaking during Khrushchev's final years. For the newest military service, the Strategic Rocket Forces (RVSN), leadership turmoil was a major problem. Inter-service rivalry over roles and missions, and doctrinal controversies, appear to have neutralised military influence more than changed policy outcomes.

After the loss of Marshal M. I. Nedelin in October 1960, the RVSN was not only without a dedicated, young commander, but suffered from rapid leadership turnover. Khrushchev's old crony, Marshal Moskalenko lasted less than two years as leader of the RVSN. In 1962 he was replaced by another officer from the Air Defence Forces (PVO), Marshal S. S. Biriuzov.[62] Biriuzov was a strong supporter of military space projects.[63]

A year later, in 1963, Marshal Biriuzov was promoted to Chief of the General Staff. His replacement as Commander-in-Chief of the RVSN was Marshal N. I. Krylov. This was a return to tradition for the RVSN, since Krylov was an artillery officer, like Nedelin.[64] However, unlike Nedelin, Krylov had no ties to Korolev. In fact, Krylov was reputed to be a major opponent of Korolev.[65] Fortunately for Korolev, the rapid turnover of leadership limited the influence of such conservative military leaders. It also offered an opportunity to break the RVSN's hold on the manned space programme.

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[59]Notably, Tiulin, the Deputy Chairman of the GKOT for missiles (and friend of Korolev), was not promoted to head the GKOT as his predecessor (Smirnov) had been.

[60]For Zverev, see Appendix 3.

[61]Note that Zverev was one of the addressees of a letter that Korolev wrote to the industrial leadership on 1 April 1963. (G. Vetrov, "Trudnaia Sud'ba Rakety N-1," Nauka i Zhizn, No. 5, May 1994, p. 23.)

[62]Moskalenko was pensioned off to the Chief Inspectorate of the General Staff. Biriuzov had been Commander-in-Chief of the PVO and Deputy Minister of Defence since 1955. For Moskalenko and Biriuzov, see Appendix 3.

[63]N. P. Kamanin, "Dlia Nego Zhit' - Oznachalo Letat'," Vozdushnyi Transport, No. 18-19, 1994, p. 12.

[64]For Krylov, see Appendix 3.

[65]Christian Lardier, L'Astronautique Sovietique, Paris: Armand Colin, 1992, p. 149.

Yet, the RVSN's main competitor for control of the manned space programme was an even weaker branch of service, the Soviet Air Force (VVS). Throughout this period Soviet Air Force General Kamanin, chief of cosmonaut selection and training, tried to transfer control over manned spacecraft R&D to the VVS. Thanks to support from Minister of Defence Malinovskii, the Main Administration of Rocket Armaments (GURVO) of the RVSN retained its authority over both missile and spacecraft R&D. In fact, Kamanin's diaries suggest that the Soviet Air Force had to struggle to retain control over one of its primary space responsibilities; cosmonaut training.[66] The Soviet Air Force was doomed, both by Khrushchev's missile doctrine and domestic political struggles, to stay near the bottom of the military service pecking order.[67]

Within the RVSN itself, support for the manned space programme varied considerably. The Commanders-in-Chief generally opposed Korolev. Like their compatriots on the General Staff, they wanted reliable weapons that could be used to defend the Motherland. To them, Korolev's spaceflight antics were more than a distraction, they were a waste of vital resources. However, the leaders of the Main Administration for Rocket Armaments (GURVO), and those who worked closely with Korolev at the Baikonur launch site, were strong supporters of manned spaceflight.[68]

Such support for the manned spaceflight programme appears to have been the exception among senior military officers at the time. This is not to say that the military was not proud of Soviet space accomplishments, but many officers disagreed with the priority they were given. To the professional military, the space programme was a symptom of a larger problem - Khrushchev's single-minded conviction that nuclear missiles had made all other weapons obsolete. Although they objected to Khrushchev's doctrinal revisions,

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[66]By 1964, Korolev was threatening to set up his own training programme in his design bureau. (N. P. Kamanin, "I Would Never Have Believed Anyone.." Sovetskaia Rossiia, 11 October 1989, p. 4, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-91-002, 16 April 1991, p. 21.) The VVS's other main responsibility was rescue and recovery of spacecraft.

[67]Unlike its counterpart in the United States, the VVS had remained functionally subordinate to the Army throughout the post-war period. The manned space programme offered a tantalising opportunity for some VVS generals to create a new, more important mission. They did not succeed.

[68]Lardier, L'Astronautique Sovietique, p. 134. This is further suggested by N. N. Smirnitskii, when he points out in his reminiscences that Marshal Tolubko, a later Commander of the RVSN, intentionally snubbed the leaders of GURVO and Baikonur during the 25th Anniversary celebrations of the RVSN in 1984. (Oral History of N. N. Smirnitskii in Mozzhorin, ed., Dorogi v Kosmos, vol. 1, p. 152.)

military leaders were generally unable, or unwilling, to do much about it. With no direct voice in policy decisions, their complaints could only be voiced in the form of bureaucratic obstructionism and oblique criticisms in the press.[69]

The USSR Academy of Sciences

Oversight and control of the Academy of Sciences was substantially improved at precisely the same time as Gagarin's flight. This was accomplished through a number of means. A new supervisory organ, re-organisation, a change of leadership, and tighter controls over membership in the Academy of Sciences and its commissions all helped to improve political control over the organisation. However, not all of these changes were detrimental to the space enthusiasts.

In early 1961, the long-discussed problems of the re-organisation of the Academy of Sciences and improving the effectiveness of scientific research were simultaneously resolved by a joint decree of the TsK Presidium and the Council of Ministers.[70] The decree was approved on 3 April 1961, the same date that the Presidium approved the flight of Vostok. Implementation of the decree began immediately, but its provisions were not made public until 12 April, the day of Gagarin's flight.

The decree created a new planning institution, the State Committee for the Co-ordination of Scientific-Research Work (GKKNIR).[71] This new All-Union State Committee was supposed to unify the scientific-research activities of the USSR Academy of Sciences, the Union Republic Academies of Sciences, and the ministries and departments of the USSR. The GKKNIR would do this by serving as the "leading" institution for the direction of research, in accordance with the directives of the party and government.[72] Whether the GKKNIR was specifically intended to co-ordinate weapons R&D is not

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[69]For an interesting, if dated, study of the latter see: Sawyer, The Soviet Space Controversy. For the military's lack of influence on policy see: S. N. Khrushchev, Krizisy i Rakety, Vol. 2, p. 28.

[70]The decree was entitled "About measures to improve the co-ordination of scientific-research work in the country and the activities of the Academy of Sciences of the USSR." (Tsikulin, Istoriia Gosurdarstvennykh Uchrezhdenii SSSR, p. 176.) See Appendix 6.

[71]See Appendix 10. GKKNIR was set up parallel to the State Scientific-Technical Committee (GN-TK), the weak successor to Gostekhnika. Since GKKNIR took over the functions of the GN-TK, "the latter suspended its activities." (Tsikulin, Istoriia Gosurdarstvennykh Uchrezhdenii SSSR, p. 176)

[72]Tsikulin, Istoriia Gosurdarstvennykh Uchrezhdenii SSSR, p. 176.

known. However, the newly appointed Chairman of the GKKNIR would have been well suited to the task.

M. V. Khrunichev was promoted from First Deputy Chairman of Gosplan to Chairman of the GKKNIR.[73] The importance of his new post is suggested by the fact that he also returned to the Council of Ministers as a Deputy Chairman. This was a most curious resurrection of a person long associated with Khrushchev's political enemies.[74] Unfortunately, Khrunichev did not live long enough to demonstrate why, or how, he had been appointed. He died unexpectedly on 2 June 1961.

Khrunichev's replacement as Chairman of GKKNIR was also a defence industrialist, but his knowledge of weapons R&D was not put to immediate use in this post. K. N. Rudnev, Ustinov's long-time deputy, and then-Chairman of the GKOT, took over the GKKNIR in June 1961. Organisationally, the GKKNIR was still on par with Ustinov's VPK and had the authority to "unify" research work in the ministries. In practice, however, the GKKNIR's authority did not extend to the defence industrial ministries. The organisation appears to have concentrated on non-defence R&D.

The decree which created the GKKNIR on 3 April 1961 also implemented the long debated re-organisation of the Academy of Sciences. At first blush it appeared that the scientists had won the battle for control over their research agenda by ridding the Academy of Sciences of the applied and engineering institutes. After the decree, one third of all Academy research institutes were transferred to various ministries and State Committees; this included nine of the twelve institutes of the Department of Technical Sciences.[75] With the demise of the Department of Technical Sciences ("home" of many of the space enthusiasts) and the ejection of applied research institutes, it now looked as if the Academicians would be free to pursue "basic research."

It soon became apparent that this re-organisation was <u>not</u> a victory for those in favour of decreased party and government control over the direction of science. It was quite

[73]For Khrunichev, see Appendix 3.

[74]Khrunichev had previously been a First Deputy Chairman of the Council of Ministers from 1955-1957, served as one of Pervukhin's Deputies in Gosekonomkom from 1956-1957. During the Sovnarkhoz reforms he was demoted from the Council of Ministers and sent to Gosplan.

[75]John Löwenhardt, <u>Decision-Making in Soviet Politics</u>, London: Macmillan, 1981, pp. 127-8.

the opposite. Along with the loss of so many institutes and employees, the Soviet Academy of Sciences was now subject to even more control over its research agenda through the newly established State Committee for the Co-ordination of Scientific-Research Work (GKKNIR). The 3 April decree had cited serious shortcomings in the work of the Academy that were ascribed to the lack of a "general state organ for the co-ordination of scientific research." Now the Academy of Sciences was to concentrate on "the most important research in the natural sciences and humanities."[76] However, the GKKNIR, not the Academicians, would decide what was "most important."[77]

The implications of this change appear to have been made clear to the Presidium of the Academy of Sciences when it met with Khrunichev (Chairman of the GKKNIR) and Kosygin (then First Deputy Chairman of the Council of Ministers) on 10 April 1961.[78] At this meeting it was announced that over the next two months there would be a review of all Academy of Sciences work, development of proposals for improving research, and the termination of "projects of no real value."[79]

For the President of the Academy of Sciences, Academician Nesmeianov, this was a brutal reversal of his efforts to free the Academy from party and government interference. On 19 May 1961 it was announced that Nesmeianov had resigned after having completed two five year terms of office, and that M. V. Keldysh had taken his place. However, this change was not a simple procedural matter within the Academy of Sciences. According to Khrushchev, the appointment of Keldysh was actually made by the Soviet leadership after Nesmeianov had "suggested" it at a meeting of the Council of Ministers.[80] According to the Academy of Sciences constitution, the President was supposed to be elected at a General Meeting. Yet, on the pretext of Nesmeianov's resignation, Keldysh was simply appointed President by the political leadership, without even the formality of a General Meeting.[81]

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[76] As quoted in Löwenhardt, Decision-Making in Soviet Politics, p. 167.
[77] The Academicians would only be allowed to provide advice to the GKKNIR. (Löwenhardt, Decision-Making in Soviet Politics, p. 170.)
[78] Löwenhardt, Decision-Making in Soviet Politics, p. 165.
[79] Löwenhardt, Decision-Making in Soviet Politics, p. 168.
[80] Nikita S. Khrushchev, Khrushchev Remembers: The Last Testament, ed. and trans. by Strobe Talbott, Boston: Little, Brown & Co., 1974, p. 61.
[81] The next General Meeting was held in November 1961.

Keldysh was willing to assert Khrushchev's priorities at the Academy of Sciences. According to Khrushchev, his long connection with defence R&D made Keldysh the perfect candidate for President.

> "Like Kurchatov, Keldysh was irrevocably committed to our concept of what needed to be done in the development of nuclear missiles... (he) has run the Academy with a firm hand."[82]

The tighter political control is suggested by the 1962 membership elections. This was the smallest group brought into the Academy of Sciences in the post-Stalin era.[83] Moreover, none of the space scientists or designers associated with Korolev were elected or promoted in this election.

The appointment of Keldysh may have signalled the end of the Academy of Sciences' hopes for independence, but it was not entirely bad for manned space programme advocates. Although the Department of Technical Sciences was officially eliminated, Korolev and his fellow space engineers simply transferred to a number of new departments that were created in the re-organisation.[84] In addition, the appointment of former-GKOT Chairman Rudnev as head of the GKKNIR, meant that Korolev (and possibly Iangel') had an ally at the head of the government organ overseeing the research agenda of the Academy of Sciences. Having Keldysh serve as both the President of the Academy of Sciences and Chairman of the Interdepartmental Commission on Spaceflight was a major advantage for Korolev. One of the few negative developments for Korolev within the Academy of Sciences was that, by 1963, Glushko and Chelomei had been appointed as members of the Interdepartmental Commission on Spaceflight.[85]

The State Commission(s) for Spaceflight

The enigmatic "State Commission," especially during this period, has long been a bane to researchers. Most Soviet sources do not even specify the name or function of this

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[82]Khrushchev, Khrushchev Remembers: The Last Testament, p. 61.

[83]See Appendix 5.

[84]The bulk of the space designers appear to have wound up as members of the Department of Mechanics and Processes of Control. It is not known when this Department was created, but it elected its first new member in the 1964 elections. A number of new and/or subdivided Departments made their appearance with this election. (G. K. Skriabin, ed., Akademiia Nauk SSSR: Personal'nyi Sostav, Book 2: 1917-1974, Moscow: Nauka, 1974.)

[85]Kamanin's diary of 21 March 1963 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'..." Vozdushnyi Transport, No. 43, 1993, pp. 8-9.

body; referring to it by the simple, singular title: "the State Commission." Even recent reports by former Chairmen of the State Commission for Spaceflight state that a single "State Commission" controlled the launches of all spacecraft; manned, unmanned, and planetary.[86] Yet, it is now evident that there was more than one "State Commission."[87]

Prior to 1961, there was only one State Commission for Spaceflight. As reported in the previous chapter, it was formed as a high-level government institution in 1958 under the leadership of K. N. Rudnev, Chairman of the GKOT. When Smirnov became Chairman of the State Commission for Spaceflight in 1962 its responsibilities were sharply curtailed. New space projects and programmes were assigned their own state commissions. The original State Commission for Spaceflight narrowed its focus to manned space projects. The confusion between all of these state commissions was increased by the fact that the membership of the state commissions overlapped. There were different chairmen for different projects, but the bulk of the membership of all of the state commissions dealing with space projects was made up of the same few ministerial, military, and technical experts.

The proliferation of state commissions for space projects represented a return to standard weapons R&D practice. The chairmen of these new state commissions were commonly the heads of the launch site or one of the leaders of NII-4, i.e. a senior military officer.[88] The military "customer" was once again in charge of evaluating R&D projects. This tradition had remained largely unchanged in the missile programme.[89] For Korolev's space projects, the responsibilities of a state commission (the State Commission for Spaceflight) had been broadened, and the chairmanship conferred on a defence industrial minister. Although the State Commission for Spaceflight retained its sweeping powers of

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[86]e.g., K. A. Kerimov quoted in Iu. A. Skopinskiy, "State Acceptance of the Space Program: 30 years of work - from the history of science," Zemlia i Vselennaia, No. 5, September-October 1988, pp. 73-79, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-89-005, 15 March 1989, p. 63; and G. Tiulin, "Zadanie Na Budushchee," Krasnaia Zvezda, 2 April 1988.
[87]Tiulin (in the same article cited above) states that he was Chairman of the State Commission for the Mars 1 mission prior to becoming Chairman of "the" State Commission (for Spaceflight) in late 1962. (Tiulin, "Zadanie Na Budushchee.") There are quite a number of other individuals who have also been identified as chairmen of a state commission for various other manned and unmanned space projects that ran simultaneously.
[88]NII-4 was the RVSN's research institute. See Appendix 7, sheet 3.
[89]The R-7 was a notable exception.

co-ordination, it no longer supervised the entire space programme. It was now only one of the many ad hoc commissions used to manage the growing Soviet space programme.

The State Commission for Spaceflight changed again in late 1962. Smirnov was replaced as Chairman by his deputy at the GKOT, G. A. Tiulin.[90] Tiulin was only a Deputy Chairman of the GKOT, but for manned space supporters the appointment of Korolev's old friend was probably seen as a major improvement. It is worth noting that this change seems to have occurred after the Cuban Missile Crisis, when Khrushchev was in a relatively weak position. However, it is quite possible that Smirnov was happy to shed his responsibility as Chairman of the State Commission for Spaceflight; he had plenty of other responsibilities and was not a space enthusiast.[91] In any case, by 1963 the original State Commission for Spaceflight had been substantially downgraded and its responsibilities limited to manned spaceflight.

Design Bureaux and Policy

The Council of Chief Designers

Korolev's Council of Chief Designers appears to have been subjected to a treatment similar to that of the Academy of Sciences. Sometime in 1961, the Council of Chief Designers was granted formal recognition and powers over the space programme.[92] The most significant change was that the Council of Chief Designers was now authorised to issue orders regarding the manned space programme that were binding on all ministries and state committees.[93]

While at first blush this may appear to be a significant increase in the power of the Council of Chief Designers, it became a way for state and party leaders to gain control over

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[90] Lardier says that this change occurred in October (Lardier, L'Astronautique Sovietique, pp. 134 & 287). However, Tiulin states that he became Chairman sometime after the launch of the Mars 1 probe. (Tiulin, "Zadanie Na Budushchee.") Mars 1 was launched on 1 November 1962.

[91] Note that the bulk of the articles written about the State Commission for Spaceflight completely ignore Smirnov's tenure as Chairman. Tiulin is one of the only people to have publicly acknowledged Smirnov's role. (Tiulin, "Zadanie Na Budushchee." This article was published prior to the articles that skip over Smirnov's chairmanship.)

[92] Indirect evidence suggests that this may have occurred as early as March 1961.

[93] B. Konovalov, "Ryvok k Zvezdam," Izvestiia, 1 October 1987.

this institution. The Council of Chief Designers had already started to fragment.[94] By formalising its existence, party supervisors now had a say in its membership. By assigning it definite responsibilities, the state (notably the VPK) could hold it accountable. Korolev could no longer use the Council of Chief Designers as a way to present a "united front." In fact, there was little likelihood that the Council of Chief Designers would abuse its new authority to issue orders, because it was too tightly supervised to get away with it.

OKB-1: Korolev

The creation of two new space design bureaux in 1960 may not have appeared threatening to Korolev at first, but combined with other changes in the domestic environment, it forced Korolev to abandon his Tsiolkovskii-inspired plans for manned spaceflight. Korolev had not only lost the confidence of Khrushchev, but now he faced an array of hostile institutions. NII-88, the GKOT, and (at times) the RVSN were no longer led by allies. The State Commission for Spaceflight had been substantially downgraded and limited. Finally, the Academy of Sciences and the Council of Chief Designers were subject to tighter control and party discipline. Korolev's attempt to set up an alternative centre for the space programme in the Academy of Sciences had failed.

Korolev found that he had to appeal to his military customers once again. However, military and industrial leaders were turning their attentions to more militarily useful missile and space projects. Even as early as January 1961, Korolev's letters suggest that he was scrambling to prove his military credentials. In mid-January Korolev wrote to Rudnev (then, still Chairman of the GKOT and head of the State Commission for Spaceflight) about the military utility of OKB-1's plan for the year.[95]

Korolev's earlier efforts to shed military projects came back to haunt him. The most obvious case of this was the preference shown to Iangel' in the missile field. However, there is also evidence that Korolev's control over military projects in his own space industry empire was slipping from his grasp. OKB-1's Filial No. 2 in Krasnoiarsk is a perfect

[94]This was not just a matter of the Glushko-Korolev fuel controversy. Other members of the Council of Chief Designers had begun co-operating with Korolev's competitors; Iangel' and Chelomei.
[95]The letter was dated 15 January 1961. (Vetrov, "Trudnaia Sud'ba Rakety N-1," May, pp. 22-23.)

example. In December 1961 it was made independent of OKB-1 and renamed OKB-10.[96] The next year work on Korolev's R-9 (SS-10) at OKB-10 was cancelled and the design bureau was assigned to work on several of Iangel"s projects.[97]

It became painfully apparent that Korolev would not immediately be able to fulfil the Tsiolkovskii vision of a robust human spaceflight programme. Not only were his manned spacecraft proposals rejected by the leadership, but he terminated his own studies of highly advanced technology.[98] Many of these, like the SK-125 rocket, were long-range projects crucial to the colonisation of space.[99] In the interest of keeping his manned space programme alive Korolev jettisoned his Tsiolkovskii-inspired plans and turned to more immediate goals.

Developments in the unmanned planetary programme run by Korolev also reflect his precipitous decline during this period. The Fall of 1962 witnessed a frenzied, and spectacularly unsuccessful, effort to launch probes to both Mars and Venus.[100] Only one, of at least six, spacecraft made it out of earth orbit, and it failed before reaching its goal.[101] When the launch window to Mars next opened, in late 1963, the Soviet Union did not even attempt a mission. When Venus again came into range (late 1963 to early 1964) the planetary programme came back to life. This time four attempts were made. The results were identical to those of 1962. Only one spacecraft was successfully launched on its way, and contact with it was also lost before it reached its goal.[102]

Lunar probes were essential to a manned lunar expedition, but efforts in this direction were sporadic. The Luna programme remained dormant from April 1960 until January 1963. Then a series of three probes designed to land on the moon and investigate

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[96]S. Golotyuk, "After Thirty Years and Thousand Satellites," Russian Space News (in English), No. 17, August 13-26 1994, p. 28.

[97]Golotyuk, "After Thirty Years and Thousand Satellites," p. 28. The Iangel' projects included the Kosmos (SL-7) rocket and two satellites. (Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, pp. 69-70.)

[98]S. Kriukov, "Blesk i Zatmenie Lunnoi Programmy," Nauka i Zhizn, No. 4, April 1994, p. 81.

[99]The SK-125 rocket project was designed to use liquid hydrogen and electro-nuclear motors in the upper stages. (Lardier, L'Astronautique Sovietique, p. 164.) Tsiolkovskii had advocated just such propulsion systems for use on manned flights to the planets.

[100]See Appendix 12.

[101]This was Mars 1.

[102]This mission marked the beginning of a new designation for planetary missions. It was known as Zond 1.

its surface were launched. The first two of these probes never made it out of earth orbit. The third, launched in April 1963, missed the moon by 8500 kilometres. A year later two more Luna missions were attempted. Both of them failed to make it out of earth orbit. Korolev wanted more Luna missions, but the dismal record of failure kept the programme limited.[103]

OKB-586: Iangel'

Iangel''s involvement in the Soviet space programme went through an unusual rise and fall between 1961 and 1964. The space projects initially authorised in August 1960 came to fruition in early 1962 and set a number of precedents. Yet, Iangel''s space efforts were curtailed later the same year. OKB-586 continued to produce new military missiles and developed space booster variants of two of them. But, Iangel''s foray into the space business was relatively limited.

There are a number of notable aspects about the start of Iangel''s space work that highlight his rise to prominence. Iangel''s space projects had been authorised in August 1960 and were ready for launch just over a year later. In fact, the launch of the first of Iangel''s new boosters and satellites was planned to coincide with the Twenty Second Party Congress. Although the launch attempt failed, this did not appear to damage Iangel''s prospects. At the close of the Party Congress, on 31 October 1961, the Central Committee and Council of Ministers issued a decree authorising the conversion of Iangel''s R-14 (SS-5) into a space launcher[104] and the creation of three new satellites at OKB-586.[105] As with the Kosmos booster project, the new launcher was a proposal that Iangel' had already developed. Work on the draft project (EP) had begun in OKB-586 six months earlier, in April 1961.[106] It is not clear who initiated the satellite projects.

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[103]Lardier, L'Astronautique Sovietique, p. 116.

[104]At first, the Soviet Union publicly identified this new booster by the same name as its predecessor - Kosmos. In later years this rocket (or a version of it) was also called Interkosmos. It's ministry designation was 65S3 and it was known in the West at the SL-8 or Large Kosmos. For the purposes of this dissertation I will refer to this rocket as Interkosmos. See Appendix 2.

[105]These three satellites were called Meteor, Strela, and Pchela. (Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 68.)

[106]Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 67.

The planned use of a Iangel' space launch to mark the Party Congress was an important change. Not only had Iangel' broken Korolev's monopoly in spacecraft design and construction, but he also broke Korolev's monopoly on political events. This was quite a change. Iangel' had never launched a spacecraft, yet he was selected to supply the space spectacular for the Congress, not Korolev.

Another notable aspect of Iangel''s space projects is that virtually everything about them was new. Not only were the booster rocket and satellite new, but they were launched from a new "cosmodrome," the missile test range at Kapustin Iar.[107] The launches of Iangel''s satellites were also supervised by a new "State Commission," chaired by the commander of Kapustin Iar, General V. I. Vozniuk.[108]

Another new thing about Iangel''s satellites was their public designation. When the first of his satellites made it to orbit on 16 March 1962, it was heralded as the first of the new "Kosmos" series. However, Kosmos was not just a new series of satellites, it was a designation applied to a wide variety of satellites as a general cover name. Among other things, the designation was used to hide unsuccessful planetary missions and unmanned tests of manned craft. Kosmos missions did include a series of scientific satellites from OKB-586. However, the bulk of the Kosmos missions were devoted to military aims, especially photo-reconnaissance.[109] By 1964 the military missions also included navigation, radar calibration, and meteorology. Exactly which, if any, of these satellites were designed at OKB-586 is unknown.

The first half of 1962 was an especially good period for Iangel'. His first Kosmos booster (SL-7) succeeded in delivering five satellites in a row to earth orbit.[110] He was similarly successful in the missile field. An upgraded version of his R-14 (SS-5) began flight tests early in the year. In addition, series production of his R-16 (SS-7) ICBM had begun in January, and tests of the silo launched version began in July. On 16 April 1962

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[107]Until this point all space launch attempts had been made from Baikonur, using versions of Korolev's R-7.
[108]For Vozniuk, see Appendix 3.
[109]The early photo-reconnaissance satellites were a product of the Korolev organisation. They were apparently built by Filial No. 1, later known as the TsSKB, in Kuibyshev.
[110]Kosmos numbers 1, 2, 3, 5, and 6. Whether the satellites themselves were successful is not known.

the Council of Ministers directed Iangel' to develop three new dual purpose missiles.[111] These missiles, known in the design bureau as the R-36, R-46, and R-56, were to carry weapons weighing five, fifteen, and fifty tonnes respectively. This family of ICBMs was also intended for use as space launchers. The R-56 was expected to be able to launch a payload of forty tonnes into earth orbit.[112]

During the second half of 1962 Iangel' began to shed his space projects. The three satellites he had been assigned to develop in October 1961, and development of his Kosmos rockets, were handed over to other design bureaux in the summer of 1962.[113] It is possible that these changes were forced on Iangel', but several sources state that the transfer was initiated by Iangel' himself.[114] OKB-586 did not abandon satellite work completely. In October 1963, the "government" approved the creation of a space design group at Iangel''s KB.[115] Yet, it seems that Iangel' was uninterested in building a space empire of his own.

The focus of attention at OKB-586 shifted away from space and back to a limited number of missiles. On 15 July 1963 three of Iangel''s ballistic missiles were accepted into the inventory: improved versions of the R-12 (SS-4), R-14 (SS-5), and R-16 (SS-7).[116] OKB-586 was awarded the Lenin Prize for the R-16 (SS-7) in April 1964.[117] In June 1964 the R-56 project was cancelled.[118] The R-46 was also cancelled at some point, so that attention focused on the R-36.[119] Iangel' remained a central figure in missile development, but he was no longer a major competitor in spacecraft development after 1962.

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[111]The decree was entitled: "About the creation of models of intercontinental ballistic and global rockets and carriers of heavy space objects." (Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, pp. 68-9) This paralleled the assignment given to Chelomei in 1960 to develop three dual purpose missiles.

[112]S. N. Koniukhov and V. A. Pashchenko, "History of Space Launch Vehicles Development," IAF/IAA paper No. IAA-95-IAA-2.2.09, as quoted by Phillip Clark in personal correspondence on 25 January 1996. The R-56 booster is also mentioned in Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr (p. 69). In this work its space payload is given as 30 tonnes.

[113]Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 69. The Meteor weather satellite was given to the All-Union Scientific-Research Institute of Electromechanics (VNIIEM). The Strela and Pchela satellites and the Kosmos rockets were handed over to M. F. Reshetnev's OKB-10.

[114]e.g., Golotyuk, "After Thirty Years and Thousand Satellites," p. 28; and Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 69.

[115]Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 71. This group at OKB-586 was known as "Complex 8" and was headed by the designer of the early Kosmos satellites, V. M. Kovtunenko.

[116]Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 70

[117]Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 71.

[118]Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 72.

[119]The R-36 was eventually accepted into the inventory as both a ballistic missile (SS-9) and a space launcher (SL-11 or Tsiklon). See Appendix 2.

OKB-52: Chelomei

V. N. Chelomei may not have been taken seriously in 1960, but that quickly changed. His desire for missile and space projects was satisfied with an abundance of assignments. He also accumulated the design, test, and production facilities needed to make these projects a reality. By the end of 1963 he had launched his first satellite, and was proving himself to be an innovative designer, and ruthless competitor.

While Chelomei had originally sold his rockets to Khrushchev as dual purpose ICBMs and space boosters, the work at OKB-52 over the next few years turned primarily to their military application. The UR-200 was designed primarily for use as an ICBM.[120] While work on the UR-200 was just beginning, Chelomei simultaneously began development of the UR-500.[121] Two models of this rocket were approved for development by the Council of Ministers on 29 April 1962; a two stage silo-based missile for carrying a huge nuclear warhead, and a three stage space launcher.[122] In addition, Chelomei took on an anti-ballistic missile project and worked on a number of ballistic and winged missiles for the Navy.[123]

Even while his designs were still on the drawing boards, Chelomei's political fortunes continued to soar. In the June 1962 elections, Chelomei was one of the thirteen people promoted to Academician of the Academy of Sciences.[124] That same year his design bureau was given a huge tract of land west of Korolev's facilities at Baikonur. There they built an enormous complex for assembling and testing the UR-200 and UR-500.[125] In late 1962 Chelomei took control of the Lavochkin design bureau (OKB-301).[126] It was merged

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[120] Lardier, L'Astronautique Sovietique, p. 98. The origins of Chelomei's UR-100 are unclear. The UR-100 (SS-11) was not accepted into the inventory until 1967.

[121] Design work on the UR-500 was begun in 1961 at the newly acquired Filial No. 1 (the former Miasishchev design bureau).

[122] V. Petrakov and I. Afanas'ev, "Strasti po Protonu," Aviatsiia i Kosmonavtika, No. 4, April 1993, p. 10. The second stage of both versions was to be based on the UR-200. The decree called for the work to be completed in three years. (Anatoly I. Kiseljov, Anatoly K. Nedaivoda, Vladimir K. Karrask, Gennady D. Dermichev, "The Launch Vehicle 'Proton': the History of its Creation, Peculiarities of its Structure and Prospects for Development," Space Bulletin, Vol. 1, No. 4, 1994, pp. 5-7.)

[123] S. N. Khrushchev, Krizisy i Rakety, Vol. 1, pp. 441-2.

[124] Skriabin, Akademiia Nauk SSSR, Book 2.

[125] Kiseljov, et al., "The Launch Vehicle 'Proton.'"

[126] Lavochkin, one of the top Soviet aircraft designers of World War II, had worked on winged missiles during the 1950s. He died in 1960 and his design bureau fell on hard times thereafter.

into OKB-52 as Filial No. 2.[127] Through use of his family connection to Khrushchev, and support of a growing number of military leaders, Chelomei was able to acquire a huge empire that was capable of turning many of his imaginative ideas into reality.[128]

The one ambition Chelomei had the most difficulty achieving was his original one; to break into the space industry. This was not for lack of political support, but a result of technical obstacles. Chelomei's first spacecraft project was a typically ambitious effort to build a satellite with the ability to manoeuvre in orbit. Manoeuvrability was essential for conducting rendezvous in space, and this was crucial to Chelomei's plans to build anti-satellite systems and shuttle-like aerospace planes. Remarkably, his tellingly named "Polet" test satellite was ready in just over two years. Unfortunately, Chelomei did not have a space rocket of his own to launch it.[129] Polet had to fly on a modified version of Korolev's R-7.

Nonetheless, Chelomei used the tests of Polet to maximum political effect. The first Polet mission on 1 November 1963 was laden with symbolism. Like Iangel''s first mission, Polet was launched under a new name, and timed to coincide with a major political event (the anniversary of the Revolution). It was an impressive accomplishment for a first satellite and won Chelomei his second Hero of Socialist Labour award.[130] The second test of Polet was equally symbolic, being carried out on 12 April 1964; "Cosmonautics Day." The fact that Chelomei was able to usurp "Korolev's" holiday was a mark of their changing relative fortunes. Although Polet was a far cry from the complex manned spacecraft that Korolev was already flying, it was a major victory.[131] These successes helped to change the perception of Chelomei. By early 1964 his proposals were taken seriously and nobody joked about where he worked.

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[127]Lardier, L'Astronautique Sovietique, p. 152. Chelomei's take-over occurred on 18 December 1962.
[128]Sergei Khrushchev had been quickly promoted to Chelomei's inner circle and regularly accompanied his boss to meetings with his father. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 485.)
[129]The UR-200 had only begun flight tests in 1963 and was directed primarily at the ICBM programme.
[130]Note Khrushchev's implicit insult to Korolev in his praise of Polet in the quotation at the beginning of this chapter.
[131]Polet was not much more than a framework with a number of rocket engines attached. Compared to the first satellites produced by Korolev and Iangel' it was an impressive accomplishment, but it still lacked fundamental and complicated systems (like life support) needed for piloted spacecraft.

The Vostok Programme

Chelomei and Iangel' may have begun to launch satellites in the early 1960s, but Korolev still had the human spaceflight field to himself. Yet, the Vostok programme was not so much a spaceflight programme, as a series of individual events. Korolev was the creative force behind each of the annual spectaculars, but taken as a whole they were only a pale shadow of what he had hoped to accomplish. As his monopoly in the space programme, and especially in spacecraft design, came under threat Korolev had to seek new allies. Ultimately, he was successful in keeping the human spaceflight effort alive, but there was continuing domestic opposition to virtually all of his future plans, even within the Vostok series.

The disjointed nature of the Vostok flights was a result of the manner in which each mission was approved. Although Korolev may have been authorised by the GKOT to build a number of experimental booster rockets and Vostok spacecraft, it appears that each manned mission proposal was individually scrutinised at the highest level. It is clear from the convoluted process of gaining approval for Gagarin's flight that there was no valid authority to carry out a "programme" of Vostok flights. It appears that the same approval procedure was followed for subsequent manned spaceflights.[132] Assuming that this was the case, each proposed mission had to run a gamut of institutions for review and implementation.[133] Each mission ultimately had to be approved by the Presidium of the Central Committee, or possibly a subgroup thereof, and then confirmed by decree of the Council of Ministers and/or TsK Presidium. It is important to note that there does not appear to have been a decree equivalent to a weapons programme production decision for the manned space programme. The manned Vostok was never put into "mass" production; the programme functioned as a prolonged weapons R&D project.

After Gagarin's mission the Vostok "programme" consisted of three "spectaculars," occurring at annual intervals. These flights were used to considerable political effect.

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[132] So far, the only Central Committee documents on the Vostok programme to come to light are those dealing with the first mission. (They were published in Izvestiia TsK KPSS, in 1991.) All indications suggest that the approval procedures did not change. However, this issue will not be fully resolved until the archives are opened.

[133] Reviewing institutions included the GKOT and/or the Academy of Sciences, the VPK, the Central Committee and its Presidium. Implementation was the duty of the State Commission for Spaceflight.

Soviet propaganda trumpeted them as irrefutable proof of the superiority of the socialist system. Yet, despite their daring and ingenuity, these missions did remarkably little to advance the technology or capability of the Soviet manned space programme.

The second manned flight came relatively quickly after Gagarin's mission of 12 April 1961. Within four days of the first flight, Korolev set his design bureau to work on the next assignment; a twenty four hour flight in space.[134] The original plan had been to build up to long duration spaceflights slowly. But a planned four-orbit mission was scrapped in favour of a more spectacular seventeen orbit mission.[135] It appears that Korolev himself initiated this change, preferring the quick, bold leap that would provide momentum for the human spaceflight programme. After three and one half months of intense preparations, German Titov lifted off in Vostok 2 on 6 August 1961.

Titov's mission was unusual in at least one respect. It is the only manned mission known to have been used for a specific foreign policy objective. Khrushchev told Korolev to make sure that the Vostok 2 was launched before 9 August 1961. This was to ensure that the flight occurred just prior to the construction of the Berlin Wall.[136] The connection between Vostok 2 and Berlin was carried through after the flight. The mission not only diverted attention from the construction of the Wall, but Titov himself was used to shore up the East German regime.[137] Although the remainder of the Vostok missions were highly publicised, none of them appear to have been used for such a specific foreign policy purpose.

One factor that may have contributed to the distancing of the space programme from specific foreign policy objectives were the medical problems encountered on Vostok 2. Titov was sick for much of the first half of the mission. Trying to discover the cause of this problem appears to have delayed the next manned mission.[138] As was obvious prior to the

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[134] J. Lowis, "Preparing the Soviet Space Booster," Spaceflight, Vol. 5, No. 2, March 1963, p. 56.
[135] Lardier, L'Astronautique Sovietique, p. 141.
[136] S. N. Khrushchev, Krizisy i Rakety, Vol. 2, p. 125.
[137] After the flight, Titov's first foreign trip was to the German Democratic Republic from 1-5 September 1961. There he not only spoke of the power of socialism, but made military threats against Western intervention in the GDR.
[138] It is now understood that a fairly high percentage of people will suffer from this sort of reaction to "zero gravity." It is known as Space Adaptation Syndrome.

first Vostok launch, cosmonaut safety was an issue to which the political leadership was keenly sensitive. Until the cause of Titov's illness was understood, another launch could be portrayed by Korolev's opponents as too much of a risk.

By Spring 1962 the space-sickness issue was apparently resolved and Korolev was ready to push ahead with the next mission. He announced to his staff in March, that the next manned mission would be a "dual flight."[139] As with the Titov "day in space," this new leap made some of his staff nervous, and for good reason. The Vostok spacecraft had no means to manoeuvre in orbit, so if the two craft got too close they could conceivably collide.[140] Korolev brushed the objections aside saying that each flight must be "a significant step forward."[141] This mission was approved, and then successfully flown as Vostok 3 and Vostok 4 in August 1962.

Although the "dual" mission was more a demonstration of precision launch timing, it was perceived throughout the world as the beginning of an orbital rendezvous project. Since the spacecraft could not manoeuvre, the mission did not really advance Soviet capabilities in orbital rendezvous, but it served to create that impression. The Soviet propaganda claims about Vostoks 3 & 4 fed US fears and drove the American manned space programme ahead. This strengthened Korolev's arguments for a more robust programme of his own.

However, Korolev did not succeed in convincing the leadership to approve a wider manned programme. All of the Vostok missions used essentially the same basic hardware, an improved version of the R-7 booster and the Vostok spacecraft.[142] The "dual" mission had been a brilliant use of limited capabilities, but there was little more that Korolev could achieve with this technology. The next mission required a bit more political ingenuity to make it appealing to the leadership. Technically, the Vostok 5 & 6 mission in June 1963, was a repeat of the 1962 "dual" mission, but politically it was another major coup.

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[139]Potts, Soviet Man in Space, Vol. 1, p. 171.
[140]The only significant manoeuvre the Vostok could make was to fire its retro-rocket to take it out of orbit.
[141]Potts, Soviet Man in Space, Vol. 1, p. 171.
[142]The booster used for the Vostok flights was publicly identified by the name of the spacecraft. It was an R-7 with a third stage known as the "E Blok."

Korolev, again, initiated this next "significant step forward;" the decision to fly a woman cosmonaut. Korolev's widow, Nina Koroleva, has stated that her husband originated the idea in order to prove that Air Force pilots were not the only people who could fly in space.[143] For Korolev, the advantage of sending a civilian non-pilot into space was that it would set a precedent that might allow him to launch engineers from his own design bureau into space. Khrushchev found the idea of sending a Soviet woman into space irresistible. From his perspective, it would demonstrate the advanced level of "average" Soviet workers and the reliability and simplicity of Soviet spacecraft.[144] Moreover, Tereshkova's flight on Vostok 6 was guaranteed to embarrass the Americans, for they had no plans to send a woman into space.[145]

Although the Vostok 5 & 6 "dual" mission was a major political triumph, it caused significant problems for Korolev. A long series of problems upset the launch schedule, so that the two spacecraft were not put into the planned orbits. Unlike the previous year, the Vostok spacecraft orbited near each other for only a brief period, and then rapidly diverged. This lack of progress from the previous "dual" mission contributed to Western speculation in 1963 that the Soviet space programme was not what it appeared to be. On top of this, Cosmonaut Tereshkova was sick for much of the flight and accomplished little of the planned scientific programme.[146] Korolev was reportedly so upset with her performance that he opposed further flights by women.[147]

With Vostoks 5 & 6 Korolev had wrung the last bit of usefulness out of his available hardware, he desperately needed an improved manned spacecraft. However, for several years, beginning in June 1960, his proposals for new manned spacecraft had been

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[143]Red Star in Orbit, edited and illustrated transcript of "Horizon Special" broadcast on 7, 14, & 21 December 1990, London: BBC Support Services, 1990, p. 11.

[144]The emphasis on reliability and simplicity of Soviet spacecraft had significant implications for the future of the manned space programme. It appears that this emphasis originated with Khrushchev. It may have been one of his ways of holding back Korolev's more extravagant plans.

[145]The first American woman in space was Sally Ride, who flew on the space shuttle in June 1983, twenty years after Tereshkova.

[146]The State Commission considered terminating her mission early. (Skopinskiy, "State Acceptance of the Space Program," p. 62.)

[147]There were five more women in training for future missions. Korolev told his wife Nina: "Space is no place for broads!" (Red Star in Orbit (transcript), p. 12) Korolev's opposition to further spaceflight by women was also noted by General Kamanin, who disagreed with Korolev on this issue. (L. N. Kamanin, "Dnevnika N. P. Kamanina," Ogonek, No. 7, 9-16 February 1991, pp. 28-31.)

disapproved. These included earth-orbital designs as well as ones aimed at a lunar mission.[148] Even before Gagarin's flight, Korolev had enlisted the help of the Soviet Air Force (VVS) in an attempt to gain approval for upgrading Vostok. In March 1961, Korolev helped Air Force leaders to develop a Tactical-Technical Requirement (TTT) for a two-person version of Vostok.[149] Korolev had an important practical reason to woo the Air Force; Chelomei's spacecraft proposals were designed for use by them. If Korolev could convince the VVS to build his spacecraft instead of waiting for Chelomei, then he might be able to defend his monopoly in spacecraft design from encroachment by the Aviation Industry.[150]

These efforts to simultaneously improve on Vostok and undermine Chelomei were frustrated by two factors. First, the authority to order new spacecraft remained lodged in the Main Administration for Missile Armaments (GURVO) of the RVSN. The VVS had no legitimate means to advance their proposals since only GURVO was allowed to submit TTTs for military spacecraft. Second, the military leadership, especially Minister of Defence Malinovskii, was completely opposed to Korolev. Malinovskii bluntly refused General Kamanin's 1962 request for support for more Vostok flights. The Minister of Defence insisted that series production of manned spacecraft was out of the question until an "appropriate military vehicle" was designed.[151] This phrase apparently meant Chelomei's space plane.[152] As long as the VVS was contemplating the use of Korolev's spacecraft, Malinovskii was not about to allow a change in procurement authority.

The next year Korolev tried a different approach to getting approval for a new spacecraft. On 10 March 1962 he submitted a proposal that included a modified Vostok capsule and a number of other components that could be launched separately (on the R-7)

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[148]For the lunar spacecraft, see below.

[149]N. P. Kamanin, "Kosmicheskie Dnevniki Generala N. P. Kamanina," Novosti Kosmonavtika, No. 9, 1994, p. 40. This appears to be the craft that Kamanin later refers to as "Sever."

[150]Kamanin explicitly states that Korolev tried to enlist the help of the military to support his monopoly on spacecraft design. (Kamanin, "Dnevnika N. P. Kamanina," Ogonek, p. 29.)

[151]Lardier, L'Astronautique Sovietique, p. 134.

[152]According to Kamanin, one of VVS Commander-in-Chief Vershinin's main worries when dealing with Korolev in 1961 was to avoid being accused of abandoning Chelomei's space plane. (Kamanin, "Kosmicheskie Dnevniki...," No. 9, p. 40.)

and assembled in orbit.[153] This design, called "Soiuz," included parts that had been "recycled" from his lunar spacecraft proposals. Thus, it could be used to perfect orbital rendezvous and docking, and later be adapted for use on a circumlunar mission.[154] Based on Kamanin's later diaries, and what is known of the role of the Academy of Sciences in earlier space research, it appears that this proposal might have been submitted to the Academy of Science's Interdepartmental Commission on Spaceflight.[155] In any case, the "Soiuz" proposal in 1962 was rejected.

By 1963 Korolev appears to have lost interest in upgrading Vostok or pushing for more flights in the series. Given the rapid development of competing designs, both by Chelomei and the US, Korolev realised that further work with the Vostok would be a dead end. New domestic circumstances and increased international pressure from the US manned space programme, encouraged Korolev to try to abandon the Vostok programme altogether.[156] A new draft design of the Soiuz spacecraft was eventually approved in 1963, but the Vostok "programme" was not terminated.

Vostok was not ended until Spring 1964. Another mission (Vostok 7), planned for mid-1964, was being developed by OKB-1. The aim of this mission is not known. Some reports state that cosmonauts were being trained for a long duration flight, while others point to another woman cosmonaut flight.[157] Given what we know about how previous manned missions were approved it seems likely that the decision regarding the next Vostok mission had not yet been made. Both options were probably prepared in hopes that one of

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[153] Korolev briefed the cosmonauts on this new design in early 1962 and described it as the successor to Vostok. (Phillip Clark, The Soviet Manned Space Programme: An Illustrated History of the Men, the Missions and the Spacecraft , London: Salamander Books, Ltd., 1988, p. 23.) This was the origin of the "7K" series of spacecraft that were the basis for virtually all subsequent Soviet manned spacecraft.

[154] I. B. Afanas'ev, "Neizvestnye Korabli," Znanie: Kosmonavtika, Astronomiia, No. 12, December 1991, p. 13.

[155] The next year (1963), another spacecraft proposal was submitted to the Interdepartmental Commission. (Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," No. 43, pp. 8-9.) Remember, that the Academy of Sciences had been able to order research rockets through the VPK in the past.

[156] Kamanin notes that during the Vostok 5&6 mission Korolev emphatically stated that he wanted to hand Vostok over to the military so that he could turn his attention to his lunar expedition plans. (Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," No. 43, pp. 8-9.)

[157] For the long-duration mission, see: Clark, The Soviet Manned Space Programme, p. 22. For the woman cosmonaut flight see: S. A. Voevodin, VSA 035: Cosmonaut Mission Assignments, electronically distributed bulletin originating in Kostroma, Russia, 25 January 1993.

them would win political approval. In any case, further Vostok flights were overtaken by a new manned project begun in April 1964 - Voskhod.

The Voskhod Programme

The three man Voskhod flight in October 1964 was a mission of great significance. It was a major technological achievement, but the most significant aspects of the first Voskhod were political. The beginnings of the mission marked a significant change in space policymaking, while the end of the mission coincided with a change of political leadership.

The first Voskhod was impressive, but more for ingenuity than innovation. Voskhod was not a new spacecraft. It was a modified version of the Vostok capsule launched on an R-7 with an improved third stage.[158] Squeezing three men into the already cramped Vostok was an amazing achievement, but to do it the Soviets had to take unprecedented risks. Many of the safety features of Vostok were eliminated.[159] As a result, the crew of Voskhod was at much greater risk than any of the Vostok cosmonauts.[160] Nonetheless the mission was an impressive achievement, if for no other reason, than the fact that the re-design, test, and launch of Voskhod was completed in about seven months.

Why did the Soviet Union suddenly rush into such a risky mission when it had shown such deliberation and risk-aversion during the Vostok series? The answer lies in international competition. In early 1964 the United States was poised to snatch the lead in human spaceflight. Not only was the new US President, Lyndon Johnson, a vigorous proponent of the Apollo lunar programme, but an early prototype of the US lunar rocket, the

[158]The Soviets were extremely reluctant to admit the connection between Vostok and Voskhod. The first photograph of the Voskhod spacecraft was not released until 15 years after the mission. (Clark, The Soviet Manned Space Programme, p. 26.) The improved third stage was known as the "I Blok." The R-7 with the "I" third stage was subsequently identified by the name "Soiuz." An improved version of this rocket is still used for all manned launches in Russia.

[159]The equipment eliminated included: the crew's pressure suits, ejection seats, and the launch escape system.

[160]As General Kamanin noted in his diary after the mission: "we were lucky beyond reason." (Kamanin, "I Would Never Have Believed Anyone..")

Saturn, was test flown in January 1964.[161] According to General Kamanin, the Saturn launch:

> "alarmed our leaders... (who wanted to) do everything possible, in order to retain our position as the leading space power."[162]

The Soiuz spacecraft (finally approved in 1963) would never be completed on time to upstage the impending US Gemini programme.

Since Khrushchev was unwilling to let the United States take the lead in manned spaceflight, he once again called on his "magician" - Korolev. In March 1964 Khrushchev told Korolev to launch a three person spacecraft by the end of the year.[163] Modifying Vostok for two people would not have been that difficult, since Korolev had already submitted proposals for a two-man version in 1961. However, Khrushchev insisted that a three man crew be launched so as to outdo the two-man Gemini spacecraft.

This demand marked two subtle, but significant changes in Soviet manned space policymaking. First, Khrushchev was now demanding specific accomplishments on a manned mission. In the past he had demanded spectacular results from each mission, but had left it to Korolev to come up with the ideas. Second, a Soviet manned space mission was now driven by the need to beat a specific US space project. Vostok missions had easily outdone the US Mercury programme, but Gemini was much more capable than Vostok. Competition with the West now overrode the domestic restraints that had kept the Soviet manned programme in check.

Initially, Korolev despaired at the challenge.[164] He had been trying to focus his attention on lunar missions since 1960, and had finally won permission to build a craft capable of a circumlunar mission. However, work on Soiuz, and the next Vostok flight were both set aside. All efforts were turned to squeezing three men into the existing spacecraft. Remarkably, the engineers at OKB-1 found ways to make it work.

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[161] With the Saturn the US could, for the first time, put a heavier payload into space than the Soviets.
[162] Kamanin's diary of 6 February 1964 as published in Kamanin, "Radi Takoi Tseli Stoit Rabotat'..." No. 43, pp. 8-9.
[163] G. Salakhutdinov, "Eshche Raz o Kosmose: Beseda s V. P. Mishinym," Ogonek, No. 34, 18-25 August 1990, pp. 4-5.
[164] Salakhutdinov, "Eshche Raz o Kosmose..."

Considering the difficulties and complications of the mission, Voskhod preparations were finished remarkably quickly. On 21 August 1964 the VPK met to approve the State Commission's proposal for the Voskhod launch schedule. Despite the fact that there were still serious concerns about safety, and that the crew assignments had not been settled, the VPK approved the proposal.[165] The schedule called for the launch of an unmanned Voskhod prototype on 5 September 1964, with the manned flight to come after the middle of the same month.[166] A series of problems with the landing and telemetry systems, and the engines, delayed the prototype test launch until 6 October 1964.[167] After a perfect twenty four hour flight the State Commission for Spaceflight, chaired by G. A. Tiulin, met on 10 October and gave approval for the launch of Voskhod on 12 October 1964.[168]

The mission was another propaganda triumph, but it was not without its problems. While in orbit, the crew of Voskhod sent greetings to North Vietnamese troops fighting American imperialism, encouraged Soviet athletes at the Tokyo Olympic games, and noted that their mission coincided with the 472nd anniversary of Columbus's discovery of the New World.[169] While the crew appeared to be relishing their role as flying ambassadors, in reality they were extremely uncomfortable. Not only were they crowded into the capsule, but during the first six orbits the cabin temperature climbed from fifteen to twenty one degrees centigrade.[170] As usual, Khrushchev made a publicly broadcast telephone call to the cosmonauts from his vacation home in the Crimea. He finished the call by jokingly saying,

> "Mikoian is here next to me, and is simply pulling the phone from my hands."[171]

These were Khrushchev's last public words as leader of the Soviet Union.

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[165]Korolev was particularly adamant about controlling the composition of the crew. In the end he not only succeeded in putting one of his top engineers on the crew (Konstantin Feoktistov), but also forced adoption of his choice for the medical doctor (Boris Egorov) that would fly in Voskhod. (Kamanin, "I Would Never Have Believed Anyone...")

[166]The target dates for the manned flight were between 15 and 20 September 1964. (Kamanin, "I Would Never Have Believed Anyone...")

[167]It flew with two mannequins on board and was designated Kosmos 47.

[168]Lardier, L'Astronautique Sovietique, p. 141.

[169]Potts, Soviet Man in Space, Vol. 1, pp. 188-9.

[170]Kamanin, "I Would Never Have Believed Anyone..."

[171]As quoted in Ia. K. Golovanov, Korolev: Fakty i Mify, Moscow: Nauka, 1994, p. 743.

On the morning of 13 October 1964, while Khrushchev was on his way to Moscow to be overthrown, the Voskhod 1 crew was preparing to land. The mission commander, Vladimir Komarov, gamely asked for a twenty four hour extension of the mission but Korolev said no with a quote from Shakespeare:

> "There are more things in heaven and on Earth, Horatio, than are dreamt of in your philosophy."

After landing it soon became apparent that things were amiss in Moscow. Khrushchev did not call the crew after landing, and the post-flight festivities were postponed.[172] The Voskhod 1 crew had to wait a week for their Moscow reception.[173] Then, the new political leadership made its first public appearance with the latest space heroes.

The fact that Khrushchev's last appearance and the new leadership's first appearance were both connected with Voskhod 1 is a striking coincidence. These coincidences, plus Korolev's quote from Hamlet, have spurred considerable speculation that there was a connection between the ouster of Khrushchev and the Voskhod mission. Such comments usually suggest that the Voskhod mission was terminated early in order to allow the plotters to take Khrushchev by surprise. This seems unlikely. The Voskhod test flight earlier in the month flew the same twenty four hour profile as Voskhod 1. In addition, as Kamanin reports in his diaries, there were problems with the temperature in the spacecraft, and also questions about the health of one of the crewmembers.[174] Since the programme for the mission was complete, there was little reason to accede to cosmonaut Komarov's request for another day in space. It is, of course, possible that Korolev or other members of the State Commission knew about, or suspected, the plan to oust Khrushchev.[175] However, there were sufficient operational reasons not to extend the flight that this was unlikely to be a factor in the conduct of the mission.

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[172] Kamanin, "I Would Never Have Believed Anyone..."
[173] The reception was delayed until 21 October 1964.
[174] Boris Egorov, the young medical doctor that Korolev had forced onto the primary crew, suffered from an alarmingly low pulse while sleeping. (Kamanin, "I Would Never Have Believed Anyone...")
[175] Kamanin noted in his diary that the change of leadership came as "... a complete surprise" to him and other members of the State Commission. (Kamanin's diary of 14 October 1964 as published in Kamanin, "I Would Never Have Believed Anyone...")

The Manned Lunar Programme

Based on Soviet space rhetoric most of the world assumed that the Soviet Union had an active manned lunar programme from the very beginning of the space age. Much of this rhetoric had been generated by space enthusiasts like Korolev, who desperately wanted to fulfil Tsiolkovskii's vision of space colonisation. Korolev knew that a state commitment to a manned lunar expedition would give the manned space programme direction, and once officially established, would be embarrassing for the leadership to abandon. However, even getting authorisation to build lunar-capable rockets and spacecraft proved difficult for Korolev. Changes in the domestic political environment in 1960-61 kept Korolev's ambitions in check. Yet, some unintended political results kept his programmes alive until Khrushchev's ouster.

One thing that had virtually no effect on Soviet lunar policy was President Kennedy's May 1961 announcement of the US lunar programme. It appears that the Soviet leadership did not take Kennedy's challenge seriously. After all, the United States was far behind in both manned programmes and rocket power. In addition, since the US had lots of aircraft and bases on the periphery of the USSR there appeared to be no strategic reason for them to develop large rockets.[176] In fact, Kennedy's own actions suggested that he was not fully committed to the moon programme.[177] Demonstrating the rather astute Soviet analysis of the technological problems of lunar missions, Khrushchev commented that the issue wasn't so much getting a person to the moon, as getting him back again.[178] Soviet manned lunar policy remained non-existent.

The Soviet leadership had other priorities, and the means to enforce them. The defence industry had a more critical task than space extravaganzas. The goal after 1960 was

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[176]This point was made by Vasilii Mishin, Korolev's top deputy and successor, in an interview in 1989. (A. Tarasov, "Polety vo Sne i Naiavu," Pravda, 20 October 1989.)

[177]In his speech to the US Congress, Kennedy had left himself room to abandon the proposal by putting the responsibility for taking up the challenge on his listeners. When meeting Khrushchev in Vienna the next month (June 1961), Kennedy pressed Khrushchev to agree to a joint lunar programme. Khrushchev agreed at first, but retracted this answer the next day. (Schlesinger, A Thousand Days, pp. 327 and 338.)

[178]Khrushchev made this comment in September 1961 (US Congress, Soviet Space Programs, 1962-1965, p. 107.) Like the problem of intercontinental range for bombers in the 1950s, it was not feasible with 1961 technology to build a single rocket that would be able to carry enough fuel for a return journey to the moon. This problem was only solved with breakthroughs in engine technology (especially the development of liquid oxygen/liquid hydrogen engines) and creative new ideas for how to conduct the mission.

to close the gap between Khrushchev's claims of intercontinental missile power and the reality of the extreme limits in Soviet capability. Missiles and military space projects took top priority. Remember, that Korolev's "N" rockets had been approved primarily as military launchers. His circumlunar spacecraft for the N-1 (the L-1) had been rejected.[179] The appointment of Kozlov as TsK Secretary for Heavy Industry, Defence, and Space, opposition by the military leadership, personnel changes in the defence industrial ministries, and new science planning mechanisms made it difficult for Korolev to continue the Vostok programme, to say nothing of starting a lunar effort.

By early 1962 the unwillingness of the Soviet Union to take up the US moon challenge, and the ramifications of the domestic political changes, were obvious to Korolev. It was at this time that he jettisoned his more extravagant technical ideas and long-range plans for space colonisation. He turned instead, to adapting existing programmes to provide options that could be sold as responses to the US manned programme.[180] The "Soiuz" spacecraft, proposed in March 1962, was one such example. One of the major advantages of "Soiuz" was that it could be launched on a modified R-7 booster. Intentionally designed to be assembled in orbit, Korolev referred to it as a "space train." By adding the proper combination of "train cars," Soiuz could also be used to carry out a manned circumlunar mission.[181] As noted above, this proposal was rejected.

Contributing to Korolev's desire to "make do" with the R-7 launcher, was the opposition to the "N-series" booster rockets. The feud with Glushko was the most immediate threat to Korolev's rockets. In his efforts to develop alternatives to Glushko, Korolev ultimately wound up with four design bureaux developing engines for the three main stages of the N-1. In addition to N. D. Kuznetsov, another aviation engine designer, A. M. Liul'ka, signed on to develop engines for the upper stages.[182] From within the GKOT, Korolev also signed up A. M. Isaev for the upper stage engines. The fourth design

[179]The N-1 was originally planned for the circumlunar mission only. Korolev hoped to build the N-2 to carry out a lunar landing.
[180]This was also the time that Korolev advanced the idea of the "dual flight" for Vostok 3 and 4.
[181]Phillip Clark points out that the "space train" design very closely followed the US Apollo spacecraft proposal made by the General Electric Corporation in 1960. (Clark, The Soviet Manned Space Programme, p. 23.) In a memo to Brezhnev in 1964, Korolev explicitly states that Soiuz had originally been designed for a circumlunar mission. (Vetrov, "Trudnaia Sud'ba Rakety N-1," May, p. 22.)
[182]Igor Afanas'ev, "N-1: Sovershenno Sekretno," Kryl'ia Rodiny, No. 9, September 1993, p. 14.

bureau was Glushko's OKB-456. Ignoring Korolev's requirement that the engines use liquid oxygen and kerosene, Glushko developed his own set of engines for the first two stages of the N-1 using hypergolic propellants.[183]

The argument over the choice of engine designer for the N-1 came down to the issue of which fuel to use. In January 1962, a special commission was appointed to investigate the fuel controversy. Although the commission recommended against some of the more exotic fuel combinations Glushko had proposed for the upper stages of the N-1, it agreed that his plans to use hypergolic propellants on the lower stages were an acceptable alternative.[184]

In early 1962, yet another threat to Korolev's "N" rockets emerged. Chelomei and Iangel' were both working on new rocket designs that had a payload capacity similar to the N-1.[185] Korolev must have suspected that these new designs were intended to replace his "N" rockets. To distinguish the N-1 from his competitor's designs, and salvage his hopes for a lunar expedition, Korolev began studies in February 1962 to increase the payload of the N-1 to 90 tonnes.[186]

Later that spring, the "N" rocket projects were frozen. A decree dated 13 April 1962 delayed completion of the N-1 by three years (to 1966) and the N-2 by eight years (to 1975).[187] In the interim, work on the N-1 was to be limited to development of the draft design (EP) and the evaluation of alternatives and expenses. By the end of the same month both Chelomei and Iangel''s designs (EPs) for heavy boosters had been approved for development by decrees of the Council of Ministers.[188]

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[183]Glushko planned to use nitrogen tetroxide and unsymmetrical dimethyl hydrazine (UDMH). As had been the case with ICBMs, Korolev was opposed to the use of such propellants for a variety of safety and scientific reasons.
[184]Vetrov, "Trudnaia Sud'ba Rakety N-1," May, p. 20.
[185]Chelomei was working on his UR-500 which could put a about 20 tonnes into earth orbit. Iangel''s R-56 was to have a 40 tonne capability. The N-1 was originally planned for a 45 tonne payload.
[186]M. Rudenko, "'Malen'kii Shag Odnogo Cheloveka...' Khronika Neizvestnoi Kosmicheskoi Zhizni," Vozdushnyi Transport, No. 29, 1994, p. 8. For reference purposes, the R-7 modified for Vostok could carry a payload of about 5 tonnes to earth orbit, and the US Saturn V moon rocket eventually carried a 130 tonne payload to earth orbit.
[187]Afanas'ev, "N-1: Sovershenno Sekretno," September, p. 13.
[188]As noted above, Iangel''s R-36/R-46/R-56 rockets were approved on 16 April 1962 (Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, pp. 68-9.) and Chelomei's UR-500 was approved on 29 April 1962 (Petrakov and Afanas'ev, "Strasti po Protonu," p. 10.).

Although the N-1 appeared to be doomed, it was rescued within five months. Korolev was given an opportunity to defend his draft proposal (EP) for the original (forty five tonne payload) N-1 in July 1962. The expert commission chosen to judge the proposal was headed by M. V. Keldysh.[189] As might be expected with Keldysh as Chairman, Korolev's project was saved. However, the expert commission did not simply endorse Korolev's original plan. It declared that what was needed was an even more powerful rocket. Keldysh's commission recommended that the N-1 be upgraded to carry a payload of 75 tonnes.[190] Thus, the commission had not only ratified Korolev's plans for a bigger N-1, but also provided a convenient distinction between the N-1 and Iangel' and Chelomei's heavy rocket projects.

In September 1962, the findings of the expert commission were ratified by a joint decree of the Central Committee and Council of Ministers.

> "With the goal of preserving the leading position of the Soviet Union in the exploration of space...,"

the decree called for the design of a larger N-1 during 1962 and 1963.[191] The rocket was supposed to be ready for flight tests in 1965.[192] The fuel question was finally resolved by this decree; the N-1 would use N. D. Kuznetsov's liquid oxygen/kerosene engines.[193]

Korolev's success with the N-1 in 1962 was not merely a matter of using the support of his allies in the Academy of Sciences; it was a decision also influenced by local politics. V. Ia. Litvinov, head of the Sovnarkhoz where Kuibyshev was located in 1962, played an important role.[194] Over the course of 1962 he had procured N-1 work for twenty eight under-utilised aviation enterprises in Kuibyshev, for example, N. D. Kuznetsov's engine design bureau.[195] Litvinov opposed cancelling the N-1 because that would have put his enterprises out of work again. Korolev himself appealed to V. I. Vorotnikov, then

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[189]This commission could also have been charged to review all of the heavy missile/launcher projects with the object of eliminating one or more of them. A number of such projects were terminated by 1964.
[190]A. Iasinskii, "Lunnyi Nositel'," Propeller, No. 54-55, 11 October 1991, p. 8.
[191]The quote is from the first line of the decree.
[192]Kriukov, "Blesk i Zatmenie Lunnoi Programmy," p. 84. (Note that this was only one year earlier than the date called for in the April 1962 decree delaying N-1 development.)
[193]Rudenko, "'Malen'kii Shag Odnogo Cheloveka...'" Glushko continued to attack the choice of fuels at every opportunity, but it was clear that Korolev's version of the N-1 was now on much more solid ground. (Vetrov, "Trudnaia Sud'ba Rakety N-1," April, pp. 79-80.)
[194]Lardier, L'Astronautique Sovietique, p. 164. For Litvinov, see Appendix 3.
[195]Lardier, L'Astronautique Sovietique, p. 164.

Secretary of the Kuibyshev Obkom, and to B. E. Dymshits, head of Gosplan at the time, to "help the people of Kuibyshev."[196] This sort of "localism," combined with support from the "experts," helped to save the N-1.

With the N-1 apparently on a more secure footing, the struggle over lunar hardware returned to spacecraft in 1963. Korolev presented a new version of the Soiuz (still planned for launch on a modified R-7) at a meeting of the Academy of Sciences Interdepartmental Commission on Spaceflight on 21 March 1963. The proposal called for using Soiuz to perfect orbital rendezvous and docking.[197] Korolev also pointed out that the same spacecraft could be used with the N-1 to carry out manned circumlunar missions. The proposal was unanimously approved by the Interdepartmental Commission.[198] However, higher approval did not come immediately.

One of the reasons for the delay was that the Soviet Union had no formal requirement for a circumlunar spacecraft. In mid-1963, just as some people in the West were beginning to realise that the Soviet Union might not have a manned lunar programme, Korolev made a formal bid to create one. With Brezhnev back as the Central Committee Secretary for Defence and Space, and the acclaim for the Tereshkova flight still resounding, Korolev pushed for authorisation of a lunar programme. On 27 July 1963, he wrote a memo to the leadership stating:

> "Fulfilment of a manned expedition to the lunar surface must be considered the basic task in the program of study and opening of space."[199]

Korolev laid the proposal squarely before the Soviet leadership. The answer was still no. Khrushchev was, in fact, telling the truth in late 1963 when he said that the Soviet Union had no immediate plans to send a man to the moon.

R&D decisions in late 1963 reinforced the anti-lunar policy of the Soviet Union. The N-1 was left out of the annual space research plan for 1964.[200] As a result OKB-1

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[196]M. Rebrov, "A Delo Bylo Tak - Sovershenno Sekretno: Trudnaia Sud'ba Proekta N-1," Krasnaia Zvezda, 13 January 1990.
[197]This version of Soiuz did not include the Vostok capsule as the 1962 Soiuz proposal had.
[198]Kamanin's diary of 21 March 1963 as published in Kamanin, "Radi Takoi Tseli Stoit Rabotat'..." No. 43, p. 8.)
[199]As quoted in Kriukov, "Blesk i Zatmenie Lunnoi Programmy," p. 84.
[200]Vetrov, "Trudnaia Sud'ba Rakety N-1," May, p. 23.

received only about half of the funding it had expected for the year. In Kuibyshev the damage was worse; N. D. Kuznetsov's engine design bureau and the Sovnarkhoz as a whole only received forty percent of their planned budgets.[201] Not only was the N-1 not included in the space research plan for 1964, but there was no military requirement for it either. The military had never completed the Tactical-Technical Requirement (TTT) for the N-1 called for in the 23 June 1960 decree.[202] As a weapons R&D project with no known requirement the "N" rockets were apparently cut from the military budget.[203]

Even the approval of the Soiuz spacecraft reflected the anti-lunar policy. On 3 December 1963, the Central Committee finally issued a decree authorising the development of the Soiuz spacecraft. However, the decree stated that Soiuz was primarily intended for military purposes. The Soviet Air Force and Air Defence Forces (PVO) were to "take part" in setting the requirements for the spacecraft and in testing it. The decree also called for the first flight to take place in 1964.[204]

In the face of US competition Soviet manned space projects suddenly became a much higher priority in early 1964. However, the attitude toward a lunar mission was slower to change. There were discussions in the Central Committee about using three N-1s to mount a lunar landing expedition between 1968-1970. Minister of Defence Malinovskii and RVSN Commander-in-Chief Krylov, apparently quashed these plans.[205] In March 1964, Khrushchev met with the N-1 designers and promised to support their plea to accelerate work on the project.[206] Yet, nothing changed. By May 1964, money and resources were running out. Korolev sent a flurry of letters asking for help on the N-1 to Ustinov (Chairman of the VSNKh), Zverev (head of the GKOT), and Serbin (head of the

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[201]Kriukov, "Blesk i Zatmenie Lunnoi Programmy," p. 83. The figures cited are: OKB-1 - 23m out of 45m rubles, Kuznetsov - 20m/50m rubles, Kuibyshev Sovnarkhoz - 9m/23m rubles.

[202]This is despite the fact that Korolev had taken pains to remind military leaders of their obligation to write a TTT for the N-1. As early as 15 January 1961, Korolev had written to Marshall Moskalenko, then Commander in Chief of the RVSN, to remind him of this obligation under the 23 June 1960 decree. (Vetrov, "Trudnaia Sud'ba Rakety N-1," May, pp. 22-23.)

[203]The cuts at OKB-1 may also have been related to the termination of other missile projects, like the R-9 (SS-10). However, the Kuibyshev cuts appear to have been aimed at the "N" rockets.

[204]Kamanin's diary of 3 January 1964 as published in Kamanin, "Radi Takoi Tseli Stoit Rabotat'..." No. 43, p. 8.)

[205]Kamanin's diary of 12 February 1964 as published in Kamanin, "Radi Takoi Tseli Stoit Rabotat'..." No. 43, p. 8.) There are indications that the Soviet military still believed that the US lunar programme was an elaborate front for a military programme.

[206]Vetrov, "Trudnaia Sud'ba Rakety N-1," May, p. 22.

Defence Industry Department of the Central Committee). In a letter drafted, but not sent, to Brezhnev at the same time Korolev pointed out that the Ministry of Defence had gradually cut funding for construction of the N-1 launch site, and that work on the Soiuz spacecraft was also being delayed because it was being treated as a low priority.[207]

Suddenly, things changed in the summer of 1964. One reason for this may be that the United States published detailed plans for the Apollo lunar expedition in May 1964.[208] According to one source, Khrushchev used these plans to mount a scathing attack on Soviet space designs at a meeting of senior party and state leaders in July 1964.[209] Regardless of whether such a meeting actually took place, there was a fundamental change in Soviet manned space policy that summer. On 3 August 1964 the Central Committee and Council of Ministers issued a joint decree entitled: "On work for exploring the moon and space."[210] The decree mandated <u>two</u> manned lunar projects. The first was a circumlunar project like the one proposed in 1960 by Korolev. The second was a manned lunar landing expedition.

Unfortunately for Korolev, this resolution was hardly a victory. The circumlunar programme was handed over to Chelomei. OKB-52 was charged with producing a lunar orbital spacecraft for launch on its UR-500 rocket. This mission was scheduled to be carried out in 1967; in time for the fiftieth anniversary of the October Revolution.[211] Given the fact that the UR-500 had yet to be built, and that Chelomei had only successfully launched two unmanned spacecraft (Polets 1 & 2), this was quite an astounding commission.

As for the lunar landing expedition, Korolev fared little better. The decree did call for priority development of a version of Korolev's Soiuz. This spacecraft, known as the Lunar Orbital Ship (7K-LOK), was to carry a two man crew to lunar orbit. However,

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[207]Vetrov, "Trudnaia Sud'ba Rakety N-1," May, pp. 21-23. The letters were dated 15 May 1964. The draft letter to Brezhnev is reproduced in Vetrov's article.
[208]This cause is suggested in M. Rudenko, "'Mne Pokazalos', Chto Nachalas' Tret'ia Mirovaia...'," <u>Moskovskii Komsomolets</u>, 15 July 1994, p. 4.
[209]Edmund (Vladimir Vladimirovich) Grondine, <u>Mesiats Zarplaty (One Month's Salary)</u>, trans. by Danielia Usikova, unpublished manuscript found in NASA Archives, 1992, pp. 16-17. Grondine suggests that this occurred at a meeting of the State Committee on Science and Technology (GKNT). However, the GKNT did not come into existence until October 1965.
[210]Afanas'ev, "N-1: Sovershenno Sekretno," October 1993, p. 3. Kamanin later noted that this decree was numbered 655-268. (Kamanin, "Radi Takoi Tseli Stoit Rabotat'..." No. 44, p. 8.)
[211]Kamanin, "Radi Takoi Tseli Stoit Rabotat'..." No. 44, p. 8.

major parts of the one man Lunar Ship (LK), for landing on the moon, were to be designed and built by Iangel"s OKB-586.[212] The decree also re-opened the question of which booster to use for the lunar landing programme. Rather than relying on Korolev's N-1, there was now to be a competition. Korolev, Iangel', and Chelomei each had until December 1964 to develop proposals for a lunar rocket. Korolev was ordered to create a plan based on his N-1, Chelomei on his UR-700, and Iangel' on the R-56.[213] After the booster rocket had been selected, the winning chief designer would have three years to carry out the mission. The decree specified that the lunar landing take place between 1967 and 1968.[214]

What is striking about the Soviet lunar landing mission is that it virtually duplicated the US Apollo plan.[215] Korolev had generated a number of lunar landing proposals in the past, but these had all required multiple large rocket (N series) launches to construct a lunar landing complex in earth orbit. These plans were ignored. The lunar landing mandated in the August 1964 decree called for the use of a single large rocket, just like the Americans. The flight profile, and the type of equipment (e.g., the small "lunar ship" for landing on the moon) also duplicated the US plan. The August 1964 decree did create a lunar landing programme, but not the one that Korolev had been advocating.

The Soviet Union had suddenly gone from no manned lunar programme, to two manned lunar programmes. This called for a huge commitment of resources, particularly since the goal was to upstage the Americans. However, overtaking the US programme would now be extraordinarily difficult, because the Americans had a big head start. For example, the US had resolved the question of what rocket to use, and who was to build it, two years earlier. The Soviet Union did not plan to make that decision until December 1964.

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[212]Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 72.
[213]Lardier, L'Astronautique Sovietique, p. 155. The latter was particularly curious because the R-56 had been cancelled just two months earlier, in June 1964. This was a far-fetched idea to begin with, since the R-56 was grossly unsuited for the mission that Khrushchev was demanding. This part of the decree is not mentioned in Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr.
[214]Kriukov, "Blesk i Zatmenie Lunnoi Programmy," p. 84.
[215]The most significant difference was in the smaller size of the Soviet crew (two versus three).

Implications and Conclusions

Space Projects and the Policy Process

For all of its remarkable international effect, the Soviet human spaceflight programme was extremely limited after Gagarin's flight, and remained virtually static in terms of both operations and equipment. After the first successful flight, the hectic pace of Vostok test and development came to a stop. There was one major space spectacular per year; not counting Gagarin's flight. No other programmes were approved until 1964.

The Vostok programme was kept alive by a number of individuals and institutions who were committed to manned spaceflight. Each of the annual missions in this programme was initiated by Korolev.[216] Several groups of experts provided support for these proposals. The USSR Academy of Sciences, especially its Interdepartmental Commission on Spaceflight, was dominated by Korolev and his allies. Although the Academy of Sciences came under the control of party-appointed defence industrialists, it was still an institution that could legitimately advocate space projects for scientific purposes. Key parts of the military also supported the manned programme, including the Soviet Air Force, and parts of the Strategic Rocket Forces (RVSN). Although the State Commission for Spaceflight was not as supportive of manned projects when it was under L. V. Smirnov, it eventually became a specialist organisation dominated by manned spaceflight enthusiasts.

There were at least two important opponents to Vostok. The first of these was the military leadership. Minister of Defence Malinovskii, his deputy - Marshal Grechko, and RVSN Commanders-in-Chief Moskalenko and Krylov were known to be opponents of Korolev in general, and his manned space programme in particular.[217] As the regime's military experts, they appear to have used their influence over capabilities and requirements to keep manned spaceflight a low priority. This was made possible by the fact that Khrushchev was also more interested in military power after mid-1960. In fact, Khrushchev himself, was the other important opponent of expansion of Korolev's Vostok programme.

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[216]Even if Korolev did not come up with the ideas himself, he was the person who was able to articulate and push the proposal.

[217]It is possible that the military leadership's animosity was not directed at Korolev, so much as at his ministerial sponsor - Ustinov. The evidence is equivocal on this point.

Decisions on Vostok missions appear to have been made one mission at a time. Since the programme was handled as an extended weapons R&D programme Khrushchev was able to exercise his prerogatives as leader to control it. In order to appeal to Khrushchev, Korolev proposed missions that were both relatively easy technologically, and irresistible politically. Each of the three manned spectaculars (Vostok 2, Vostok 3/4, and Vostok 5/6), pandered to the political leadership's desire for space theatre, while working within the tight technological limits of the Vostok/R-7 technology.

Once there was a formal decree for a Vostok mission, there appears to have been little problem in implementing the decision. The State Commission for Spaceflight does not appear to have been lacking in resources or authority to get the job done. However, an important factor in the success of these missions was Korolev's fanatical commitment to the task, and his remarkable ability to make the Soviet system work.

The next major space project authorised by the Soviet Union was Voskhod in 1964. Although Korolev had been pushing for a new spacecraft since at least 1960, this particular mission, and design, was initiated by Khrushchev. Driven by his desire to maintain the "leading position" of the Soviet Union in manned spaceflight, Khrushchev was even willing to sacrifice the safety of the cosmonauts. There was apparently little role for other institutions and individuals because this decision was imposed by Khrushchev. Since this was a high-priority crash programme, there appears to have been little problem in implementing Voskhod. It went from order to fulfilment in seven months.

The change in manned lunar policy was much like the decision on Voskhod. Again, this was initiated by Khrushchev, on the basis of competition with the West. Khrushchev's remarkable control over these decisions is suggested by the chief designers' assignments in this programme. Korolev had been the first, and foremost, advocate of both lunar projects. However, he was completely left out of the circumlunar project, and he was likely to be nothing more than a subcontractor for the lunar landing project.[218] This was another

[218]It is not clear who was to be responsible for the lunar project, but it is likely that whoever won the rocket competition would have overall charge of the project. The odds of the N-1 being selected as the primary rocket looked slim in August 1964.

programme imposed by the political leadership, even though the ideas had a long pedigree in OKB-1.

The Role of the Chief Designers

For the manned space programme Korolev remained the most important of the three chief designers, but his influence over policy was deliberately limited during this period. OKB-1 was the only design bureau with the leadership and experience to conduct a manned programme. This allowed Korolev to dominate the agenda for the existing manned space project (Vostok). However, his manned lunar ambitions were stymied and his efforts were channelled into limited, annual demonstrations of ingenuity. This is largely attributable to Korolev's fall from Khrushchev's good graces. Khrushchev effectively terminated Korolev's direct access after growing disillusioned with his failure to deliver an effective ICBM, and his petty feuding with other designers.[219] This forced Korolev to submit his proposals through the maze of formal institutions. During this period many of the formal institutions were led, or controlled, by people who were hostile to Korolev's manned spaceflight plans. In addition, Khrushchev set up a space competitor for Korolev.[220] These were deliberate changes, designed to restrain Korolev and reduce his influence.

In addition, all of the institutions that Korolev had previously used to propel the Soviet space programme along the path he wanted were neutralised. The Council of Chief Designers, splintered by individual feuds and ambitions, had its independence stripped by formalisation in 1961. The Academy of Sciences, perhaps envisioned as a more appropriate home for his space programme, wound up under the control of the same defence industrialists that had controlled the space programme from the start.[221] Even the State Commission for Spaceflight had its responsibilities for implementing space policy narrowed, and its influence substantially diluted. Finally, Korolev's efforts to use new allies in the Soviet military were blocked by hostile senior military leaders.

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[219] Korolev and Khrushchev still met, but Khrushchev no longer took Korolev's judgements at face value.
[220] Khrushchev explicitly stated that one of the reasons he approved Chelomei's bid to enter the space and missile field in April 1960 was to provide a competitor to Korolev. (S. N. Khrushchev, Krizisy i Rakety, Vol. 1, p. 492.)
[221] This was in the form of the GKKNIR and in the appointment of Keldysh as President of the Academy of Sciences.

The systematic prejudice against OKB-1 had major consequences for Korolev. Between 1961 and 1964 he had considerable time to come up with new manned spaceflight proposals. However, he did not have the resources to carry them out. The restraint of OKB-1 allowed Korolev's competitors, both international and domestic, to close the yawning gap in manned spaceflight capabilities. When Khrushchev finally did decide to expand the manned space programme in 1964, there were alternatives to depending on Korolev. The degree to which competing foreign and domestic plans were adopted shows how spectacularly Korolev's influence had declined.

Chief Designer Iangel' had no apparent influence on the manned space programme, and does not appear to have wanted any. Iangel''s interest was in missiles. He did get involved in unmanned space work in 1962, possibly due to the promotion of L. V. Smirnov.[222] However, Iangel' did not hold onto this space work for long. He appears to have been quite willing to hand such projects off to the parts of Korolev's missile empire that he acquired during this period.[223] Iangel' did get assigned part of the manned lunar landing project, but there is no evidence that this was at his request.

V. N. Chelomei was the most politically influential of the missile designers during this period. His role in the manned space programme was limited primarily because of his lack of capability in this field. Like Korolev before him, Chelomei was granted direct access to, and the trust of, Khrushchev. Chelomei desperately wanted to run his own manned space programme, especially one that made use of manoeuvrable "space planes." However, technical obstacles and the increasing emphasis on military projects limited his progress in this direction. Until August 1964, Chelomei's main function regarding the manned space programme was as a goad to Korolev. With the August 1964 lunar decree, Chelomei became a direct competitor.

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[222]As noted above, Smirnov had been Director of the Dnepropetrovsk missile factory. In 1962 he was promoted to Chairman (Minister) of the GKOT and head of the State Commission for Spaceflight.

[223]This was the case with the Kosmos rocket and two satellite projects. These were handed over to Reshetnev's OKB-10, which had originally been a filial of OKB-1.

Objectives and Purposes of the Soviet Manned Space Programme

The Soviet manned space programme was a limited, and somewhat reluctant, undertaking for most of the Khrushchev era. Although the manned programme became a regular, and highly visible feature of Soviet politics, with important strategic and ideological aspects, it was not a top national priority until late in this period. In general, military R&D programmes took priority, and the manned space programme was not a military programme. The manned programme may have been carried out, in large measure, by military forces, but it was based in the defence industry. Military aims were not a primary motivation for the manned missions of this period.

The primary reasons for continuing, and then accelerating the manned programme, were political and ideological competition with the West. The manned space programme served as proof of the superiority of the socialist system to the world audience.[224] Thus, to some degree, the manned space programme was imposed by earlier, imprudent propaganda boasts, combined with the US reaction to them.[225] In this regard, the Tsiolkovskii vision of the colonisation of space did have an influence on Soviet space policy. However, this was an indirect and delayed influence. The purpose of the Soviet manned space programme was always short-term political gain. The aim colonising space was consistently sacrificed to this end.

This was never more evident than in the manned lunar policy announced in August 1964. Korolev's original lunar proposals had been aimed at laying the foundation for building a colony on the moon. Such plans had been rejected. Only when it was clear that Soviet prestige was in danger, was a two-pronged manned lunar effort authorised. This programme was aimed at nothing more than maintaining the image of Soviet space superiority. The lunar landing plan (adopted by both the US and the USSR) was not a plan for long-term exploration, but a politically motivated quick-fix.

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[224] i.e. both inside and outside the Soviet Union.

[225] Korolev's early attention to space propaganda turned out to be one of his most valuable investments.

Implications for the Soviet Political System

With regard to manned space policy, the Soviet political system seemed to have become even more Stalinist between 1961 and 1964. The space programme was an item of particular interest to the Soviet leader and he appears to have had no difficulty in exercising direct, and detailed control over it. If anything, Khrushchev became more powerful, or at least more brazen in his use of that power, by 1964.[226] Khrushchev could blatantly lavish his favour on Chelomei, despite opposition from subordinates like Ustinov, the GKOT, and (initially) the military.[227] He could also reverse his long-standing policy on manned spaceflight and begin three manned programmes in less than six months.[228] Apparently the "conflict school" underestimated Khrushchev's hold on power.

Khrushchev's control was exercised through both party and state organs during this period. Of particular importance was the party's role in personnel decisions. In his rise to the top Khrushchev had promoted a number of people associated with Korolev's space and missile projects. However, when his priorities changed, Khrushchev had little trouble "promoting" space programme enthusiasts out of important policy positions. Two examples of this were the "promotions" of Brezhnev and Rudnev. Both were moved to posts where their enthusiasm for Korolev's plans would be useful, but not interfere with Khrushchev's other priorities.

Re-organisation of institutions was another old tool that proved useful in asserting leadership priorities. Most of the institutions used to manage the space programme were ad hoc. Restructuring the assignments and changing the leadership of such bodies was a perfectly legitimate government function. This was an especially effective way to tame institutions like the Council of Chief Designers and the State Commission for Spaceflight. Such organs became more specialised and more accountable in the later Khrushchev years.

Another reason why space enthusiasts were less likely to get out of hand was the improvement in political oversight during this period. Such oversight was never as

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[226]Khrushchev does appear to have suffered a setback after the Cuban Missile Crisis, but there is little evidence of this in the manned space programme.

[227]Gosplan official G. N. Pashkov noted that Khrushchev personally ordered the re-direction of resources to Chelomei. (Rebrov, "A Delo Bylo Tak...")

[228]These were Voskhod and the two lunar programmes.

intrusive, or as effective, as it had been under Stalin. However, it was much improved since the mid-1950s. The Central Committee and the VPK now filled the oversight functions of Beriia and the security forces. As had always been the case, it was still possible for designers close to the leader to circumvent intermediate officials and control mechanisms. Yet, after his experience with Korolev, Khrushchev was more careful about who he trusted in this way. He ensured that he had alternative sources of advice and information.[229]

One of the old Stalinist techniques that Khrushchev used to ensure reliable advice and information was competition. He set his subordinates, especially designers, in competition with one another. Stalin had used this technique to get the maximum effort out of his aviation designers.[230] Khrushchev deliberately applied this to the missile and space fields during this period - setting Chelomei as a competitor to Iangel' and Korolev. This particular choice had the effect of directly involving the defence industrial bureaucrats in space competition. Khrushchev had not only pitted Chelomei against Iangel' and Korolev, but had created competition between the GKAT (the Aviation Industry under Dement'ev) and the GKOT (Ustinov's old armaments ministry).[231] It is not clear if Khrushchev intended this. Also, as earlier in the aircraft industry, comparison with international accomplishments was another competitive source of information for the leadership.

Much as Khrushchev sought to improve oversight and control, some of his political innovations actually hampered his ability to control large R&D projects. Of particular note in this regard is the destruction of the central ministries. Sovnarkhoz leaders tended to promote local interests at the expense of the leader's priorities. This was certainly the case with Korolev's N-1 rocket project. Toward the end of Khrushchev's reign such "localism" came under heavy criticism. Creation of the VSNKh, and other government reorganisations, indicated the desire for improved central control.

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229 In Chelomei's case, one of the sources was Khrushchev's son, Sergei.

230 Ustinov appears to have employed the same technique himself in the 1950s, using Iangel' as a competitor to Korolev. It is not known whether Ustinov chose to do this on his own or was ordered to do so.

231 It is important to note that, although conflict in the Presidium was relatively low, at the ministerial level conflict was a fact of life. The "conflict school" appears to have been correct in noting the high level of conflict in Soviet politics, but appears to have misjudged the level to which it extended in the early 1960s.

Many of Khrushchev's decisions were the result of his loss of faith in his "experts;" an experience that paralleled Stalin's re-assessment of the aviation industry after the Spanish Civil War. On technical issues like weapons or spacecraft design, the political leadership had to rely on experts. However, expertise and political reliability often did not go hand-in-hand. This was especially true in the field of manned space, where virtually all of the experts had been closely tied to the Korolev, and committed to Tsiolkovskii's vision of space colonisation. Although Khrushchev had relied on experts, and faith in the monolithic unity of party leadership in the 1950s, he quickly reverted to Stalinist techniques when he became disillusioned with this approach.

For the manned space programme, and for his fellow Presidium members, the recourse to Stalinism reached dangerous proportions in 1964. Khrushchev had taken to dictating policy, down to a level of detail at which he had no competence. This political change, which was particularly pronounced in a number of fields in 1964, appears to be what convinced his once loyal Presidium subordinates to oust him.[232]

[232]"What essentially raised the leading group against him was the degeneration of collective rule into personal near-despotic rule and the menace to the stability of the political system." (Marie Mendras, "Policy Outside and Politics Inside," in Brown, ed., Political Leadership in the Soviet Union, p. 142.)

Chapter 7: The End of Hare-brained Schemes? (1964-1970)

"The Soviet Union will not be beaten by the United States in a race for a human being to go to the moon"

Cosmonaut Vladimir Komarov
Japan, July 1966

Overview

The new Soviet leadership put an end to the Khrushchev style of policymaking and a number of his policies. The ultimatums and high-risk foreign policy were replaced by a more measured and self-assured style. To most appearances, this new approach also seemed evident in the Soviet space programme. Even in the face of sharp US competition in manned spaceflight and numerous other distractions and disasters, the Soviets seemed to make balanced, if slow, progress toward their long-term goals. In reality, the end of the Khrushchev era in the manned space programme took five years to arrive.

After Khrushchev, Soviet unmanned space projects grew into an array of large and distinct programmes of their own.[1] Satellite projects became much more diverse, as the number and variety of Soviet space launches, and their earthly utility, grew dramatically. The new direction became evident in 1965 with the launch of the first successful Soviet communication satellites.[2] In addition to communication, meteorology, and scientific satellites, they also put a wide array of new military satellites into regular use. In 1967, for the first time since 1957, the total number of Soviet space launches exceeded those of the United States. From this point forward, the Soviet Union maintained a substantial lead in the yearly number of satellite launches.[3]

However, the Soviet manned space programme appeared to be much less active during the first five years under the new leadership. The manned space programme no

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[1]The broader Soviet space programme of the late 1960s is beyond the scope of this chapter. Unmanned programmes will only be discussed as they relate to the chief designers and the manned space programme.
[2]The first Molniia communication satellite had actually been launched in August 1964 (under the name Kosmos 41), but its antenna failed to deploy once in orbit. Two "Molniia 1" satellites were launched in 1965 (April and October).
[3]The number of US launches peaked in 1966 and then steadily declined for a number of years. Annual Soviet launch numbers climbed until the late 1970s and levelled off at a fairly high rate until the demise of the Soviet Union. Much of this "gap" is attributable to the differences in design and the satellite operation philosophies of the two countries.

longer served as the centrepiece of Soviet political and ideological propaganda. After one more manned spectacular, the programme seemed to move in a different direction. A new spacecraft, with apparently modest aims, was introduced. However, a series of tragedies slowed the programme down. While the US successfully raced to the Moon, the Soviets flew only eight spacecraft with men on board between Khrushchev's ouster and 1970. Five of the eight spacecraft were launched in 1969. To all appearances manned spaceflight was a lower priority for the Soviet Union's new leaders. It seemed as though the US was only racing itself to the moon.

The first Soviet manned space mission after Khrushchev's ouster was the second, and last, of the Voskhod series. This was another space spectacular that pre-empted announced US space plans. Voskhod 2 was launched just five days before the first US manned Gemini mission (Gemini 3) and featured another major "first."[4] On 18 March 1965, cosmonaut Alexei Leonov became the first man to leave his craft and "walk" in space. This was a feat that the US did not plan to try until the second manned Gemini mission.[5] Yet, after this mission the Voskhod programme disappeared.

Along with Voskhod, the Khrushchevian use of the manned space programme as a blunt political tool also seemed to disappear. The US went on to score a number of "firsts" of its own with the ten flight Gemini programme between 1965 and 1966. These accomplishments appeared to have gone unchallenged by the Soviet Union. A US Congressional analysis of the period found that:

> "The Soviet approach to space exploration is one of confidence, assurance, and restraint....Perhaps, the real source of the change was the change in the character of the leadership itself. Khrushchev had politicized space in the crudest manner. Space was made an appendage to his 'missile diplomacy' of threats and terror. Not so with Brezhnev and Kosygin... The approach of the new leadership suggests a style that is matter-of-fact, straightforward, 'businesslike,' as they say, seemingly implying Soviet superiority..."[6]

The Soviet Union still made great use of its achievements in space, and was quick to point out its "firsts." But, the days of always having to pre-empt and surpass US

[4]Gemini 1 and Gemini 2 were unmanned tests.
[5]The first US space "walk" came on Gemini 4, launched on 3 June 1965.
[6]US Congress, Senate Committee on Aeronautical and Space Sciences, Soviet Space Programs, 1966-1970, 92nd Congress, 1st session, 9 December 1971, pp. 38-39.

accomplishments in space appeared to have passed. The Soviet manned programme seemed to have been disconnected from international competition and directed toward some other goal. It was hard to tell precisely what that goal was, because the leadership did not announce any specific objectives, and also because the manned space programme was so frequently interrupted by tragedy.

The series of tragedies began early in 1966. In January 1966, the mysterious "Chief Designer of Spacecraft" died. The Soviet Union not only revealed his death, but finally identified him as S. P. Korolev. He was given an elaborate state funeral, and his ashes were interred in the Kremlin Wall. The leadership downplayed the impact of Korolev's death, but the long delay before the next manned spaceflight suggested that his loss was keenly felt.

When the next manned spacecraft was finally launched in 1967, the mission ended in tragedy. The inaugural flight of the Soiuz spacecraft, known as Soiuz 1, began on 23 April 1967. After one day of flight, with no dramatic accomplishments to report, cosmonaut V. M. Komarov was taken out of orbit. On returning to Earth, the parachutes failed to open properly and Komarov plummeted to his death.

Within a year the Soviets were rocked by another cosmonaut death. Iurii Gagarin, the first man in space, and icon of the Soviet space programme, was killed in the crash of a training aircraft on 27 March 1968.[7] Although the next manned launch went ahead at the end of 1968, the seemingly senseless death of Gagarin was clearly a major blow to the Soviet Union.

The US manned programme was not without a tragedy of its own. In January 1967, the first three Apollo astronauts were burned to death when a fire broke out in the pure oxygen atmosphere of their spacecraft during a dry run of their upcoming launch. This occurred just four months before Komarov's death on Soiuz 1. Like the Soviets, the American manned programme was grounded until late 1968 while they re-designed and tested their spacecraft.

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[7]The exact cause of this crash continues to be the source of some controversy in Russia. For example, see: S. M. Belotserkovskii, <u>Gibel' Gagarina: Fakty i Domysly</u>, Moscow: Mashinstroenie, 1992.

The second manned Soiuz mission came after the spacecraft had apparently been thoroughly tested without a cosmonaut on board.[8] In October 1968, Soiuz 3, piloted by Georgii Beregovoi, conducted a rendezvous but did not dock with the unmanned Soiuz 2. Given the fact that Soiuz docking had twice been fully tested without a cosmonaut onboard, this was a singularly unspectacular mission.[9]

With the Apollo spacecraft made safer, the US accelerated its lunar programme. A crew tested the Apollo capsule in earth orbit in October 1968.[10] On the second manned Apollo flight the US sent the crew of Apollo 8 into orbit around the moon during Christmas, 1968. This bold mission, which was the first manned test of the new Saturn V rocket, had been added to the Apollo programme just four months earlier.

In January 1969 the Soviet Union launched another pair of Soiuz spacecraft. Soiuz 4 & 5 were both manned, and two of the cosmonauts "spacewalked" from one craft to the other. Although the transfer of crewmen between separately launched spacecraft was another "first," by 1969 it was not particularly impressive. The fact that the two men had to "spacewalk" to get from one craft to another suggested that Soiuz was not as sophisticated as Apollo.[11] The Soviets launched spacecraft at a frenetic pace throughout 1969, but there were no more manned missions until October.[12]

Meanwhile, the United States achieved its ambition of "landing a man on the Moon and returning him safely to the Earth."[13] Two Apollo missions, including a "full dress rehearsal" in lunar orbit, were carried out in the first half of 1969. Then, Apollo 11 was launched in July. While most of the world watched on live television, Neil Armstrong and Edwin "Buzz" Aldrin became the first humans to set foot on the Moon on 21 July 1969.[14] In November 1969, the US carried out yet another lunar expedition.

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[8]These tests were conducted under the Kosmos designation. The Soviet Union did not reveal the connection between these flights and the Soiuz programme, but it was evident to many observers.

[9]Soiuz spacecraft had been docked automatically in October 1967 (Kosmos 186 and 188) and in April 1968 (Kosmos 212 and 213). See Appendix 13.

[10]This test was known as Apollo 7. It was launched on 11 October 1968.

[11]US Apollo spacecraft had an integral docking mechanism and hatch that allowed transfers between spacecraft without going into open space.

[12]Quite a number of the 1969 launches were reconnaissance satellites used to observe the Sino-Soviet border conflict.

[13]The words are from President Kennedy's speech of May 1961.

[14]The USSR and the PRC were among the few countries not to carry the first moon walk on live television.

To the dismay of some Americans, their victory in the moon race had little apparent effect on the Soviet Union's international political fortunes. Ironically, the evident ease with which the US appeared to accomplish the Moon landings, and the lack of any apparent Soviet manned lunar effort, reinforced the Soviet contention that there never had been a race to the Moon. Even before the first US landings, it was clear that the space race was largely a dead political issue. In June 1969, the Nixon administration cancelled the last three planned lunar expeditions.[15]

The Soviet Union reacted to the moon landings with politeness, but not praise. Despite occasional comments to the contrary by Soviet cosmonauts, the Soviet Union had never publicly accepted the US lunar challenge.[16] In early 1969 they pointed out that the USSR would rely on safer, "humane," and cheaper unmanned probes to explore the moon. (A Soviet probe landed on the moon while the Apollo 11 crew was there.) After the Apollo landings, Brezhnev himself noted the "outstanding flight to the Moon" by the US.[17] But on the whole, the Soviets dismissed the US lunar programme as a risky, political stunt.

The Soviet Union accomplished another manned spaceflight "first" in October 1969, and used the occasion to formally announce their long-term plans for space exploration. The "triple flight" of Soiuz 6, 7, and 8 was the first three spacecraft rendezvous. At the Kremlin reception for the Soiuz 6, 7, and 8 crews, Brezhnev stated that the Soviet Union had been "going on its own path...proceeding persistently and purposefully." He pointed out that the establishment of space stations was "the main route of man into space."[18] According to the Soviet leaders, all of the work of the last five years had been directed toward fulfilling the Tsiolkovskii plan for the development of space. Earth-orbital space stations were the second step into space. The Moon and the planets would come later.

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[15]The United States had originally planned ten lunar expeditions (Apollo 11 through Apollo 20). The last US lunar mission flown was Apollo 17 in December 1972.

[16]See the quote at the beginning of this chapter. According to General Kamanin, Komarov's slip of the tongue in Japan brought immediate complaints from the Central Committee and the Minister of Defence. (Kamanin's diary of 21 July 1966 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 44, 1993, pp. 8-9.) While visiting Japan in April 1969, Academician B. N. Petrov publicly repudiated the late cosmonaut Komarov's statement. (As quoted in US Congress, Soviet Space Programs, 1966-1970, p. 373.) For B. N. Petrov, see Appendix 3.

[17]As quoted in US Congress, Soviet Space Programs, 1966-1970, p. 41.

[18]As quoted in M. P. Vasil'ev, Saliut na Orbite, Moscow: Mashinstroenie, 1973, p. 4.

Institutions and the Policymaking Environment

The Party

The Presidium/Politburo of the Central Committee

The vilification of Khrushchev after his "retirement" made it clear that his successors had not been happy with the policymaking process. There was immediate condemnation of Khrushchev's hare-brained schemes, his subjectivism, voluntarism, wishful thinking and boasting. The new leadership set out to correct these problems, but did so in a way that conformed to their mutual interests. The emphasis was on collective leadership, "respect for cadres," and scientific decisionmaking. As in the leadership transition immediately after Stalin's death, the practice of collective leadership was particularly evident in the Presidium after the ouster of Khrushchev.

The leading collective quickly made a number of changes to the party. The Central Committee (TsK) Plenum that removed Khrushchev passed a resolution stating that the posts of party leader and head of government (Chairman of the Council of Ministers) should not be held by the same person again.[19] About six weeks later they announced that Khrushchev's division of the party into agricultural and industrial parts was to be reversed.[20] The priority of the leadership was not only to correct Khrushchev's errors, but to ensure that no one would be in a position to repeat them.

The party remained the pre-eminent political organ, but it operated with considerably more restraint than it had under Khrushchev. Brezhnev moved cautiously to secure his control over the party, and the traditional concerns of the party leader. In 1966 he managed to have N. V. Podgornyi promoted out of the TsK Secretariat to Chairman of the Presidium of the Supreme Soviet.[21] Podgornyi's Secretariat post in charge of cadres was filled by an associate of Brezhnev, A. P. Kirilenko. In this way Brezhnev assured his pre-eminence in the party without violating the principle of collective leadership. In fact, until the early

[19]T. H. Rigby, "The Soviet Political Executive, 1917-1986," in Archie Brown, ed., Political Leadership in the Soviet Union, Bloomington: Indiana University Press, 1989, p. 41.
[20]Pravda, 17 November 1964. (As noted in Jerry F. Hough and Merle Fainsod, How the Soviet Union is Governed, Cambridge: Harvard University Press, 1979, p. 253.)
[21]This was a post that Brezhnev himself had managed to use to reasonably good effect from 1960 to early 1964. It could thus be depicted as a promotion.

1970s the Soviet Union was apparently headed by a triumvirate: Brezhnev as head of the party, Kosygin as head of the government, and Podgornyi as head of state. This was even true with regard to some space programme matters.[22]

During the Twenty Third Party Congress in 1966, the conservative nature of the leading collective became especially evident. Returning to pre-Khrushchev titles, the Presidium was re-named the Politburo, and the First Secretary once again became known as the General Secretary. Changes to the membership of the Politburo were minor. Not counting Khrushchev, only two of the surviving members elected in 1961 were not returned to the leading political body in 1966.[23] The full membership remained at eleven, while the number of candidate members rose from five to eight. Between the Twenty Third Party Congress in 1966 and the Twenty Fourth Party Congress in 1971 changes in the Politburo were relatively infrequent and generally maintained the rough balance between institutions and regions.[24]

The Party Leadership and Missile / Space Policy

Unlike the succession after Stalin's death, the question of control over weapons R&D policy was not a major issue after the ouster of Khrushchev. Brezhnev easily assumed Khrushchev's authority for setting the broad outlines of policy on such issues, particularly space policy. However, the new emphasis on collective leadership, "respect for cadres," and scientific decisionmaking limited Brezhnev's ability to issue detailed policy directives on his own.

Brezhnev was the obvious successor to Khrushchev for leading space policy, both for institutional and personal reasons. Khrushchev had re-asserted the right of the First Secretary to control weapons R&D during the 1950s and had also closely identified the missile and space programmes with that office. In addition, Brezhnev had much more

[22]Kamanin notes in his diary that after the death of Gagarin "Brezhnev, Kosygin, Podgornyi (and other leaders)" met with the cosmonauts to discuss the necessity for further aeroplane flying by the other cosmonauts. (Kamanin's diary of 31 March 1968 as published in N. P. Kamanin, "Dlia Nego Zhit' - Oznachalo Letat'," Vozdushnyi Transport, No. 9, 1994, pp. 8-9.

[23]These were Mikoian and Shvernik.

[24]John Löwenhardt, James R. Ozinga, and Erik van Ree, The Rise and Fall of the Soviet Politburo, London: UCL Press, 1992, p. 61.

experience with these matters than any of his colleagues, having served as TsK Secretary for Defence and Space for a total of four and a half years.

Even after moving to Chairman of the Presidium of the Supreme Soviet in 1960, Brezhnev was, after Khrushchev, the political leader most associated with the manned space programme. He was also the only surviving full member of the Presidium / Politburo to have been named a Hero of Socialist Labour for the first Vostok flight.[25] While head of the Supreme Soviet, Brezhnev presented the state awards to the cosmonauts after their flights. He was particularly conspicuous at the welcoming ceremony in Moscow for Bykovskii and Tereshkova in June 1963.[26] Thus, Brezhnev was the Presidium / Politburo member with the greatest connection to the manned space programme. The post-Khrushchev emphasis on expertise and scientific decisionmaking made it relatively easy for Brezhnev to assert himself in matters of space policy.

However, the same emphasis on scientific decisionmaking prevented Brezhnev from exercising the degree of control that Khrushchev had enjoyed. In order to avoid "subjectivism" and "hare-brained schemes," experts were granted much more control over the generation of policy options, and over execution. This was evident in the enhanced control of the military over questions of military-technical doctrine. Such control also had a direct impact on the space programme, as the military had a greater input to decisions about missiles and military space programmes. In the manned space programme, the civilian experts also laid claim to a greater role in decisionmaking. Brezhnev's relatively limited control over such issues may also have been related to his cautious personality, but the official emphasis on scientific decisionmaking certainly allowed the experts (in most fields) a greater role.

Brezhnev's assumption of authority over space policy had significant ramifications. Nearly all of Brezhnev's association with space was connected with "Ustinov's" design bureaux, i.e. Korolev and Iangel'. Brezhnev had been closely associated with Korolev and

[25]It appears that only three members of the Presidium were honoured with the award for the first human spaceflight: Khrushchev, Kozlov, and Brezhnev. Ustinov had also won the Hero of Socialist Labour for Vostok, but was only a candidate member of the Presidium / Politburo.

[26]Brezhnev read their Hero of the Soviet Union citations and gave his own speech. Cosmonauts were named Heroes of the Soviet Union after their flights.

his successes from 1957 to 1960. Then, when Khrushchev authorised Chelomei's venture into missiles and space in 1960, Brezhnev was shunted out of his Secretariat post supervising these programmes. It is not clear whether Brezhnev had any substantial influence over manned space policy when he returned to this post after Kozlov's incapacitation. Khrushchev had, by then, become increasingly involved in the detailed direction of the extremely limited manned programme and may have had alternative channels to control space policy.[27] Although Brezhnev had little direct connection with the Dnepropetrovsk missile facilities, he did have strong ties to the region, and many of his protégés were undoubtedly involved with the missile industry there.[28] It seems certain that Brezhnev was predisposed to favour Korolev, and likely that he also favoured the Iangel' design bureau.[29]

It also seems likely that there were other full members of the Presidium / Politburo that had some sort of connection to the space programme, but only one has come to light so far - A. P. Kirilenko.[30] Kirilenko, who took Podgornyi's post as TsK Secretary in charge of personnel in April 1966, had both formal and informal connections to the space industry. However, it is unclear if his loyalties were consistent throughout the period. His connections with the aviation industry dated back to the Second World War and suggest that he may have been pre-disposed to Chelomei. In addition, he was First Secretary of the Dnepropetrovsk region when Iangel''s design bureau was founded there in the 1950s. Such proximity does not seem to have made for warm relations. Kirilenko's behaviour on several occasions suggests that he was not an ally of Iangel'. In fact, Kirilenko was said to

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[27]The evidence on this is fragmentary. The Russian Sovnarkhoz (under S. A. Afanas'ev) was involved in co-ordinating missile efforts from at least 1961. This may have been the mechanism by which Khrushchev bypassed Ustinov to favour Chelomei. (Oral History of S. A. Afanas'ev in Iu. A. Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, Moscow: MAI Press, 1992, pp. 34-48.)

[28]Brezhnev was the First Secretary in Moldavia at the time of the decree transferring the Dnepropetrovsk Automobile factory to the Ministry of Armaments, and was Second Secretary in Kazakhstan when the decree establishing the Iangel' Bureau was issued in 1954. It seems unlikely that he was involved in either of these decisions since his involvement in defence industry management does not appear to have begun before 1956.

[29]There are reports that Chelomei had personally insulted Brezhnev in the 1950s thus alienating him long before he assumed power. (David Easton Potts, Soviet Man in Space: Politics and Technology from Stalin to Gorbachev, Vol. 1, PhD dissertation, Georgetown University, June 1992, p. 222.)

[30]For Kirilenko, see Appendix 3. There are a number of indirect hints that Podgornyi may have supported Chelomei, but the evidence for this is sparse and contradictory.

have favoured the Korolev design bureau in the late 1960s - early 1970s because his son-in-law, Iurii Semenov, was a senior designer there.[31]

Just as Brezhnev and Kirilenko stand out as the two full members of the Presidium / Politburo with a connection to the missile design bureaux, there were also two candidate members who had a connection. The most tenuous of these connections was that of V. V. Shcherbitskii. His connection with the aerospace industry dates back to 1952, when he was made First Secretary of the Dnepropetrovsk city party at the time that the automobile factory there was handed over to the Ministry of Armaments to produce missiles. He later rose to be First Secretary of the provincial party organisation. In 1961 Shcherbitskii became Chairman of the Ukrainian Council of Ministers and candidate member of the Presidium of the Central Committee of the Communist Party of the Soviet Union. However, in 1963, after a disagreement with Khrushchev and Podgornyi he was demoted, and sent back to Dnepropetrovsk to serve again as First Secretary of the regional party organisation.[32] Unlike Kirilenko, Shcherbitskii appears to have found his proximity to Iangel' to be pleasant. His close association with Dnepropetrovsk, and the coincident rise and fall of his fortunes and those of OKB-586 suggest that Shcherbitskii was positively connected to Iangel'.

There is no doubt about the preferences of the second candidate member of the Presidium / Politburo with a connection to the space programme. D. F. Ustinov had been propelled to the top of the Soviet government structure on the strengths of the Korolev and Iangel' design bureaux. As Minister of Armaments and, later, Defence Industry, he had founded these design organisations and made his reputation on their missiles and spacecraft. Although, by 1960, Ustinov was apparently in a position to benefit from Chelomei as well, his loyalties clearly remained with "his" design bureaux.[33] Ustinov joined the Presidium as a candidate member in March 1965 when he was moved from head of the VSNKh to the

[31]Roald Z. Sagdeev, The Making of a Soviet Scientist: My Adventures in Nuclear Fusion and Space from Stalin to Star Wars, New York: John Wiley & Sons, 1994, pp. 180-1.

[32]John Löwenhardt, The Soviet Politburo, Edinburgh: Cannongate, 1982, pp. 127-128.

[33]As Chairman of the Military Industrial Commission (VPK) Ustinov was ostensibly the manager of all defence industry. But he was a strongly opposed to letting Chelomei into the missile and space business. (Sergei N. Khrushchev, Nikita Khrushchev: Krizisy i Rakety, Vol. 1, Moscow: Novosti, 1994, p. 495.) Notably, when Ustinov was finally in a position to dismantle the Chelomei design bureau in 1976, he did so immediately.

TsK Secretariat.[34] There, he took over Brezhnev's post as Central Committee Secretary for Defence and Space. Brezhnev appears to have deferred to Ustinov in most subsequent space policy decisions, but Ustinov himself was not in a position to implement his personal preferences over the objections of more senior members of the Presidium / Politburo.

The emphasis of the new leading collective on "respect for cadres" also had ramifications for space policy at the Central Committee level. Like the Politburo, membership in the TsK was nearly static throughout this period.[35] The Central Committee elected at the Twenty Third Party Congress in 1966 had only twenty more full members than the previous one. Of the 195 members of the Central Committee, 139 were holdovers from the 1961 election.[36] Notably, this left the defence industrialists and military leaders that Khrushchev had installed in 1961, largely in place. From the TsK they were still able to push their various agendas.

The Government

The Council of Ministers and the Ministry Structure

Changes in the Soviet government after the removal of Khrushchev appeared to be more substantial than those in the party, but the main thrust of these changes was rationalisation of duties, in keeping with old models. As the new Chairman of the Council of Ministers, A. N. Kosygin benefited from Khrushchev's reinvigoration of this post. From this position he also oversaw the re-ministerisation of the Soviet government and attempted to carry out economic reforms.

The dissolution of the Sovnarkhoz system and the re-creation of the central ministries was the most significant government change made by Khrushchev's successors. It was not, however, a very radical change. Parts of the central ministerial structure had survived the Sovnarkhoz reforms.[37] When the VSNKh was created in 1963, a network of

[34]The Supreme Sovnarkhoz (VSNKh) was made redundant by the re-creation of the ministries. V. N. Novikov became chairman of the VSNKh until October 1965, when it was formally disbanded.
[35]Significant change in the Central Committee did not come until the Twenty Fourth Party Congress in 1971.
[36]Robert V. Daniels, "Political Processes and Generational Change," in Brown, ed., Political Leadership in the Soviet Union, pp. 115-6.
[37]e.g., the Ministries of Defence, Foreign Affairs, Culture, Agriculture, Health, etc... Of course, the defence industrial ministries also remained largely intact in the form of State Committees.

"State Branch Committees" and "State Production Committees" was created to plan the Union economy.[38] In 1965 these institutions readily became full-fledged ministries again.[39]

For the defence industrial ministries the changes were even less noticeable. At least some of the defence industrial ministries were "re-created" in March 1965, well before the demise of the VSNKh in October.[40] The government co-ordination and oversight organ for the defence industry, the Military-Industrial Commission (VPK), also remained in place. Moreover, when Ustinov was promoted to the TsK Secretariat from chairman of the VPK in March, his replacement was another missile industry leader, L. V. Smirnov.[41]

The continuity of leadership in the ministries was even more striking than that at the top of the Soviet government. Twenty two of the thirty three industrial and construction ministers appointed in 1965 had been minister, or deputy minister, of the same organisation in 1957. The record among the defence industrial ministries was even more impressive. Only one of the re-created defence industry ministries had a different leader in 1965 than in 1957.[42] This was the Ministry of Defence Industry. The only reason for the change of this Minister is that the entire series of intervening leaders had been promoted to more senior positions. The long, and uninterrupted tenure of the defence industrial ministers gave them a major advantage in asserting their prerogatives in their field of expertise.

In other fields, defence industrialists were swept aside in personnel changes at other government organs. In particular, the remnants of Ustinov's missile clique was purged from the leadership of the planning organs. The State Committee for the Co-ordination of Scientific-Research Work (GKKNIR) was replaced by the State Committee for Science and Technology (GKNT).[43] Chairman of the GKKNIR, K. N. Rudnev, was moved to the

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[38]V. A. Tsikulin, Istoriia Gosurdarstvennykh Uchrezhdenii SSSR 1936 -1965, (Uchebnoe posobie), Moscow: Ministerstvo Vyschego i Srednego Spetsial'nogo Obrazovaniia RSFSR/ Moskovskii Gosudarstvennyi Istoriko-arkhivnyi Institut, 1966, p. 176.
[39]A comparison of the two organisational charts of the Soviet government (one for 1 January 1965, the other for 15 December 1965) in the appendices of Tsikulin, Istoriia Gosurdarstvennykh Uchrezhdenii SSSR, strongly emphasises this organisational continuity.
[40]e.g., the Ministry of General (missile and space) Machinebuilding was established in March 1965.
[41]Like Ustinov, Smirnov had been head of the "missile ministry" (at the time known as the GKOT) just prior to his promotion to head of the VPK.
[42]See Appendix 4, sheet 3.
[43]See Appendix 10.

post of Minister of Instrumentbuilding, Means of Automatisation, and Systems of Control. V. A. Kirillin, who had most recently been serving as a vice president of the Academy of Sciences, was named Chairman of the GKNT.[44]

While new leadership, reflecting the broader non-defence industry responsibilities of the central government was installed in the planning organs, the influence of the missile industry did continue. Most crucially, V. M. Riabikov returned to Gosplan from the VSNKh, as head of the defence industry department. G. N. Pashkov, remained head of the missile and space section of Gosplan, a post he had effectively held since 1946.[45] These parts of Gosplan continued to operate as a virtually independent unit. This continued the tradition of special departments within the Gosplan structure designed to ensure priority for military projects. Most Gosplan departments "represented" their industry in the plan-building process. What was different with the defence industry department (known colloquially as "the tenth floor"), was that it's plans began with decrees by the VPK establishing the schedule and priority of its projects. Gosplan, as a whole, was the junior partner in this relationship.[46] Thus, while Ustinov and the missile industry leaders had been removed from direct leadership of the planning organs, they maintained control over crucial elements within the, now larger, organisations.

The Defence Industrial Ministries

The almost complete absence from the Presidium / Politburo of senior ministers involved in weapons programmes was a marked contrast to the leadership transition after Stalin's death. In 1953 a majority of Presidium members had some involvement in management of various weapons programmes at a high level.[47] After Khrushchev's ouster there were no defence industry ministers as full members of the Presidium / Politburo. Only candidate member Ustinov had ever been a defence industry minister.

Although the defence industrial ministries were thinly represented in the Presidium, they were in an extraordinarily strong position with regard to the new ministerial structure.

[44]For Kirillin, see Appendix 3.
[45]For Pashkov, see Appendix 3.
[46]Sagdeev, The Making of a Soviet Scientist, p. 187.
[47]Khrushchev was a notable exception in this regard. See Chapter 3.

As described above, the defence ministries, and their leaders, survived the Sovnarkhoz period virtually unchanged. The co-ordinating and executive organs of the central government were still dominated by missile industry leaders. The lasting power of these institutions is suggested by the fact that the defence industrial ministry structure remained fundamentally unchanged from 1957 until the demise of the Soviet Union. The five defence industrial State Committees under the VPK in 1964, became the seven defence industrial ministries of the VPK system in 1965. Only two new ministries were added after this. Of the four "new" defence industry ministries created after 1957, all came from just two of the original State Committees.[48]

For the space programme the most important of these new ministries was the Ministry of General Machinebuilding (MOM). The MOM was formally created by decree of the Supreme Soviet on 2 March 1965.[49] It brought together most of the research institutes, design bureaux and enterprises involved in the missile and space industry. These included not only NII-88, Korolev's OKB-1 and Iangel"s OKB-586, but also the aviation industry design bureau that had been involved with engine and missile design. This meant that Chelomei's OKB-52 was now in the same ministry as the other two major aerospace design bureaux. The Ministry of General Machinebuilding itself, was directly descended from the Ministry of Armaments. It appears to have been formed primarily from part of that Ministry's post 1957 incarnation, the State Committee for Defence Technology (GKOT).[50]

However, there are indications that the MOM was not simply created by turning the missile administration of the GKOT into a ministry of its own. The primary clue in the mixed heritage of the MOM is the choice for its first Minister, S. A. Afanas'ev. Afanas'ev had worked in the missile industry until 1957. He then moved into Sovnarkhoz leadership and eventually become Deputy Chairman of RSFSR Council of Ministers and Chairman of

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[48]See Appendix 4, sheet 3. The three unchanged State Committees were: Aviation Industry, Shipbuilding, and Medium Machinebuilding. The State Committee for Radio-Electronics was the source of two of the "new" ministries (created in 1961 and 1974) and the State Committee for Defence Industry (Ustinov's old ministry) created the other two (in 1965 and 1968).

[49]N. Tarasenko, "Ekonomika Kosmosa: Dostizheniia, Problem, Perspektivy," Ekonomika i Zhizn, No. 16, April 1991, pp. 6-7. See Appendix 7, sheet 4.

[50]Iu. A. Mozzhorin and A. Eremenko, "Ot Pervykh Balisticheskikh do...," Aviatsiia i Kosmonavtika, No. 8, August 1991, pp. 34-5.

the All-Russian Sovnarkhoz.[51] In these posts Afanas'ev appears to have been responsible for directing resources to Chelomei and his missile projects.[52] Another fact about Afanas'ev that makes him unusual for a defence industrialist is that he publicly announced his support of the Liebermann economic reform proposals in 1964.[53] The Liebermann reform ideas were first mooted under Khrushchev, and served as the basis for Kosygin's subsequent economic reform efforts. It seems likely that Afanas'ev's appointment was meant to be both a merger of aerospace management, and a check on Ustinov and/or Brezhnev's control over the missile and space industry.

The Military

Although the professional military had no direct representation in the Presidium / Politburo, they received most of what wanted from the new political leadership.[54] Khrushchev's one-sided emphasis on nuclear missiles and penchant for dictating doctrinal details had severely limited the one thing that the military leadership had longed for: control over the military-technical aspects of doctrine. In the mid 1950s they had begun to enjoy this privilege. However, after Zhukov's removal from the Presidium they had once again lost control of military-technical doctrine to the party leader.

After Khrushchev's ouster, the military asserted its expertise and won increased control over military-technical doctrine. In the atmosphere of the time, the General Staff appeared to be just the sort of organisation that should be allowed more latitude to employ its expertise.[55] This decision was made all the easier by the fact that the initial objectives of the political leadership and the military coincided. Both groups were in favour of the improvement of conventional forces and a rapid build-up of real nuclear missile capability.[56]

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[51]This was a Russian Republic organisation like the VSNKh, but created before it. Confusingly, the two organisations share the same initials. For Afanas'ev, see Appendix 3.
[52]Oral History of S. A. Afanas'ev in Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, p. 44.
[53]Karl F. Speilmann, "Defense Industrialists in the USSR," Problems of Communism, September-October 1976, p. 56.
[54]Military leaders were formal members of the Defence Council. See below.
[55]Brezhnev cultivated connections with military leaders and developed a fairly close relationship with Marshal Grechko. (Malcolm Mackintosh, "The Soviet Military's Influence on Foreign Policy," in Michael MccGwire, Ken Booth, John McDonnell, Soviet Naval Policy: Objectives and Constraints, New York: Praeger, 1975, p. 27.)
[56]David Holloway, Technology, Management and the Soviet Military Establishment, Adelphi Paper No. 76, London: IISS, 1971, p. 8.

Marshal Zakharov, who returned to the post of Chief of the General Staff in October 1964, was particularly eager to assert a more "balanced" military doctrine.[57]

At the top of the Ministry of Defence, very little changed between Khrushchev's removal and the early 1970s. Marshal Malinovskii served as Minister of Defence until his death in 1967. He was replaced by his long-time associate and First Deputy Minister, Marshal A. A. Grechko.[58] If anything, Grechko's attitude toward Korolev's manned space programme was even more negative than his predecessor's. Both Malinovskii and Grechko made it clear that they were not interested in "Academy of Sciences" space projects.[59] The only missile designer that they were interested in was Chelomei.[60]

Although Marshal N. I. Krylov remained Commander-in-Chief of the Strategic Rocket Forces (RVSN) from 1963 until his death in 1972, there were significant changes at lower levels of the RVSN after Khrushchev's ouster. These changes were related to the resolution of two major issues: the control of military space assets, and preferences for missile designers.

The question of authority over space assets was finally resolved in favour of the RVSN. As already noted in Chapter 6, the Soviet Air Force (VVS), had been trying to break the RVSN's monopoly over ordering and evaluating spacecraft. A number of other organisations supported this view. By 1964 they had apparently convinced Chief of the General Staff, Marshal Biriuzov, to create a Central Administration of Space Systems (TsUKOS) subordinate to the Minister of Defence.[61] This separated missiles from space systems and put control of the latter in the hands of the Minister of Defence, rather than the

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[57]Marshal S. S. Biriuzov died in a plane crash in Yugoslavia shortly after Khrushchev's "retirement." Marshal Zakharov had been fired by Khrushchev a year earlier for criticising his "adventurist" military policy. (Malcolm Mackintosh, personal interview, London, 26 April 1995.)

[58]There were rumours in 1967 that Ustinov would be appointed Minister of Defence. He had to wait another nine years for this job. (Holloway, Technology, Management and the Soviet Military Establishment, p. 38.) For Grechko, see Appendix 3.

[59]Malinovskii said as much to the Commander-in-Chief of the Soviet Air Force in January 1965, and Grechko made similar remarks in 1967. (Kamanin's diary of 1 February 1965 and 18 February 1967 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 44, 1993, pp. 8-9, and No. 46, 1993, pp. 8-9.)

[60]Oral History of N. N. Smirnitskii, in Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, pp. 149-50.

[61]Kamanin's diary of 12 December 1968 as published in N. P. Kamanin, "Mne Ochen' Obidno Za Nashikh Parnei...," Vozdushnyi Transport, No. 12, 1993, p. 11.

Commander-in-Chief of the RVSN.[62] After Biriuzov's death this new arrangement "was torpedoed by the Rocket Forces" - TsUKOS was subordinated to the RVSN.[63] Apparently this was sold as a temporary measure, but the RVSN maintained control over TsUKOS, and its successors, until 1982.[64]

Coincident with victory over the TsUKOS issue, there appears to have been a major purge of the senior staff of the RVSN. Based on the limited data available, it appears that many of those who had supported Ustinov's designers (Korolev and Iangel') left the RVSN in early 1965. General K. A. Kerimov, later Chairman of the State Commission for Soiuz, appears to have been one such victim. G. S. Narimanov, who became deputy director of the newly founded Institute of Space Research (IKI) of the USSR Academy of Sciences, may have been another.[65] It appears that the lower echelons of the RVSN now fell into line with the Ministry of Defence leadership in a preference for Chelomei over Korolev and Iangel'.

Another significant change within the RVSN was the conversion of the Plesetsk ICBM site into a space launch facility. The decision to use Plesetsk as a space launch site had been made in 1963 and "practical arrangements" for this had been completed by June 1964.[66] The first space launch from Plesetsk took place on 17 March 1966 when Kosmos 112 was put into orbit. By 1969 Plesetsk was the most active space launch facility in the world.[67] Plesetsk was the home of the military space programme and the Soviet government refused to acknowledge its existence.[68] At first, these space launches were

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[62] Missile requirements and evaluation remained under Main Administration of Missile Armaments (GURVO) of the RVSN.

[63] Oral History of N. F. Shlykov in Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, p. 221.

[64] S. Ermak and V. Men'shikov, "Voenno-kosmicheskie Sily Rossii," Aviatsiia i Kosmonavtika, No. 9-10, September-October 1993, pp. 2-3.

[65] Sagdeev, The Making of a Soviet Scientist, pp. 165-6. For suggestions that Narimanov had supported Iangel' over Chelomei see: Oral History of I. E. Shashkov in Mozzhorin, ed., Dorogi v Kosmos, Vol. 2, pp. 102-3.

[66] The decision was part of two Council of Ministers resolutions: No. 15-5, 2 January 1963 and No. 999-347 on 16 September 1963. ("Cosmodrome Plesetsk," brochure published by the Russian Space Forces, Mirny-12, (no other publication details given).)

[67] In 1969 Plesetsk was the launch site for 37 satellites, and thus (permanently) took the title of most active launch site from Baikonur.

[68] Mr. Geoffrey Perry and his students at the Kettering Grammar School in England analysed the orbit of Kosmos 112 and announced the existence and location of the new launch site. The Soviet government did not acknowledge the existence of Plesetsk until 1983. (Nicholas L. Johnson, Soviet Military Strategy in Space, London: Janes Publishing, 1987, p. 80.)

conducted with R-7-type rockets from the launch pads originally built for the ICBM version of the R-7 (SS-6).[69] Apparently the R-7 ICBMs were taken out of the active missile inventory some time shortly after this - around 1967.[70]

The Soviet Air Force (VVS) also began to fall into line with the attitudes prevalent within the higher military leadership. The final blow in this change came with the selection of Marshal P. S. Kutakhov as Commander-in-Chief of the Soviet Air Force following the death of Marshal K. A. Vershinin in March 1969.[71] Prior to his selection Kutakhov had not been involved with the space programme, and in his first actions he made it clear that he would not be as supportive as his predecessor.[72] Even General Kamanin, head of cosmonaut training, began to turn against Korolev's successors and favour Chelomei's manned space projects.[73]

For the first three years under Khrushchev's successors, the VVS also lost ground on the issue of control over cosmonaut training. The space design bureaux, the Academy of Sciences, and the Ministry of Health made joint efforts to break the VVS monopoly on cosmonaut training.[74] It was only in taking the blame for the tragic death of Gagarin that the VVS gained high-level political approval for its monopoly of cosmonaut training.[75] After this, VVS control over cosmonaut selection and training was virtually unassailable.

[69]Kosmos, Interkosmos, and other boosters were also later launched from Plesetsk.

[70]C. Peebles, "Tests of the SS-6 Sapwood ICBM," Spaceflight, Vol. 22, No. 11-12, November-December 1980, p. 342.

[71]Marshal Kutakhov had been First Deputy Commander of the VVS since 1967. (Voennyi Entsiklopedicheskii Slovar', Moscow: Voennoe Izdatel'stvo, 1984, p. 388.)

[72]According to Kamanin, when Kutakhov was ordered to cut the staff of the VVS by ten percent in October 1969, the reductions were carried out "mainly at the expense of outer space." (Kamanin's diary of 31 December 1969 as published in N. P. Kamanin, "Mne Ochen' Obidno Za Nashikh Parnei...," Vozdushnyi Transport, No. 14, 1993, p. 11.)

[73]This was evident as early as 28 December 1968, when Kamanin noted with disdain in his diary that Chelomei's manned lunar landing project had been pushed aside in favour of the N-1. (N. P. Kamanin, "Mne Ochen' Obidno Za Nashikh Parnei...," Vozdushnyi Transport, No. 13, 1993, p. 11.)

[74]Kamanin's Diaries of 11 August and 2 September 1966 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 44, 1993, pp. 8-9, and No. 45, 1993, pp. 8-9.

[75]Central Committee and Council of Ministers Resolution No. 932-331 of 27 November 1968 on the causes of the Gagarin aircraft accident specifically singled out General Kamanin for a severe reprimand. However, it also upgraded the VVS Centre for the Preparation of Cosmonauts (TsPK) into a "testing institution First Class" named in honour of Gagarin. (Kamanin's Diaries of 4 and 7 December 1968 as published in N. P. Kamanin, "Dlia Nego Zhit' - Oznachalo Letat'," Vozdushnyi Transport, No. 18-19, 1994, p. 12.)

The USSR Academy of Sciences

After several lean years, the USSR Academy of Sciences enjoyed a revival of its fortunes after the end of 1964. One sign of this was the change in science planning organs mentioned above. With regard to the space programme, the role of the Academy of Sciences grew dramatically. The Institute for Space Research (IKI) was created in 1965. Although many of the scientists in IKI were not enthusiasts of manned spaceflight, the new organisation did provide the Academy of Sciences with a focal point for its various space research programmes.[76] In addition, in 1965-1966 the Academy of Sciences was given control of the small fleet of ships used for tracking and communication with manned spacecraft.[77]

As President of the Academy, M. V. Keldysh continued to be the most powerful scientific figure in the space and missile field. He also continued to serve as the Chairman of the Interdepartmental Commission on Spaceflight. Yet, Keldysh appears to have been exceedingly cautious in using his authority. From 1960 to 1964 his support for Korolev's projects had been crucial, but had generally come couched in terms of compromise.[78] His decisions and policies in the late 1960s were characterised by the same sort of caution and compromise.[79]

Another characteristic of the post-Khrushchev era at the Academy of Sciences was the increase in the size and balance of the membership. The number of new members allowed into the Academy of Sciences had dropped dramatically in the later Khrushchev years.[80] But in the 1966 election the numerical restraints were apparently lifted.[81] The 1966 election also saw the first promotions, and initial elections, of missile and space

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[76]IKI was created by grouping together all of the various institutes that had been involved in space research. Many of these organisations were fierce competitors and their marriage in IKI was unwelcome. One of the few things that many of them could agree on was that the manned space programme interfered with their scientific work. (Sagdeev, The Making of a Soviet Scientist, pp. 160-62.)

[77]Christian Lardier, L'Astronautique Sovietique, Paris: Armand Colin, 1992, p. 182.

[78]For example, his efforts to save the N-1 project by pointing out the inadequacies of the project, while simultaneously urging the design of a more powerful version.

[79]This approach caused great consternation among other space programme leaders including Kamanin, Glushko, and Barmin. (See: Kamanin's diary of 5 November 1969 as published in N. P. Kamanin, "Mne Ochen' Obidno Za Nashikh Parnei...," Vozdushnyi Transport, No. 14, 1993, p. 11.)

[80]In 1958 34 Academicians (full members) were elected. In 1960 - 11; in 1962 - 13; in 1964 - 28. See Appendix 5.

[81]There were 46 Academicians elected in 1966. Numbers of candidate members showed similar trends.

designers since Chelomei's election in 1962. Among the new entrants was M. K. Iangel' who was elected directly to Academician after years of exclusion.[82] Designers who had been associated with Korolev also did well in the 1966 elections.[83] Thus, the Academy not only enjoyed a growth in numbers, but some balance among the missile design bureaux. It was no longer dominated solely by Korolev's sympathisers.

The State Commission(s) for Spaceflight

In the last half of the 1960s the State Commission for Spaceflight continued to become more like a "normal" weapons programme commission. The special "co-ordination-directional functions" that the State Commission for Spaceflight had exercised were largely returned to the ministries.[84] The State Commission now

> "concentrated its main attention on preparation and carrying out of flight-design tests."[85]

The State Commission for Spaceflight (under G. A. Tiulin) supervised the last Vostok dual mission in 1963 and the two Voskhod missions in 1964 and 1965. Either between the two Voskhod missions, or shortly thereafter, the functions of the State Commission for Spaceflight became more limited.

Although the State Commission for Spaceflight no longer enjoyed the sweeping powers it had under Khrushchev, it was still more than a standard weapons evaluation commission. The manned space programme continued to be an object of keen leadership attention. Thus, the State Commission for Spaceflight exercised special "steering" functions during the process of developing manned missions, rather than simply managing the execution of the flights.[86] As before, decisions of the State Commission were still reviewed and approved by the Military Industrial Commission (VPK), and manned mission proposals

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[82] Iangel' had been elected to full membership of the Ukrainian Academy of Sciences in 1961, but had been ignored by the USSR Academy of Sciences.

[83] Three were promoted from candidate to academician: Barmin, Mishin, and Piliugin. V. P. Makeev, a protégé of Korolev, became a candidate member.

[84] B. Pokrovskii, "'Tovarishch Predsedatel' Gosudarstvennoi Komissii!...'," Aviatsiia i Kosmonavtika, No. 11, November 1988, p. 43.

[85] Pokrovskii, "'Tovarishch Predsedatel' Gosudarstvennoi Komissii!...'," p. 43.

[86] Iu. A. Skopinskiy, "State Acceptance of the Space Program: 30 years of work - from the history of science," Zemlia i Vselennaia, No. 5, September-October 1988, pp. 73-79, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-89-005, 15 March 1989, p. 63.

apparently had to be approved by the party leadership.[87] The State Commission for Spaceflight continued to have a broad mandate, but it's authority to deal directly with design bureaux and enterprises had been reduced by the re-creation of the ministries.

The tendency toward "normalisation" was also evident in the creation of new State Commissions for Spaceflight. In 1965 General K. A. Kerimov became Chairman of the "State Commission for Flight Testing of the Soiuz Spacecraft."[88] General Kerimov had just left the Strategic Rocket Forces (RVSN) to head a department in the Ministry of General Machinebuilding.[89] G. A. Tiulin remained head of the State Commission for Voskhod flights until at least mid-1966.[90] In October 1966 Minister S. A. Afanas'ev (MOM) was appointed Chairman of a "Council for the Exploration of the Moon" that apparently functioned as the State Commission for the lunar landing programme.[91] Then, in December 1966, Tiulin was put in charge of another State Commission, this one for manned circumlunar flights.[92]

Thus, by the end of 1966 there were at least three State Commissions for the manned spaceflight programme.[93] There continued to be considerable overlap in membership, and this continued to cause problems. It appears that State Commission meetings were regularly scheduled one after another on the same day in order to facilitate attendance by the members. As the pace of the programmes picked up, such convenient

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[87]It is not clear whether a Politburo decree was needed for each mission after Khrushchev. However, approval of TsK Secretary Ustinov was needed, even for unmanned tests in the manned programmes of the late 1960s.

[88]"Rockets go into Space," Sovety Narodnykh Deputatov, No. 4, April 1988, pp. 50-53, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-89-005, 15 March 1989, p. 64. This source is an interview with Kerimov; the commission name is his.

[89]Kamanin's diary of 11 May 1965 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 44, 1993, pp. 8-9. The tone of Kamanin's remark, and the complete absence of Kerimov from a recent history of the RVSN, further suggest that his departure from the rocket forces was less than amicable.

[90]The Voskhod programme was planned to include more than two flights. See below.

[91]Kamanin's diary of 5 October 1966 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 45, 1993, pp. 8-9. The quoted title is the one used by Kamanin in his diary entry for 5 October 1966. He later refers to the L-3 (lunar landing) State Commission with Afanas'ev as Chairman. These organisations appear to be one and the same.

[92]This was the UR-500K/L-1 programme. (Kamanin's diary of 20 December 1966 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 45, 1993, pp. 8-9.)

[93]One each for: Soiuz spacecraft development, the circumlunar (L-1) project, and the lunar landing (L-3) project.

scheduling was not always possible.[94] By the end of 1969 it appears that the State Commissions for the lunar programmes had withered away. Kerimov was left as Chairman of the State Commission for Spaceflight.[95]

The Design Bureaux and Space Policy

The Council of Chief Designers

For the first year and a half after Khrushchev's removal from office the Council of Chief Designers was, for all intents and purposes, non-existent. Not only was it irretrievably split by the feud between Korolev and Glushko (that dated from the 1958 incident about ICBM fuels), but also by resentment among the rest of its members. The mutual animosity was summed up by Chief Designer Barmin, who noted in 1965 that

> "We worked in a friendly manner when we were all leaders... Now there is one Chief Theoretician and one Chief Designer."[96]

After Korolev's death the Council of Chief Designers was revived, but with substantial changes to its membership and function. According to General Kamanin's diaries, meetings of the Council of Chief Designers in 1968 included Keldysh, Chelomei, Ministry of General Machinebuilding (MOM) officials, and various military leaders.[97] The expansion of the Council brought in even greater discord, making it even less likely to challenge its political overseers. On several occasions, when proposals to change existing plans were made in the State Commissions, the Council of Chief Designers was assigned to evaluate the possibility.[98] Rather than serving as an elite technical leadership body that

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[94]Kamanin mentions an inconclusive meeting of the lunar landing State Commission in September 1968. He identifies the problem as the absence of two leading members (Tiulin and Mishin) who were away working on the circumlunar programme. (Kamanin's diary of 17 September 1968 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 50, 1993, p. 10.)

[95]As Kerimov said: "After the completion of tests, the Soiuz stayed 'in our hands.' We were assigned to oversee its operation and, when the Saliut and Mir were developed, their operation as well." ("Rockets go into Space," p. 64.)

[96]The occasion of this "muttered" comment was the Korolev's appeal to his fellow designers, to work together on the moon project, made during the Voskhod 2 post-flight celebrations. The references to the Chief Theoretician and Chief Designer are to Keldysh and Korolev. (Kamanin's diary of 21 March 1965 as published in L. N. Kamanin, "Dnevnika N. P. Kamanina," Ogonek, No. 7, 9-16 February 1991, pp. 28-31.)

[97]Kamanin's diary of 30 May 1968 as published in N. P. Kamanin, "Dlia Nego Zhit' - Oznachalo Letat'," Vozdushnyi Transport, No. 16, 1994, p. 11.

[98]See: Kamanin's diary of 18 January 1967 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 46, 1993, pp. 8-9.

drove the space agenda, the Council of Chief Designers began to function as a subcommittee of the State Commissions.

OKB-1/TsKBEM: Korolev/Mishin

Falling afoul of Khrushchev in 1960 was not without its eventual benefits for Korolev. After October 1964, OKB-1 enjoyed a reversal of fortune. Korolev's projects received top priority once again. As the favoured chief designer, he was assigned direct responsibility for a number of space projects, some of which he was not particularly enthusiastic about.[99] After the creation of the new Ministry of General (missile and space) Machinebuilding the major design bureaux were renamed. In January 1967, OKB-1 officially became the Central Design Bureau for Experimental Machinebuilding (TsKBEM).[100]

In addition to increased funding for its projects, another sign of the change of fortunes was Korolev's ability to focus his design bureau's work on manned lunar projects. OKB-1 shed virtually all other remaining design projects to other organisations. Communication and weather satellite projects were passed on to the appropriate ministries for control.[101] Unmanned space probes were transferred to the newly independent Lavochkin Design Bureau under the control of G. N. Babakin.[102] The only remaining missile work assigned to the Korolev Bureau was the solid fuel missile project.[103] This appears to have been carried out by a largely autonomous subdivision. From 1965 onward, Korolev was left primarily with the two major projects that most interested him, the N-1 lunar rocket and manned spacecraft.

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[99]For example, Korolev was sent to personally supervise the launch of lunar probes in early 1965. A task he saw as a major imposition. (Kamanin's diary of 31 March 1965 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 44, 1993, pp. 8-9.)

[100]Apparently this did not affect colloquial usage. Many documents of the period still refer to it as OKB-1, or simply "the Korolev Bureau".

[101]Lardier, L'Astronautique Sovietique, p. 284.

[102]From 1962-1965 the Lavochkin Bureau had been subordinated to Chelomei as Filial Number 2. See Appendix 11. For Babakin, see Appendix 3.

[103]This had begun with the RT-1. The follow-on RT-2 (SS-13) was first tested in February 1966 and accepted into the inventory in 1968. (G. A. Kustova, ed., Ot Pervogo Sputnika do Energii - Burana i Mira, Moscow: RKK Energiia, 1994, p. 63.)

Just as Korolev was poised to achieve his lunar ambitions, he died in a botched surgical operation on 14 January 1966. First Deputy Chief Designer, Vasilii Pavlovich Mishin, became acting chief designer of TsKBEM.[104] Mishin, who had been Korolev's deputy since the 1940s was clearly not a leader of the same stature as his predecessor. There appears to have been a prolonged debate over who should take charge of TsKBEM and its lunar projects. Ustinov is said to have preferred G. A. Tiulin for the post.[105] However, the staff of TsKBEM had written a letter to the leadership on the night of Korolev's funeral insisting that Mishin was the only suitable choice.[106] For reasons that are, as yet, unclear Mishin was finally confirmed as chief designer on 11 May 1966.[107]

At first, Mishin was in an extremely weak position, but he managed to hold on to Korolev's gains. One of Mishin's problems was that he was not seen as an equal by the other members of the Council of Chief Designers. If this wasn't clear from the delay in his appointment, it became obvious in the Academy of Sciences. Mishin was advanced from candidate member to Academician in the July 1966 election, but did not assume Korolev's place on the Presidium of the Academy of Sciences. That position eventually went to another missile/space designer promoted to Academician in July 1966, N. A. Piliugin.[108] Piliugin had been one of the six original members of the Council of Chief Designers.[109]

Given Mishin's stature, and the long string of failures and disasters that followed his appointment, it seems surprising that he survived as chief designer. Several things appear to have helped him to keep his post. First, Mishin was remarkably successful in distributing the responsibility for failures. Second, he was reportedly "protected" by Politburo member A. P. Kirilenko. This was ostensibly because Mishin had been

[104]For Mishin, see Appendix 3.
[105]Oral history of V. P. Mishin in Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, p. 121.
[106]Oral history of E. V. Shabarov in Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, p. 182.
[107]Oral history of V. P. Mishin in Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, p. 121.
[108]G. A. Tiulin, "Vpereedsmotriashchii," Krasnaia Zvezda, 18 May 1988. Piliugin joined the Academy of Sciences Presidium in 1967. For Piliugin, see Appendix 3.
[109]If the position on the Academy of Sciences Presidium had been filled by seniority among the chief designers Glushko would have taken Korolev's position. Glushko had been elected an academician at the same time as Korolev, 1958. The original Council of Chief Designers is shown at Appendix 8.

promoting Kirilenko's son-in-law to top positions at TsKBEM.[110] Kamanin's diary entries also suggest that Ustinov later wanted to keep Mishin in place long enough to blame him for the failure of the manned lunar project.[111]

OKB-586/KBIu: Iangel'

Like Korolev's bureau, Iangel''s bureau received a major boost and became more specialised after the ouster of Khrushchev. During the summer of 1965 OKB-586 was assigned to develop a wide array of military and scientific satellites and to modify its boosters to launch them.[112] In 1966 Iangel''s bureau was also renamed: KB Iuzhnoe. Throughout the rest of the 1960s KB Iuzhnoe devoted much of its attention to taking over the ballistic missile business from Chelomei's design bureau. Yet, since Chelomei was strongly favoured by the military, this issue was not resolved until the 1970s.

Virtually all of the Iangel' bureau's non-military space work was for small earth-orbital satellites. The series of research satellites ordered in June 1965 developed into a number of projects. One of these was the Interkosmos series of satellites. These were satellites which included experiments from "fraternal socialist" countries under the terms of the Interkosmos agreement signed in 1967. The first launch in this series was in 1969 from Kapustin Iar on a Iangel'-designed Interkosmos (SL-8 or Large Kosmos) booster. The only human spaceflight project still assigned to KB Iuzhnoe during this period was the development of the engine unit (Blok E of the N-1) for the lunar landing craft. Ground test firing of the engines for this project only began in February 1969.[113]

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[110] Kirilenko's son-in-law, Iu. P. Semenov, supervised work on the circumlunar (L-1) spacecraft. (Potts, Soviet Man in Space, Vol. 2, p. 236.) Semenov later led the design work for the Saliut space stations. He is now President of the "S. P. Korolev Space Corporation Energiia."
[111] Kamanin's diary of 27 December 1967 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 48, 1993, pp. 8-9.
[112] The satellites included geophysical, magnetic, and meteorological scientific satellites and reconnaissance and anti-satellite systems. (V. Pappo-Korystin, V. Platonov, and V. Pashchenko, Dneprovskii Raketno-Kosmicheskii Tsentr, Dnepropetrovsk: PO Iuzhnyi Mashinstroitel'nyi Zavod and KB Iuzhnoe, 1994, pp. 73-4.) Iangel' was also involved in the development of the Fracto-Orbital Bombardment System (FOBS).
[113] Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 77.

OKB-52/TsKBM: Chelomei

Khrushchev's favouritism had allowed Chelomei to amass a huge aerospace design empire, but with his patron gone he was exposed to attacks from the very people he had earlier displaced.[114] It did not take long for Ustinov and his associates to denounce the "errors" of the recent past.[115] As an official at OKB-52 put it:

> "The comrades in the ministry literally instantaneously shifted gears from 'universal approval' of our projects to total suppression of any initiative of ours. A menacing commission arrived at the enterprise for 'looking into' the activity of the OKB..."[116]

In short order many of Chelomei's missile and space projects were cancelled. His favourite, the "space plane" project, was transferred to the Mikoian design bureau.[117] Chelomei's UR-200 ICBM was axed.[118] His anti-ballistic missile project was also cancelled.[119] Citing a change in military doctrine, the ICBM version of the UR-500 (Proton) was also cancelled around this time.[120] One of the few projects to survive was the space launcher version of the UR-500.

In addition, there were major organisational changes unfavourable to Chelomei. On 2 March 1965 he lost Filial No. 2. As noted above, it reverted back to the name "Lavochkin Design Bureau" and fell more under Korolev's influence as the inheritor of his

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[114]At some point Chelomei is said to have boasted that he was the "most expensive man" in the Soviet Union. This was a reference to the budget of his design organisations. (Sagdeev, The Making of a Soviet Scientist, p. 202.)

[115]G. N. Pashkov, head of the space department of Gosplan pointed out that the favouritism of Chelomei was an error of judgement that had completely disorganised the space programme for the previous five years. (Lardier, L'Astronautique Sovietique, p. 153.)

[116]M. Rudenko, "Star Wars - History of the 'Death' of a Unique Spaceplane," Trud, 26 August 1993, p. 6, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-93-005, 5 October 1993, p. 33.

[117]There, G. Lozino-Lozinskii worked on a new "space plane" known as "Spiral". (Lardier, L'Astronautique Sovietique, p. 155; and Peter Pesavento, "Russian Space Shuttle Projects, 1957-1994: Part 1," Spaceflight, Vol. 37, No. 5, May 1995, p. 160.)

[118]Dmitri Khrapovitskii, "Absolutely Unclassified: The Ground Waves of Space Politics," Soiuz, No. 15, April 1990, p. 15, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-90-005, 26 November 1990, p. 86.

[119]Asif Siddiqi and Dennis Newkirk, "The FGB Core Module of the International Space Station Alpha: A Historical Overview of its Lineage and Organizational Origins," paper presented at the Society for the History of Technology Conference, 21 October 1995, Charlottesville, Virginia, USA, p. 5.

[120]Anatoly I. Kiseljov, Anatoly K. Nedaivoda, Vladimir K. Karrask, Gennady D. Dermichev, "The Launch Vehicle 'Proton': the History of its Creation, Peculiarities of its Structure and Prospects for Development," Space Bulletin, Vol. 1, No. 4, 1994, p. 5; and V. Petrakov and I. Afanas'ev, "Strasti po Protonu," Aviatsiia i Kosmonavtika, No. 4, April 1993, p. 11.

interplanetary probe projects.[121] As with the other design bureaux, OKB-52 also lost its old name. It was now known as the Central Design Bureau for Machinebuilding (TsKBM) (a designation confusingly close to the name later assigned to Korolev's KB - TsKBEM).[122]

Chelomei did, however, retain several important programmes. He continued to develop space station projects for the military throughout the period. The draft project (EP) for his "Almaz" Orbital Piloted Station (OPS) was accepted by the Military-Industrial Commission (VPK) sometime in 1967.[123] The UR-100 (SS-11) ICBM project also survived and later grew into the UR-100N (SS-19). Initially, Chelomei even retained the circumlunar mission that had been assigned to him in the August 1964 decree. This programme was under serious threat in 1965 due to delays in the development of the UR-500 launcher.[124] Sensing the danger, Chelomei managed to prepare a two stage version of the UR-500 and successfully tested it on 16 July 1965.[125] Thus, Chelomei managed to keep his circumlunar spacecraft and rocket projects alive through the summer of 1965.

What is surprising, at first glance, is that Chelomei's Design Bureau survived at all. S. A. Afanas'ev, the Minister of General Machinebuilding was known to be a supporter of Chelomei. Under his direction the Ministry continued to authorise speculative design work by Chelomei's bureau. Above this level, however, there is no definite evidence that Chelomei had any "protection" from the political leadership. It is possible that Chelomei had supporters on the Politburo. Yet, the postulation of such support is not necessary to explain the survival of TsKBM.

Chelomei's most consistent and avid supporters were the military leadership, especially Marshals Malinovskii and Grechko.[126] If Politburo membership were all that

[121]Lardier, L'Astronautique Sovietique, p. 152; Kustova, ed., Ot Pervogo Sputnika do Energii - Burana i Mira, pp. 2-3.

[122]One of the few things Chelomei did not lose immediately was Sergei Khrushchev. The younger Khrushchev remained employed as a senior engineer at TsKBM until 1968.

[123]Lardier, L'Astronautique Sovietique, p. 203.

[124]Korolev had prepared a letter for Brezhnev pointing out the problems and urging the cancellation of the UR-500. (The letter is reproduced in G. A. Vetrov, "Trudnaia Sud'ba Rakety N-1," Nauka i Zhizn, No. 5, May 1994, pp. 24-26.)

[125]Kiseljov, et al., "The Launch Vehicle 'Proton'," p. 5. (After the successful flight Korolev's letter was not sent and remained in the OKB-1 archive.)

[126]The full reasons for this support are not clear. Chelomei started out well behind Korolev and Iangel' so it seems unlikely that the support was due to the superior quality and speed of development of Chelomei's

counted, military support would not have been sufficient to keep Chelomei's design bureau open. However, in the post-Khrushchev era of collective and scientific decisionmaking, the military had considerably more influence over weapons acquisition policy. At the top political level such decisions would first have been considered by the Defence Council before coming to the attention of the Politburo.[127] Unlike the Politburo, the Defence Council included the Minister of Defence as a member. Given the consensual style of decisionmaking then in vogue, the Minister of Defence could block changes in his area of expertise.[128] This explanation is further suggested by the lavish attention Chelomei gave to military leaders in trying to gain and maintain their support.[129] Thus, Chelomei's bureau was kept alive by several well-placed supporters, largely on the basis of military projects.

The Voskhod Programme

The flight of Voskhod 2 in March 1965 was the end of an era. It was the last Soviet manned spaceflight supervised by Korolev, and the last America-beating spectacular. It also marked the final use of the Vostok-type spacecraft for human spaceflight. However, this is not what was intended.

The Voskhod programme, as originally authorised, called for at least three manned missions. In May 1964 General Kamanin noted that Korolev talked to him about adding a fourth Voskhod mission, to be flown in 1967.[130] Only the first of these missions was intended for a three person crew. The subsequent Voskhod spacecraft appear to have been designed for two-person "spacewalk" or long-duration missions. Experience with "space

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products at this point. (By the late 1960s Chelomei's missiles were much improved.) It seems more likely that the military leadership simply objected to Ustinov and his missile industry clique.

[127]It is not clear that Defence Council decisions were really discussed by the Presidium / Politburo. Later evidence suggests that such decisions were simply announced at Politburo sessions. Whether this was the practice during the late 1960s is not known.

[128]There is dramatic evidence of this in the 1969-1970 struggle over whether to authorise production of Iangel"s MR-UR-100 (SS-17) or Chelomei's UR-100N (SS-19). Both were produced. (Oral History of N. N. Smirnitskii, in Mozzhorin, ed., Dorogi v Kosmos, Vol. 1, pp. 149-50.)

[129]For example, Kamanin reports that Chelomei gave a five hour long personal tour of his design bureau to a group of Soviet Air Force Generals on 28 December 1966. (Kamanin's diary of 28 December 1966 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 45, 1993, pp. 8-9.)

[130]Kamanin's diary of 12 May 1964 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 43, 1993, pp. 8-9.

walking" and longer duration missions were essential to Korolev's lunar mission plans.[131] It is not clear when or why the "spacewalk" mission(s) were approved, but Korolev began work on them concurrently with the first (three man) Voskhod.

The change of political leadership contributed to the delay of the second Voskhod mission, but the real problems with Voskhod 2 were technical. Korolev had originally promised Khrushchev that Voskhod 2 would be launched in November 1964.[132] The delays in launching the first Voskhod had already made a November launch unrealistic. An unmanned test for the second mission was finally flown on 22 February 1965 under the name Kosmos 57. During the second orbit the spacecraft exploded. The problem apparently was not specific to the Voskhod spacecraft, for Korolev was able to conduct a re-test of the system that failed on a photo-reconnaissance mission on 7 March 1965.[133]

Voskhod 2, launched eleven days later, was very nearly a disaster itself. When cosmonaut Leonov had finished his "spacewalk" he discovered that his spacesuit had inflated so much that he could not fit back in the airlock. Only through dangerously deflating his spacesuit, and exercising spectacular agility, was he able to get back inside.[134] Then, while preparing for their return to Earth, cosmonauts Beliaev and Leonov discovered that their automatic guidance system had failed. Because of the one-orbit delay this caused, and the inaccuracies of the manual re-entry procedure, the cosmonauts landed deep in a snow-covered forest 3,200 kilometres from the landing zone.[135]

A number of additional Voskhod missions were planned, but were never launched for a variety of reasons. None of the missions proposed for later in 1965 materialised due to delays in completing the spacecraft and the continued wrangling over who would fly in

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131On Korolev's lunar landing spacecraft designs there was no internal hatch between the lunar orbital ship and the lunar landing ship. The cosmonaut going to, and returning from, the Moon would have to "space walk" from one ship to the other. Korolev referred to the "space walk" craft as "Vykhod" (exit).

132N. P. Kamanin, "I Would Never Have Believed Anyone..," Sovetskaia Rossiia, 11 October 1989, p. 4, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-91-002, 16 April 1991, p. 21.

133This mission was identified as Kosmos 59. (Lardier, L'Astronautique Sovietique, p. 143.)

134While busy saving his life Leonov left a film camera behind. Perhaps as a result of the consequent scarceness of footage, Soviet propagandists spliced in some film of Leonov practising his space walk in a water tank. This led to some Western reports that the space walk had been a hoax. (Potts, Soviet Man in Space, Vol. 1, p. 213.)

135Beliaev and Leonov are said to have spent a cold night in the spacecraft hiding from hungry wolves. The rescue team reached them the next day by ski. (Dennis Newkirk, Almanac of Soviet Manned Spaceflight, Houston, Texas: Gulf Publishing Co., 1990, p. 37.)

them.[136] The technical and political leaders finally settled on a mission for early 1966. Voskhod 3 was scheduled to coincide with the Twenty Third Party Congress, and was planned to break the space endurance record recently set by the US.[137] Due, at least in part, to Korolev's death in January, the mission was not launched in time for the Party Congress. After the Party Congress was over there were still strong indications that the Soviet Union planned to go ahead with this mission.[138] According to General Kamanin, Ustinov and VPK Chairman Smirnov cancelled this flight at the last minute, over the objections of the State Commission for Spaceflight.[139] Kamanin's explanation for this decision is that Ustinov, Smirnov, and G. N. Pashkov (Gosplan space department head) saw "no future" in the Voskhod. They wanted to put all efforts into the new Soiuz spacecraft and the lunar programme.[140]

This set an important precedent for the post-Korolev era: Ustinov was now clearly in charge of space policy and there was no one with the authority or temerity to bypass him. It does not appear that the chief designers played any significant role in the decision to cancel Voskhod in 1966. On the contrary, Mishin could have used an easy success to shore up his position (he was still only acting chief designer). The cancellation of the Voskhod programme was forced on TsKBEM (formerly OKB-1) by Ustinov.

The Manned Lunar Programmes

Khrushchev's spectacular reversal on lunar policy may have been a "hare-brained scheme," but the new leadership did not change the basic policy set in the 3 August 1964

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[136]Korolev continued to push for launching more of the engineers from his design bureau. General Kamanin opposed Korolev's efforts to circumvent Air Force control over cosmonaut selection and training. Kamanin also continued to push for the idea of an all-woman space "walk." Other leaders, like VVS Marshal Rudenko, tried to advance cosmonaut candidates of their own.

[137]Gemini 7 remained in orbit for nearly 14 days in December 1965. The Soviet long-duration mission appears to have been planned for 18 days.

[138]Soviet Air Force Commander-in-Chief Vershinin discussed an upcoming flight in an article in Pravda on Cosmonautics Day (12 April) 1966. This was four days after the end of the Party Congress. (Peter Pesavento, "An examination of rumoured launch failures in the Soviet manned programme. Part 1: Voskhod/1966," Journal of the British Interplanetary Society, Vol. 43, No. 9, September 1990, p. 381.)

[139]Kamanin's diaries of 22 December 1968 and 1 September 1969 as published in N. P. Kamanin, "Mne Ochen' Obidno Za Nashikh Parnei...," Vozdushnyi Transport, No. 12, 1993, p. 11; and No. 13, 1993, p. 11. There was only one State Commission for (manned) Spaceflight at this time.

[140]Kamanin's diary of 22 December 1968 as published in N. P. Kamanin, "Mne Ochen' Obidno Za Nashikh Parnei...," Vozdushnyi Transport, No. 12, 1993, p. 11.

joint decree of the Central Committee and the Council of Ministers. The goal was unchanged - to accomplish a circumlunar mission to celebrate the fiftieth anniversary of the Bolshevik Revolution and conduct a lunar landing within the following year. A third manned project, to develop the Soiuz spacecraft, ran in parallel with the two lunar projects. Eventually, variations of the Soiuz became the primary spacecraft for both lunar projects.[141] The basic thrust of Soviet manned space policy in the second half of the 1960s remained unchanged: to upstage the US manned lunar programme. The most significant modification after Khrushchev's ouster was the replacement of Chelomei's organisation with Korolev's as the favoured OKB.

Khrushchev had left the decision on a booster rocket for the lunar landing programme until December 1964. With Khrushchev gone, Korolev's N-1 design easily won approval.[142] Not only did Korolev supporters dominate the political leadership, but Korolev's booster was in a much more advanced state of development than Chelomei's. In addition, Korolev's leadership skill and dedication to manned exploration of the Moon were well known to all of the key figures in the party and government. If they were going to race to the moon, then Korolev probably seemed a safer bet than Chelomei.

To a great extent this decision, and ones to follow, were typical of the trend of relying on experts and scientific decisionmaking. In this case the ambitions of the experts were not wholly compatible with those of the leadership. Korolev was not simply interested in beating the Americans to the moon; he wanted to use the moon as a foothold for further exploration of the solar system.[143] As with previous projects, his personal agenda coloured his technical decisions and drove him to seek unquestioned control over the manned space programme.

Korolev's first problem was that there was still considerable bureaucratic resistance and competition to his plans. Minister of Defence Malinovskii was completely opposed to

[141]The return capsule of both spacecraft had the same basic design. The continuity is also evident in the design bureau designations for these projects. See Appendix 2.
[142]L. N. Kamanin, "S Zemli Na Lunu i Obratno," Poisk, No. 12, July 1989, pp. 7-8.
[143]This was an ambition he made clear as late as September 1965. (Vetrov, "Trudnaia Sud'ba Rakety N-1," May, p. 27.)

supporting the lunar projects.[144] Moreover, Korolev's rival, Chelomei, still had control of the circumlunar programme. There was a distinct possibility that, were Chelomei to achieve a quick success, Korolev's lunar landing programme might be cancelled, or transferred to Chelomei.[145]

Korolev made several attempts to cancel the circumlunar effort in favour of his landing programme, or to substitute his own equipment for Chelomei's.[146] Finally, sometime in the fall of 1965, Korolev managed to take over the circumlunar programme.[147] Arguing that Chelomei had no experience in manned spacecraft and that the UR-500 was inadequate for the task, Korolev said that drastic measures were needed to meet the circumlunar deadline (then two years away). He proposed putting the fifth stage of the N-1 (Blok D) and a modified Soiuz (7K-L1) on top of Chelomei's UR-500.[148] This project, known as the UR-500K/L-1, replaced Chelomei's circumlunar project. It was formally approved by the VPK on 15 December 1965.[149] The UR-500K/L-1 project not only put an end to Chelomei's lunar spacecraft plans, but it gave Korolev overall charge of the circumlunar programme.[150]

Korolev had won back his monopoly in manned spacecraft and technical leadership over the lunar programmes, but he was still unsatisfied with Soviet space priorities. In the days just prior to his death, Korolev produced a flurry of seemingly contradictory critiques of Soviet space policy. Complaining that competition among the designers was a "gross and fundamental error", Korolev called for a single lunar plan as the only way to beat the

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144 Soviet Air Force Commander-in-Chief Vershinin quotes Malinovskii as saying "We cannot afford to, and will not, build super powerful space boosters and make flights to the moon. Let the Academy of Sciences do all that." (Kamanin's diary of 1 February 1965 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 44, 1993, pp. 8-9.)

145 The close involvement of Korolev's nemesis, engine designer V. P. Glushko, in the UR-500 (Proton) circumlunar booster project probably added to Korolev's concern and irritation on this score.

146 Vetrov, "Trudnaia Sud'ba Rakety N-1," May, p. 26.

147 This appears to have been accomplished at a conference on lunar programmes. Korolev was trying to arrange such a conference in early September 1965. (Kamanin's diary of 1 September 1965 as published in L. N. Kamanin, "Dnevnika N. P. Kamanina," p. 82)

148 This proposal was made at a meeting on 8 September 1965. (Petrakov and Afanas'ev, "Strasti po Protonu," p. 11.)

149 I. A. Marinin and S. Kh. Shamsutdinov, "Programmy Lunnykh Poletov," Zemlia i Vselennaia, No. 4, July-August 1993, p. 63.

150 The "K" suffix on the UR-500 designation is reported to have stood for "kosmos" (space). It also just happens to be the initial of the person who took over the programme.

Americans to the moon.[151] Yet, Korolev was simultaneously downplaying the competitive aspects of the lunar programme. His last major proposal included slipping the target dates for the lunar missions by two years.[152] In the last of his annual New Year's articles for Pravda, Professor Sergeev (Korolev) also emphasised the difficulties of a lunar landing project.

> "There is no need to say how long, how strongly, how relentlessly the moon has caught the attention of man. The dream of humanity has been the desire for a child of the earth to at last land on the lunar surface. Unfortunately, this task is not a simple one and not so close to achievement."[153]

The apparent contradiction in these comments captures Korolev's dilemma. He had to use competition with the US, and the existing decrees, in order to maintain the priority of the lunar effort. At the same time he probably realised that trying to beat the US to the moon at this late date might not be possible. In order to beat the United States he would again have to sacrifice his long-range objective of building a permanent bridge into space. A lunar programme aimed purely at upstaging the US would, like the manned programme under Khrushchev, be a political stunt, not a sustainable programme. Unfortunately for Korolev and his successors, the stunt was exactly what the political leadership wanted. In any case, Korolev did not live long enough to resolve his dilemma.

After Korolev's death and the cancellation of Voskhod 3 in early 1966, the lunar programmes became the clear focus of Soviet manned space efforts. Korolev's successor, V. P. Mishin picked up these projects where Korolev had left them. Soviet cosmonauts were organised into overlapping teams to prepare for the variety of possible missions.[154] Minister of General (missiles and space) Machinebuilding Afanas'ev was appointed chairman of the Council for the Exploration of the Moon in October 1966. In November, the Military-Industrial Commission (VPK) decreed that spacecraft and rocket projects should be treated as "special state assignments."[155] In the same month an expert

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[151]Vetrov, "Trudnaia Sud'ba Rakety N-1," May, p. 24.
[152]Kamanin's diary of 24 January 1966 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 44, 1993, pp. 8-9.
[153]Pravda, 1 January 1966 as translated in Nicholas Daniloff, The Kremlin and the Cosmos, New York: William Morrow & Co., 1972, p. 118.
[154]Sergei Voevodin, "Komandiry Otriada Kosmonavtov TsPK," Propeller, No. 18, June 1993, p. 4.
[155]Kamanin's diary of 10 November 1966 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 45, 1993, pp. 8-9.

commission under the chairmanship of M. V. Keldysh approved the draft project (EP) for a two-man lunar expedition.[156] The Soviet Union also conducted the first unmanned earth-orbital tests of the new Soiuz spacecraft in November and December 1966.[157]

At about this time Chelomei made an unsuccessful bid to win control of the lunar landing programme. Chelomei had continued to work on lunar spacecraft "at his own risk,"[158] but apparently with the consent of Minister Afanas'ev. Based on his UR-700 rocket, his plan would have more closely matched the US Apollo mission; allowing a crew of three. Chelomei's proposal won the approval of a "panel of experts" of the Ministry of General Machinebuilding in September 1967.[159] However, it was apparently not a significant threat to Mishin. Ustinov and L. V. Smirnov (Chairman of the VPK), opposed Chelomei's proposal.[160] Specialists from TsKBEM (formerly OKB-1) prepared a report that "killed" the UR-700 project.[161] In early 1969 the UR-700 lunar landing project was formally cancelled, only to be replaced by Ministry approval for a study about using the UR-700 for a manned Mars mission.[162] It appears that none of these new manned spaceflight proposals were ever approved above the Ministry level.

Early in 1967 the lunar programmes were given a significant boost by the political leadership. A joint Central Committee and Council of Ministers decree of 4 February 1967, declared unsatisfactory the work of the ministries on the 3 August 1964 lunar programme decree.[163] The new decree stated that

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[156]One of the Soviet cosmonauts would land on the moon while the other waited in lunar orbit. The US planned on a crew of three, with two astronauts landing on the moon. The N-1 was not powerful enough to carry a crew that large.
[157]Only one of these Soiuz craft made it into orbit, Kosmos 133, launched on 28 November 1966. See Appendix 13.
[158]Kamanin's diary of 28 December 1966 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 45, 1993, pp. 8-9.
[159]Siddiqi and Newkirk, "The FGB Core Module of the International Space Station Alpha," pp. 5-6.
[160]Kamanin's diary of 28 December 1966 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 45, 1993, pp. 8-9.
[161]M. Rebrov, "A Delo Bylo Tak - Sovershenno Sekretno: Trudnaia Sud'ba Proekta N-1," Krasnaia Zvezda, 13 January 1990. (Like many thwarted design proposals, the UR-700 continued to re-appear in new forms.)
[162]This UR-700 Mars project was terminated fairly quickly - by April 1970. (Siddiqi and Newkirk, "The FGB Core Module of the International Space Station Alpha," pp. 5-6.)
[163]Notably, this decree was issued just days after the fatal Apollo capsule fire (27 January 1967). Whether there was any connection between the US setback and the decree is not clear.

"A flight around the moon by a manned spacecraft and the landing of a manned mission on the moon shall be considered to be objectives of national importance."[164]

This decree also set new, and extraordinarily unrealistic deadlines: a circumlunar mission within six months and a lunar landing by September 1968.[165] Given the criticism of the ministries, and the completely unrealistic deadlines, it seems unlikely that the designers had much to do with this decree. Chief Designer Mishin may have welcomed the support, but the likelihood of failure must have tempered his enthusiasm.

The new decree belied the intense opposition to the lunar programme by the military leadership[166]. First Deputy Minister of Defence Grechko made it clear to General Kamanin that "in general, I am against Moon missions."[167] It is worth noting that Grechko made this statement two weeks after the decree and less than two months before he was appointed as Minister of Defence.[168] Despite the lack of military support the decree seems to have had the intended effect on the manned lunar programmes.

Even before the decree, the circumlunar programme had already been accelerated. G. A. Tiulin had been appointed head of the State Commission for the UR-500K/L-1 programme at the very end of December 1966. With the circumlunar mission a high priority, the UR-500K/L-1 was rushed into tests. Thus, the L-1 spacecraft was tested simultaneously with the Soiuz spacecraft it was derived from. There were three unmanned tests between March and September 1967; at least two of which were clearly failures.[169] By the middle of 1967 it was clear that an extended series of tests would be needed before the circumlunar equipment would be ready for manned flight. It was also clear that the original goal of a circumlunar mission for the fiftieth anniversary of the Revolution (1967) would not happen. However, it might still have been possible to upstage the US.

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[164]Kamanin's diary of 15 March 1967 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 46, 1993, pp. 8-9.
[165]Kamanin's diary of 15 March 1967 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 46, 1993, pp. 8-9.
[166]To opponents of the lunar programmes, like the military leadership, the criticisms of the industrial ministries and the unrealistic deadlines in the decree may have been seen as a victory.
[167]Kamanin's diary of 18 February 1967 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 46, 1993, pp. 8-9.
[168]Marshal Malinovskii died on 31 March 1967. Grechko became Minster of Defence on 12 April 1967.
[169]See Appendices 13 and 14.

The February 1967 decree also accelerated the Soiuz spacecraft development programme - with disastrous consequences. Although the Soiuz spacecraft had failed on all three of its earlier test flights, an extremely ambitious plan was made for the first manned mission in April 1967.[170] Soiuz 1 with one cosmonaut on board would be launched first, followed by Soiuz 2 with three cosmonauts on board. After docking in space, two of the cosmonauts from Soiuz 2 would "spacewalk" to the other craft and return to Earth in Soiuz 1.[171] However, when Vladimir Komarov was launched in Soiuz 1 on 23 April 1967, one of the two solar panels on his spacecraft failed to open.[172] The shortage of power contributed to a cascade of other problems. The second Soiuz launch was cancelled and, as the situation worsened, Komarov's mission was curtailed. After skilfully overcoming numerous problems Komarov managed to get Soiuz 1 out of orbit, only to have the parachutes foul on opening. His craft plummeted to earth and exploded on impact.

Komarov's death had an extremely sobering effect.[173] It also raised numerous questions about the manned space programme and its leadership. After this, manned spaceflight decisions became conservative in the extreme. Mishin retained his job, apparently thanks to support from Brezhnev, but his plans and leadership were attacked by other space leaders.[174] In October 1967 Keldysh attacked "Mishin's" plan to put a single cosmonaut on the moon instead of two.[175] Keldysh had been Chairman of the Commission

[170]In an interview in 1990 Chief Designer V. P. Mishin specifically denied that there had been more than one test of Soiuz before the first manned mission. He took the English expert Phillip Clark to task for such accusations. (G. Salakhutdinov, "Eshche Raz o Kosmose: Beseda s V. P. Mishinym," Ogonek, No. 34, 18-25 August 1990, pp. 4-5.) However, a close examination of Kamanin's diaries and other evidence make it clear that Clark was correct. See Appendix 13.

[171]Leonard Nikishin, "Soviet Space Disaster on the Revolution's Anniversary: How and Why Cosmonaut Komarov Died," Moscow News (in English), No. 9, March 1992, p. 16; and L. N. Kamanin, "Zvezdy Komarova," Poisk, No. 5, June 1989, pp. 4-5.

[172]In keeping with Soviet practice the plans for a second launch were not made public. However, it was suspected by some observers, since the Soviets had taken the unprecedented step of applying a number to the first launch of a new series, i.e. "Soiuz 1" versus "Soiuz".

[173]Its influence was perhaps heightened by recency of the Apollo deaths. While some Soviet statements about the US accident were sympathetic, many claimed that the deaths were a result of US recklessness and capitalist greed. The implication was that such a thing could never happen in the Soviet space programme. (US Congress, Soviet Space Programs, 1966-1970, p. 231.)

[174]A. Tarasov, "Polety vo Sne i Naiavu," Pravda, 20 October 1989. There have been reports that Mishin either objected to the launch of Soiuz 1, or that he did not sign certain documents needed to authorise the flight. If this were the case, then Mishin's position vis-a-vis Ustinov would also have been strengthened.

[175]Kamanin's diary of 10 October 1967 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 47, 1993, pp. 8-9.

that had approved this very plan less than a year before.[176] In December 1967 Minister Afanas'ev admitted to General Kamanin that he had tried to fire Mishin, but Ustinov insisted on keeping Mishin in place until the N-1 lunar rocket began tests.[177]

Such complete turmoil was guaranteed to cause further difficulties. Mishin, who was in a relatively stronger position in 1967, chose this time to be particularly obstinate about crew selection. Following the example of his predecessor, he proposed cutting the Soviet Air Force completely out of the lunar programme and replacing VVS cosmonauts with engineers from his own design bureau. Further delays in equipment design, and delivery of subcomponents, also caused continuing changes to the planned launch schedule. Between December 1967 and March 1968 Kamanin noted at least three changes that delayed the target dates for the circumlunar and lunar landing missions.

Coming on top of all of these problems, Gagarin's death in March 1968 demoralised and further distracted the manned space programme leadership. The investigation of the plane crash that killed Gagarin and a highly experienced instructor pilot apparently baffled the space leadership and kept them busy for several months.[178] The rather inconclusive findings of the accident investigation panel, which suggested that the cause was pilot error, elicited a sharp protest from the rest of the cosmonauts.[179] Far from putting the issue behind them, the official accident report appears to have further undermined confidence in the leadership and aggravated a number of already tense relations.

However, General Kamanin used the intense political scrutiny of Gagarin's training as a way to advance his agenda. His greatest strides appear to have been made when TsK Secretary Ustinov made his first visit to the Cosmonaut Training Centre in April 1968.[180] When the decree on the Gagarin accident was published on 28 November 1968, all but one

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[176] S. L. Leskov, Kak My Ne Sletali Na Lunu, Moscow: Panorama, 1991, p. 9.
[177] Kamanin's diary of 27 December 1967 as published in N. P. Kamanin, "Radi Takoi Tseli Stoit Rabotat'...," Vozdushnyi Transport, No. 48, 1993, pp. 8-9.
[178] Gagarin and Colonel V. S. Seregin had crashed in what appeared to be a perfectly serviceable aircraft on a routine training mission.
[179] An entire series of excerpts from Kamanin's diaries, including a transcript of the cosmonauts' letter of protest, was published by Vozdushnyi Transport between March and May 1994. (N. P. Kamanin, "Dlia Nego Zhit' - Oznachalo Letat'," Vozdushnyi Transport, Nos. 9-19, 1994.)
[180] Kamanin's diary of 4 April 1968 as published in N. P. Kamanin, "Dlia Nego Zhit' - Oznachalo Letat'," Vozdushnyi Transport, No. 10, 1994, p. 11.

of Kamanin's April requests to Ustinov were granted.[181] One of Kamanin's more important gains was to secure the role of the Air Force as the primary cosmonaut selection and training organisation in a Central Committee and Council of Ministers decree. Although the design bureaux were able to nominate engineers for cosmonaut duty, after this there was no longer any question of setting up their own independent training programmes.

While everyone struggled with the loss of Gagarin, the questions about the next manned mission went unresolved. Before the second unmanned Soiuz docking test in April 1968 (Kosmos 212 & 213), Ustinov had insisted that a third complete test be carried out before re-attempting the mission originally intended on Komarov's flight (Soiuz 1).[182] According to Kamanin, Mishin lobbied heavily for a simpler mission. In order to get his way he simply did not prepare the two spacecraft needed to carry out the third unmanned docking test demanded by Ustinov.[183] Mishin even convinced the State Commission for Soiuz to recommend a simpler single-ship manned mission that could be conducted sooner.

Ustinov overruled this decision. He insisted that the next manned mission fulfil the requirements originally set for Soiuz 1 - i.e. the docking and crew transfer.[184] He also wanted it successfully tested at least three times before risking another cosmonaut. Perhaps, he hoped to eclipse the, as yet unflown, US Apollo. However, Ustinov was not willing to risk another cosmonaut fatality to do so. Nor did he want to allow Mishin to get away with unilaterally changing the flight programme.

The State Commission for Soiuz met in early June 1968 and duly decreed another unmanned test for later in the summer, but this was not a complete victory for Ustinov.[185]

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[181]The one request that was not granted was to transfer authority for ordering manned spacecraft from the RVSN to the Soviet Air Force. This was the one question that Ustinov had balked at on the day of his visit. See Kamanin's diaries for 4 April, 6 April, 4 December, and 12 December 1968 as published in N. P. Kamanin, "Dlia Nego Zhit' - Oznachalo Letat'," Vozdushnyi Transport, No. 10, 1994, p. 11; No. 11, 1994, p. 13; No. 18-19, 1994, p. 12; and N. P. Kamanin, "Mne Ochen' Obidno Za Nashikh Parnei...," Vozdushnyi Transport, No. 12, 1993, p. 11.

[182]Kamanin's diary of 20 April 1968 as published in N. P. Kamanin, "Dlia Nego Zhit' - Oznachalo Letat'," Vozdushnyi Transport, No. 12, 1994, p. 12. The first unmanned Soiuz docking test had been conducted in October 1967 (Kosmos 186 & 188). See Appendix 13.

[183]Kamanin's diary of 3 June 1968 as published in N. P. Kamanin, "Dlia Nego Zhit' - Oznachalo Letat'," Vozdushnyi Transport, No. 16, 1994, p. 11.

[184]Kamanin's diary of 29 May 1968 as published in N. P. Kamanin, "Dlia Nego Zhit' - Oznachalo Letat'," Vozdushnyi Transport, No. 16, 1994, p. 11.

[185]Kamanin's diary of 12 June 1968 as published in N. P. Kamanin, "Dlia Nego Zhit' - Oznachalo Letat'," Vozdushnyi Transport, No. 16, 1994, p. 11.

The summer unmanned test would not include docking, but would simply test the one available Soiuz spacecraft. Mishin also got his way for the manned mission that would follow. The State Commission recommended flying the simpler single cosmonaut rendezvous with an unmanned Soiuz. Mishin had been advocating such a mission for some time. It appears that Mishin's technical arguments and the pressure to fly some sort of manned mission before the year was over prompted the political leadership to accept the State Commission's more conservative recommendations.[186] Delaying the docking and crew transfer mission not only set back the Soiuz and lunar programmes, but indicated the leadership's extreme aversion to risking cosmonaut lives.

Despite all of these problems with Soiuz, the Soviet Union retained its extremely ambitious plans to upstage the US by launching the two-man UR-500K/L-1 around the moon in late 1968. In fact, this was the reason why the US accelerated the Apollo flights in mid-1968. Frank Borman, commander of Apollo 8, stated that his mission was changed to a lunar orbital flight in August 1968 based on Central Intelligence Agency reports about the Soviet circumlunar plans.[187]

The US did manage to upstage the Soviet Union with Apollo 8, but it was not for want of trying on Soviet side. The UR-500K/L-1 project was plagued by a series of failures during its unmanned tests - identified publicly as the Zond series.[188] There were two failures in the first half of 1968, followed by a launch pad accident in July that pushed back the third flight test. After the third attempt (Zond 5) returned to Earth, Pravda trumpeted that the "Earth - Moon - Earth Route" was open.[189] But this mission, and the one that followed in November, each failed for a different reason. In November 1968 General Kamanin noted in his diary that at least two fully successful L-1 tests would still be required before a manned flight would be allowed. He expected that a manned circumlunar

186 The two missions were flown in August (Kosmos 238) and October (Soiuz 2/3) 1968.
187 Frank Borman and R. J. Sterling, Countdown: An Autobiography, New York: William Morrow, 1988, p. 189.
188 See Appendix 14.
189 Pravda, 23 September 1968.

flight would come no earlier than the first half of 1969.[190] Other sources say that the crews and equipment were readied for a circumlunar launch on 9 December 1968, but that permission for the launch was not granted.[191] There were people in the West who worried about a Soviet circumlunar launch up until 21 December, when Apollo 8 was launched.[192] However, the Soviets never put a crew on the UR-500K/L-1.

In early 1969, with the L-1 programme overtaken and the lunar landing (N-1/L-3) programme yet to get off the ground, the leadership made the first significant change in lunar policy in four and a half years. The Central Committee and Council of Ministers issued resolution number 19-10 on 8 January 1969: "About the work plans for research of the Moon, Venus and Mars by automatic stations."[193] The most significant measure of this decree was the establishment of a third lunar programme to beat the Americans. The decree assigned top priority to the development of an unmanned probe to return a sample of the Moon's surface to Earth. It was at this time that Soviet propaganda began to talk about unmanned lunar exploration as safer and more "humane."[194] The Soviet Union made two attempts to return a lunar sample before the United States' manned landing.[195] The July attempt, known as Luna 15, crashed on the moon while the crew of Apollo 11 was on the surface.[196] The Soviet Union was clearly trying to upstage the US manned lunar programme up until the last possible second.

While the unmanned lunar soil return programme became the top priority, manned programmes and policy were left in limbo. Kamanin complained bitterly to his diary in

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[190]Kamanin diaries of 9 and 13 November 1968 as published in N. P. Kamanin, "Mne Ochen' Obidno Za Nashikh Parnei...," Vozdushnyi Transport, No. 12, 1993, p. 11; and L. N. Kamanin, "S Zemli Na Lunu i Obratno," pp. 7-8.

[191]Marinin and Shamsutdinov, "Programmy Lunnykh Poletov," p. 69.

[192]Peter Pesavento, "A review of rumoured launch failures in the Soviet manned programme. Part 2: The Lunar Project/1968-1969," Journal of the British Interplanetary Society, Vol. 43, No. 9, September 1990, p. 391.

[193]Kamanin's diary of 30 January 1969 as published in N. P. Kamanin, "Mne Ochen' Obidno Za Nashikh Parnei...," Vozdushnyi Transport, No. 13, 1993, p. 11.

[194]Soviet criticism about the riskiness of the Apollo programme was based heavily on the fact that US spacecraft could not be completely tested without astronauts on board (e.g., the Apollo 8 lunar orbital mission in December 1968). This was not mere propaganda. It represented a fundamental difference in design philosophy and attitude toward risk. It is also one of the reasons why the deaths of Komarov and Gagarin had such a devastating impact on the Soviet programme.

[195]See Appendix 15. The rocket used to launch these probes was the same one used for the UR-500K/L-1 circumlunar programme. It is not clear how the use of this rocket affected the Chelomei and Korolev design bureaux.

[196]This programme was finally successful on the sixth attempt, Luna 16, in September 1970.

January and February 1969 about the complete lack of any plans for the next manned spaceflight.[197] Neither the circumlunar, nor the lunar landing programme had been cancelled and unmanned tests continued. However, there was no indication from the leadership about whether these projects would ever fly with cosmonauts on board.

Just as the priority was shifting to the unmanned sample return probe, the N-1 lunar (landing) rocket was finally ready to be tested. For a first launch, the test in February 1969 went reasonably well. Unfortunately, one of the thirty engines on the first stage failed, causing a fire that crippled the rocket and eventually caused it to crash. A second launch, in early July 1969, fell back on the launch pad just seconds after lift-off.[198] The ensuing explosion virtually destroyed the launch pad.[199]

Despite these setbacks, the technical leaders of the space programme were actively pursuing plans to carry out a lunar landing until at least September 1969. The cosmonaut training centre still had a group of cosmonauts training for the lunar mission.[200] Development work on the lunar landing simulator also continued into September 1969.[201]

The circumlunar programme continued into late 1969 as well. A fully successful unmanned test was finally conducted in August 1969 under the name Zond 7. In September, the State Commission for the circumlunar programme met to discuss when the first manned mission would be launched.[202] Such a mission was never attempted.

Sometime during the next two months the political leadership finally changed manned space policy.[203] An important clue about this change was given by Academy of Sciences President Keldysh while he was visiting Stockholm in October 1969:

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[197]Kamanin's diary of 22 January and 11 February 1969 as published in N. P. Kamanin, "Mne Ochen' Obidno Za Nashikh Parnei...," Vozdushnyi Transport, No. 13, 1993, p. 11.
[198]Had the launch been successful the spacecraft would have executed an unmanned circumlunar mission just prior to the Apollo 11 lunar landing. See Appendix 16.
[199]There were two N-1 launch pads. The pad destroyed in this accident was rebuilt for future N-1 launches. Both were later converted into launch facilities for the Energiia-Buran space shuttle system.
[200]Voevodin, "Komandiry Otriada Kosmonavtov TsPK," p. 4. The lunar cosmonaut group had been reduced somewhat around March 1969.
[201]Kamanin's diary of 3 September 1969 as published in N. P. Kamanin, "Mne Ochen' Obidno Za Nashikh Parnei...," Vozdushnyi Transport, No. 13, 1993, p. 11.
[202]Kamanin's diary of 19 September 1969 as published in N. P. Kamanin, "Mne Ochen' Obidno Za Nashikh Parnei...," Vozdushnyi Transport, No. 14, 1993, p. 11.
[203]If there was a decree associated with this decision, it has yet to come to light.

> "At the moment, we are concentrating wholly on the creation of large satellite stations. We no longer have any scheduled plans for manned lunar flights."[204]

Shortly after this, Brezhnev himself, specifically citing Tsiolkovskii's predictions, pointed out that the Soviet Union had always been concentrating on the development of earth-orbital space stations. This was portrayed as part of the long-term Soviet plan for space exploration.[205] There were indications of this (new) emphasis during the January 1969 Soiuz 4/5 mission, which was billed in some coverage as the world's first "experimental space station."[206] However, Brezhnev's October 1969 announcement marked a major change - the first significant change of manned space policy since Khrushchev.

The policy change was felt immediately inside the Soviet space programme. The operational objective of the Soiuz 6, 7, and 8 "triple" mission was to investigate spacecraft docking - an assignment necessary for the manned lunar programme. Soiuz 6 and 7 were supposed to dock while Soiuz 8 filmed the process.[207] The docking attempt failed.[208] Nonetheless, the "triple" Soiuz (6, 7 and 8) mission in October 1969 was declared a major success as a step toward the construction of the first orbital space stations. In November 1969, the lunar training group at the Cosmonaut Training Centre was disbanded. It was replaced by a group training for space station missions.[209]

Although the two manned lunar programmes were effectively abandoned in late 1969, there was no formal decision to cancel them. As a result, both programmes continued, although neither was anticipated for immediate manned use. There was another,

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[204]As quoted in Daniloff, The Kremlin and the Cosmos, p. 170.
[205]Official Soviet sources claimed thereafter that Soiuz had been developed primarily to advance their space station plans. e.g., Evgeny Riabchikov, Russians in Space, trans. Guy Daniels, New York: Doubleday & Co., Inc., 1971, p. 232.
[206]Potts, Soviet Man in Space, Vol. 2, p. 242.
[207]A. Iasinskii, "Vechnyi 'Soiuz'," Propeller, No. 12-13, April 1994, p. 8.
[208]According to one source General Kamanin was "called onto the carpet" by Ustinov over this failure. (F. S. Alymov, Zagadki Zvezdnykh Ostrovov, Kn. 6, Moscow: Molodaia Gvardiia, 1990, p. 72, as quoted in Potts, Soviet Man in Space, Vol. 2, p. 262.)
[209]Voevodin, "Komandiry Otriada Kosmonavtov TsPK," p. 4.

barely publicised, circumlunar mission in October 1970.[210] This mission used the last remaining L-1 spacecraft and thereby brought the circumlunar programme to an end.[211]

The manned lunar landing programme continued for at least another four years. Asked why the programme was not cancelled, M. V. Keldysh is said to have remarked that to do so would have been an admission of failure. Nobody was willing to do that.[212] Still justified on the basis of the August 1964 and February 1967 decrees, the lunar landing programme remained one of the major projects under Mishin at TsKBEM.[213] In the course of several reviews and revisions, the programme metamorphosed into a plan to build extended duration manned outposts on the moon. While this may have been in keeping with Korolev's original lunar dreams, it was apparently not something that the political leadership was willing to support.

The key to Mishin's lunar plans was the completion of the N-1 rocket. The N-1 development programme continued well into the early 1970s. In May 1974, shortly before the fifth planned test of the N-1, Mishin was sacked and TsKBEM was merged with V. P. Glushko's engine design bureau to create NPO Energiia. On his first day as head of NPO Energiia, Glushko scrapped the N-1 project.[214] Oddly enough, this was not the end of manned lunar plans, for Glushko then proposed his own lunar base project. This was to be launched on an entirely new rocket of his own design, called "Vulkan." This project was quickly buried by an "improvised commission" from the Academy of Sciences.[215]

New Directions and Purposes

Three major directions for the Soviet manned programme were established in 1970. First among these was the use of space as an arena of international co-operation. This was

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[210] The mission was known as Zond 8.

[211] Kamanin's diary of 26 October 1970 as published in N. P. Kamanin, "Mne Ochen' Obidno Za Nashikh Parnei...," Vozdushnyi Transport, No. 15, 1993, p. 12. Some L-1 spacecraft had apparently already been modified for other purposes.

[212] Sagdeev, The Making of a Soviet Scientist, p. 178.

[213] Litvinov, former head of the Kuibyshev Sovnarkhoz, served as Deputy Minister of General Machinebuilding for Lunar Programmes until 1973. It seems likely that he used this position to protect "his" N-1 industries in Kuibyshev.

[214] Leskov, Kak My Ne Sletali Na Lunu, p. 24.

[215] Sagdeev, The Making of a Soviet Scientist, p. 183. Sagdeev was head of the Institute for Space Research (IKI) of the Academy of Sciences at the time and claims to have been on the commission that reviewed Glushko's project.

not a completely new policy for the Soviet space programme. Even in the early 1960s, Soviet scientific leaders had engaged in working-level co-operation with their counterparts in the West.[216] In June 1966, President DeGaulle of France signed an agreement on co-operation in space research with the Soviet Union.[217] Nine countries of the Socialist Bloc signed the Interkosmos agreement on joint unmanned space research in 1967.[218] All of these endeavours were useful in enhancing the prestige of the Soviet Union.

In 1970 international co-operation began to be applied to the manned space programme. Technical discussions with the US about building a compatible docking system for mutual space rescues blossomed into plans for a joint US-Soviet docking mission. In May 1972 the US and Soviet Union signed an agreement that created the Apollo-Soiuz Test Project.[219] The Soviet Union accorded this programme extreme priority.[220] By the time the mission was flown in 1975 US-Soviet relations had already begun to sour. Nonetheless, the project served its purpose as a demonstration of superpower parity in space.

The other two new directions in space were both related to the use of manned space stations. Again, this was not an entirely new idea. Earth-orbital stations had a long history in the Soviet Union. Building a space station had been seen by the Soviet space visionary K. E. Tsiolkovskii as a necessary step toward the moon. Korolev had built this idea into his early space plans, but had abandoned it under pressure of the race to the Moon.[221] By the time Mishin took over TsKBEM (formerly OKB-1), it had no space station programme.

On the other hand, Chelomei had been working on a military space station since Khrushchev's time. It was planned as a means of ocean reconnaissance, and a counter to

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[216] David S. F. Portree, Thirty Years Together: A Chronology of U.S. - Soviet Space Cooperation, NASA Contractor Report 185707, February 1993, pp. 1-7.

[217] Although at this time Kosygin normally represented the Soviet Union when dealing with the West, Brezhnev signed this agreement on behalf of the Soviet government. (Lardier, L'Astronautique Sovietique, p. 5.)

[218] Pappo-Korystin, et al., Dneprovskii Raketno-Kosmicheskii Tsentr, p. 75. In the late 1970s the Interkosmos agreement was extended to manned programmes. Thus began a long series of "guest cosmonaut" visits to Soviet space stations.

[219] Portree, Thirty Years Together, p. 16.

[220] This went so far as to have two Soiuz boosters and spacecraft ready for launch on the date of the mission. The Soviet Union also built a variety of entirely new facilities for this mission.

[221] In an article in the premier issue of Aviatsiia i Kosmonavtika (January 1961), Professor Sergeev (Korolev) laid out his plans for an entire complex of orbital stations. (See also the reference to this article in: Riabchikov, Russians in Space, pp. 175-6.)

the US Manned Orbiting Laboratory (MOL) project. Chelomei had submitted his draft proposal (EP) for the Almaz Orbital Piloted Station (OPS) project the day prior to Khrushchev's ouster.[222] This was one of the few Chelomei projects that was not cancelled in the wake of the leadership change in 1964. In 1967 the proposal was finally approved by the Military-Industrial Commission (VPK). By the end of 1969 there were ten Almaz stations being assembled at the Khrunichev plant, a part of Chelomei's OKB-52.[223]

When Soviet space policy was re-oriented to the development of orbital stations in late 1969, Ustinov ordered Chelomei to share his Almaz design with TsKBEM (formerly OKB-1). Mishin opposed this, on the grounds that it would divert resources from the still-existing lunar landing programme. Ustinov forced him to accept the project.[224] Several of the unfinished Chelomei stations, and copies of the blueprints, were transferred to TsKBEM. There, Iurii Semenov was assigned as chief designer of the crash project to convert the Almaz into the craft eventually known as Saliut.[225] The Saliut station, and the Soiuz spacecraft, became the basis for the programme that is still the centrepiece of the Russian manned space effort.

Chelomei's Almaz space station remained the basis of the military manned space programme until the mid-1970s. Even though the US had cancelled its military space station in 1969, three Almaz space stations were launched under the Saliut name and manned by Soviet military crews.[226] After Ustinov became Minister of Defence in 1976 this programme was terminated, but the military manned space programme was not. Military space efforts were instead shifted to the Energiia-Buran space shuttle programme.[227] Thus, a specifically military effort was the third main theme of development of the Soviet manned space programme.

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[222]12 October 1964. (Lardier, L'Astronautique Sovietique, p. 203.)
[223]Dmitrii Payson, "Without the Secret Stamp: 'Salyut' and Star Wars," Rossiyskiye Vesti, 21 November 1992, p. 4, as translated in FBIS, Science and Technology Central Eurasia: Space, JPRS-USP-93-001, 25 March 1993, p. 67.
[224]Payson, "Without the Secret Stamp," p. 67.
[225]Potts, Soviet Man in Space, Vol. 2, p. 269. Saliut was originally known as Zaria (Dawn). Apparently the name was changed just prior to its launch in April 1971 to "salute" the tenth anniversary of Gagarin's flight on Vostok 1.
[226]Saliut 2, 3, and 5 were actually Almaz military space stations.
[227]Ia. K. Golovanov, "Kuda Zhe My Letim?," (5 part series), Izvestiia, 12-17 December 1991. (Note that the Energiia-Buran was not designed by Chelomei.) (The shift of military efforts to the space shuttle

For the next twenty years international co-operation, science-oriented "civil" space stations, and military projects remained the main themes of development of the Soviet manned space programme. All of these projects served to emphasise the superpower status of the Soviet Union and enhance its prestige.[228] Fundamentally, the manned space programme was no longer about establishing appearances, but about maintaining them.

Implications and Conclusions

Space Projects and the Policy Process

Although there were few flights to prove it, from 1964 until late 1969 the Soviet Union's manned space programme was more active and diverse than at any other time in its history. All of these projects had been initiated while Khrushchev was in power. The few adjustments and changes to manned space policy were driven largely by the party leadership. There was substantial domestic opposition to many of the policies, but this does not appear to have had a significant impact on their implementation. Such opposition did, however, appear to contribute to the stagnation in policy objectives until the Khrushchevian ones had been eclipsed by the US Apollo programme.

The Voskhod programme was the only manned programme to be deliberately cancelled by the new leadership. This had always been an interim programme, authorised primarily to forestall the appearance of US leadership in manned spaceflight. Voskhod was also useful for other purposes, including preparation for lunar flights and gaining the experience needed for military space missions. Launching the planned Voskhod 3 mission soon after Korolev's death could have solidified Chief Designer Mishin's authority. However, the programme was terminated in 1966 by the party leadership (primarily Ustinov).

Voskhod succumbed to a number of changes in the international and domestic political environment. Technologically, it was far behind the second and third generation of

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programme paralleled changes in the US. After the Manned Orbiting Laboratory (MOL) was cancelled in 1969, the US military concentrated its manned spaceflight plans on the space shuttle.)

[228]The nature of the military programme was not revealed, but its public successes were still useful for enhancing Soviet prestige.

US manned spacecraft.[229] Using Voskhod to maintain the appearance of space supremacy would have been extremely difficult. The recent death of Korolev also influenced the decision to cancel Voskhod in two ways. First, with Korolev gone, there were no technical experts with the stature to argue with political leaders like Ustinov. Second, Korolev's successors at OKB-1 were not up to the task of running so many manned programmes (Voskhod, Soiuz, circumlunar, lunar landing) at the same time. Maintaining space leadership meant developing a new spacecraft quickly, and the political leadership recognised that this was not likely to be done if Voskhod was kept alive. In this regard, the failure to "deliver" Voskhod 3 for the Twenty Third Party Congress probably contributed to the decision to channel all efforts into the other existing manned programmes.

The Soiuz spacecraft development project was apparently re-directed twice after 1964. Soiuz was authorised late in 1963 primarily as a military project. Although there is no evidence available to show a formal change in purpose, in effect, Soiuz was re-directed to serve the needs of the manned lunar programmes. The Soiuz design became the basis for manned spacecraft for both lunar programmes.[230] Planned Soiuz missions were also designed to test those techniques (docking and "space walking") most needed for the manned lunar programme.[231] Korolev may have initiated this return to his original plans, but he would not have been able to carry it out without the support of the party leadership.

The second re-direction of Soiuz came in 1969 and served as the means of changing the aim of the Soviet manned space programme without repudiating earlier policies. Soiuz development had been so delayed by tragedy and failure that its lunar objective was overcome by events. The re-direction of Soiuz toward orbital space station support was certainly not initiated by Chief Designer Mishin. He wanted to concentrate on the lunar landing programme. The impetus here may have come from a number of sources, but the decision was clearly driven by the party.[232] The party effectively abandoned its lunar

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[229]A modification of Vostok, Voskhod was no match for the US Gemini or Apollo spacecraft.

[230]As noted above, the circumlunar spacecraft was originally to have been designed by Chelomei.

[231]Orbital rendezvous may have been useful for military interception and observation, but there was little need for military spacecraft to dock and even less call for their crewmen to exit the spacecraft.

[232]The re-orientation toward space stations would have served the interests of a number of members of the existing Council of Chief Designers and the Interdepartmental Commission on Spaceflight (e.g., Chelomei). However, aside from indications that Keldysh supported the idea, there are no solid clues about the origins of this proposal.

ambitions and settled for a more modest manned orbital programme. Ustinov forced OKB-1 to turn Chelomei's military space station into a scientific space station. Soiuz then became the means of delivering cosmonauts to these space stations.

The decision to develop Chelomei's Almaz military space station is still shrouded in secrecy. However, it appears that this was simply one of a series of manned military spacecraft design projects. Modifications of Vostok, Voskhod, and Soiuz, as well as a variety of "space planes" had all been authorised for research as manned military spacecraft. Almaz was unusual for a military space project because it was eventually flown with cosmonauts on board.[233] The reasons for this decision are beyond the scope of this dissertation, but the decision to begin development of Almaz is not.

The Almaz programme decision, made around 1967, was probably considered a non-high priority weapons R&D decision. It could easily have been sold as part of the broader military re-equipment programme of the time, and as a counter to the US military's Manned Orbiting Laboratory. As with other Soviet manned space projects, the decision to develop Almaz did not necessarily obligate the political leadership to fly it with cosmonauts on board. Allowing the military "experts" to develop a space station may have been opposed by Ustinov, but it was probably seen as a strategically prudent idea with little risk.

The top priority manned space project until the end of 1968 was the circumlunar project. Korolev had first tried to kill this project, but after realising that the political leadership insisted on hedging its lunar "bets," he turned his attention to winning control of it. Just months before his death he snatched control of this project (one that he had first proposed in 1960) from Chelomei. Korolev's successors very nearly upstaged the US Apollo programme by using a combination of Chelomei's UR-500 plus Korolev's upper stage and spacecraft.

Failure to beat the US led to an unceremonious demise for the UR-500K/L-1 circumlunar programme. There was apparently little bureaucratic support for the politically-inspired project that had required an uncomfortable marriage between Chelomei and Korolev's design bureaux. However, rather than cancel it, the leadership simply neglected

[233]It was the only Soviet military space project to do so.

the project. The remaining circumlunar spacecraft were used up as unmanned research probes.

The lunar landing programme never achieved the same priority as the circumlunar programme, but it took a lot longer to die. The hardware for this project was much slower to come to fruition. By the time the first N-1 moon rocket was ready, the leadership had already re-directed efforts toward the use of an unmanned probe to upstage the US lunar programme. Nonetheless, once started, the momentum behind the lunar landing project was strong. Not only were there key supporters of the N-1 project scattered throughout central and regional government bodies, but party and space leaders had good reason not to scrap the N-1. Rather than admit failure, it was better to let the N-1 programme proceed as a low priority. In the (likely) event of failure, the chief designer could then take the blame. Thus, the N-1 rocket project continued until 1974 when Chief Designer Mishin was sacked. As in the case of the circumlunar programme, the "decision" to terminate the lunar landing project was more a matter of neglect than action.

In addition to the changes noted above, there were at least two other times when the post-Khrushchev leadership made significant manned policy decisions. The first came in February 1967, when the Politburo and Council of Ministers decreed an acceleration of the manned space programme and a re-emphasis on the two lunar programmes. This decision appears to have been driven by the simultaneous desire to upstage the West, and mark the fiftieth anniversary of the Revolution with an appropriate spectacular. The decree was so unrealistic that it seems unlikely that anybody responsible for implementing it would have initiated it. It probably originated with the political leadership. The fatal results of this decree appear to have temporarily weakened Ustinov's authority to dictate specific mission details, but the party did maintain overall control of space policy.

The second active decision by the political leadership was to create the automated lunar soil return project. This was, of course, an unmanned project, but the decision implied the end of the manned lunar programmes. It is not clear who initiated this change, but the decision was once again made by the party leadership, for political, not technical reasons. The chief designers and technical leaders of the manned lunar projects had much to lose from this decision.[234] Their interests and views were ignored. In fact, the political leadership simply ignored both manned lunar projects after the US won the race to the moon.

After 1969 the Soviet manned space programme became a much lower political priority. There were still three active manned projects, but only two of these were ever authorised to be flown with cosmonauts on board. These were the civil and military space station programmes. Ustinov clearly favoured the former, and was eventually able to strangle the latter. The third programme, the manned lunar landing, existed only as a rocket development project. The political leadership apparently had little intention of authorising a manned lunar landing in the 1970s. Eventually, Chief Designer Glushko was allowed to do the dirty work of ending the N-1 moon rocket programme.

One of the most striking things about the space policymaking process under the post-Khrushchev leadership is that no new ideas were implemented. Korolev, Chelomei, and Khrushchev had initiated many new manned space projects in earlier years. However, after Khrushchev the space programme, and the political struggles surrounding it, all centred on "old" ideas. Soiuz, the lunar programme, orbital space stations, and even Chelomei's military space station had all been proposed prior to Khrushchev's ouster. All new manned spaceflight proposals, were rejected by the party leadership.[235] The manned space programme's "new" direction in late 1969 was actually the oldest of manned spaceflight proposals. When faced with failure in the race to the moon, the leadership returned to Korolev's Tsiolkovskii-inspired rhetoric of the late 1950s. The systematic development of space stations was re-asserted as the essential basis for the eventual colonisation of space.

[234]The Lavochkin Design Bureau, which was responsible for the lunar soil return probe, was one of the few organisations that clearly stood to gain.

[235]This included a number of Mars mission proposals not discussed here. It also included other moon landing proposals like Chelomei's UR-700 lunar mission, Mishin's later variations on the N-1 lunar base project, and Glushko's "Vulkan" lunar project.

The Role of the Chief Designers

Although the fortunes of individual chief designers and their bureaux changed dramatically after the "retirement" of Khrushchev, their role in policymaking was largely unchanged. Designers still wielded considerable power and authority, and it was still possible to use informal political connections to their advantage. Yet, they were enmeshed in oversight and control mechanisms that limited their influence on manned spaceflight policy decisions.

Korolev remained the driving force behind the Soviet manned space programme; this is even true for the ghost of Korolev, to judge by events after 1966. In the mid 1960s, as in the mid 1950s, he took advantage of the newly favourable circumstances and the turmoil of leadership transition to advance his ambitions. He was able to regain a monopoly on civil manned spacecraft and the lunar missions. This was not an indication of his control over manned space policy, but was a matter of leadership preference for Korolev over Chelomei. Korolev's policy initiatives (e.g., the elimination of the circumlunar programme and delaying the target dates for the lunar landing) were ignored. But his design bureau and his early ideas became the dominant features of the Soviet manned space programme.[236]

When Korolev died his design bureau continued to dominate manned spaceflight. Korolev himself may have been irreplaceable, but the mantle of technical leader of the manned space programme readily fell on the new chief designer of the Korolev Bureau, Vasilii Mishin.[237] After the Soiuz 1 disaster Mishin won more control over technical questions and the flight schedule. However, this did not last long. The US victories over both manned lunar projects undermined Mishin's legitimacy as leader of the space programme. Not only was Ustinov eager to (re-)claim personal leadership of the programme, but other institutions were motivated to weaken Mishin's hold on the manned space programme.[238] Like its late leader, TsKBEM (OKB-1) remained the embodiment of Tsiolkovskii's dreams, but was mainly a pawn in the greater political game.

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[236]Even today, the Russian manned space programme largely "belongs" to the "S. P. Korolev Space Corporation Energiia," the institutional descendent of OKB-1.

[237]However, it is worth noting that the titles: Chief Designer of Spacecraft (Korolev), and Chief Theoretician of Spaceflight (Keldysh) disappeared from public use after Korolev's death.

[238]e.g., The Soviet Air Force managed to put a stop to Mishin's plans for his own cosmonaut training programme.

While the Korolev bureau became the specialist in manned spacecraft, Iangel''s design bureau (KB Iuzhnoe) became an important part of unmanned spacecraft programmes. The earth-orbital scientific programme, and especially the Interkosmos satellite programme became the domain of "Ustinov's" other design bureau. Some other design bureaux, many of them spun off from Korolev's bureau, built satellites for specific applications, but KB Iuzhnoe seems to have inherited the earth-orbital scientific satellite programme. As for manned space policy, Iangel' played no detectable role.

Having pinned his star to Khrushchev, Chelomei was bound to be the big loser after October 1964. Ustinov and his missile industry associates made quick work of most of Chelomei's projects and began to dismantle his empire. The only thing that saved him was the military and the sympathetic Minister of General (missiles and space) Machinebuilding, S. A. Afanas'ev. Whether opposed to Ustinov, or simply preferring Chelomei over the alternatives, the military's power over R&D orders and evaluation of new weapons were effective in protecting OKB-52 for a number of years. Chelomei may have fallen to a lower priority, but he still retained a number of important missile and military spacecraft orders.[239] In addition, Minister Afanas'ev kept Chelomei's UR-700 manned projects alive by continuing to authorise design work on lunar and Mars versions of the rocket.

Design bureau competition, deliberately used by Khrushchev, continued after his ouster but gradually disappeared from the manned space programme. Competition between the missile design bureaux, especially Iangel' and Chelomei, was particularly fierce and continued into the 1970s.[240] But, in the manned spaceflight programme, Korolev's bureau was favoured, even to the point of appropriating space station hardware from Chelomei. In effect the two manned programme design bureaux became specialised - Chelomei was limited to manned military projects, and Korolev's bureau won control of the rest of the manned programme.

This specialisation in the manned programme suggests a number of conclusions, especially when compared to the competition that continued in the field of ICBM design.

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[239]These programmes were all terminated in 1976, when Ustinov became Minister of Defence.
[240]See footnote number 128 above.

The post-Khrushchev leadership appears to have rejected the idea of design bureau competition, but was unable to put a stop to it in missile design.[241] How could the political leadership control competition between the aerospace design bureau on manned space projects, but not on missile projects? The difference appears to hinge on the issues of expertise and institutions. For missile projects, the military (especially the General Staff), not only had special expertise, but had more influence over weapons decisions under the new leadership. This was a result of the rejection of Khrushchev's "subjectivism" and "hare-brained schemes," in favour of collectivism and scientific decisionmaking.

The manned space programme was different from missile programmes in several ways. There was no institutional equivalent of the General Staff in the space programme. Manned space programme development and execution had always been the responsibility of a collection of ad hoc organs like the State Commission for Spaceflight and the Interdepartmental Commission on Spaceflight of the USSR Academy of Sciences. Although Korolev's bureau had a high concentration of experts, it was not the only institution that could claim a guiding role. In fact, that role had always been played by the party. After Khrushchev's ouster the party's claim to expertise was re-inforced by the promotion of Ustinov to TsK Secretary for Defence and Space. Ustinov (and Brezhnev) had considerable authority in this field and did not face opposition from a legitimate, well-organised "expert" institution. Thus, the party could dictate virtually all manned space R&D decisions. The one exception was for manned military space R&D projects - like the Almaz space station. Here the military was able to win authorisation for its "own" designer - Chelomei.[242] On all other programmes, Ustinov was able to kill Chelomei's manned spaceflight proposals.

Party control over the design bureaux was also reinforced by the re-centralisation of the government in 1965. Oversight and control mechanisms were strengthened, although the collective leadership in the Politburo may have been less likely, or less able, to use them

[241]It is not clear if the spurning of competition was inspired by ideology, practical considerations, or both. Competition had clearly been wasteful and inefficient. It was also difficult for the collective leadership to manage.
[242]Remember, that this decision appears to have been made about the time of the Soiuz 1 disaster - i.e. when Ustinov may have been particularly weak.

in some cases. The multitude of local and central political institutions of the Khrushchev era, were replaced by a simpler hierarchy. In terms of manned space policy, there was now a single chain of command running down to the design bureaux from the ministries and the VPK, with oversight by the Central Committee Secretariat. Chief designers could still "misappropriate" intellectual labour, but it was substantially more difficult to re-direct other resources. The likelihood of even a favoured designer "hijacking" a high priority project was much lower than it had been during the leadership transition in the 1950s.

Objectives and Purposes of the Soviet Manned Space Programme

Although Brezhnev tried to picture it so in late 1969, the Soviet manned space programme was not the product of a coherent long-term plan. Scientific space stations had never previously been an object of Soviet manned space policy. This goal had been smothered by Khrushchev's emphasis on military projects and favouritism of Chelomei in the early 1960s. In the mid-1960s, space stations had also been pushed aside by the race to the moon. Ironically, Tsiolkovskii's ideas finally did come to justify and define the Soviet manned space programme, but this was not the result of a plan.

Khrushchev's lunar schemes drove the manned space programme until 1970. They remained manifestations of Khrushchev's view of spaceflight as a means of demonstrating the superiority of socialism by leaping into the utopian future. This view was increasingly out of step with the post-Khrushchev emphasis on rational, scientific development across a broad front. Yet, as far as the political leadership was concerned the massive Soviet lunar efforts were still justified as a way to upstage the Americans. Only the failure of the lunar programmes forced a change in the purpose and direction of manned spaceflight.

There were, in fact, a number of objectives and purposes for the Soviet manned space programme, but only one of these really mattered. Many of the chief designers (including Mishin and Glushko) remained committed to a manned lunar landing as the way to begin Soviet colonisation of outer space. Other space enthusiasts (e.g. Keldysh) were willing to accept the more modest space station programme as the way ahead. The military had plans of its own for manned spaceflight, but had continually been frustrated by the priority given to defence industry/Academy of Sciences projects. This was the way the political leadership wanted it. Manned spaceflight was a political tool, and this was the only purpose that really mattered to the policymakers.

Thus, the manned space programme was neither a military, nor a civil or scientific programme. There were manned military spacecraft development projects, but until the 1970s none of these were ever flown with cosmonauts on board. The military did play an important role in the execution of the manned space programme, but as far as the military leadership was concerned this was a reluctant undertaking. The programmes that they were assisting, were based on the initiatives of defence industrialists and conducted at the behest of the party. The USSR Academy of Sciences also played a role in justifying the programme and vetting proposals. However, scientists generally served as consultants, not as the prime movers of the programme.

The political purpose of the manned space programme did not change, but after 1969 its goal did change. In keeping with the change in the correlation of forces, the goal of the manned space programme was now to confirm, rather than establish Soviet power. By the late 1960s the manned programme was no longer needed as a substitute for real strategic power, because the Soviet Union had achieved real strategic power. It was also not needed as a demonstration of the effectiveness of the Soviet socialist system for rapid modernisation, since the Soviets believed they had made that point quite effectively. Faced with the limits of their capability, the Soviet leadership seemed satisfied to settle for a manned space programme that was more broadly useful and, simultaneously, served to confirm the advanced state of Soviet science.

Implications for the Soviet Political System

Khrushchev's successors may have been trying to improve the policymaking system, but the evidence in the field of manned space policy suggests that their efforts were largely counterproductive. As in 1950s, the new leadership believed that the problems of the past had been caused by the personality of the previous leader. They seemed to believe that the political system would work better if they placed more trust in their subordinates.

By emphasising collectivity, stability of cadres, and scientific decisionmaking on the basis of expert opinion, they did make the political system less susceptible to the whims of the party leader. However, this approach proved inadequate for resolving the conflicts inherited from the Khrushchev era.

Control over manned space policy still resided with the party. Yet, unlike Khrushchev, Brezhnev was unwilling, or unable, to dictate policy. Whether this was primarily a result of changes in institutions and practices, or simply a matter of Brezhnev's personal style is unclear. However, it is clear that Brezhnev did not intervene in manned space policy in the way that his predecessor had. Space policy fell within his purview, and he enjoyed the occasional benefits to be derived from it, but he did not actively control it.

Brezhnev left responsibility for manned space policy to Ustinov. Ustinov had been highly successful in managing the programme in the past. Party rank, experience, and the absence of a formidable technical leader left Ustinov's policy decisions virtually unassailable in the first year after Korolev's death. However, Ustinov appears to have suffered a setback after the Soiuz 1 disaster. In addition, the full members of the Politburo were able to block new policy decisions and constrain Ustinov, especially in personnel matters.

Brezhnev was wise, or cautious, enough not to associate himself too closely with the manned space programme. He relied instead on his preferred experts (Korolev, Ustinov, Mishin) and their (hoped for) successes to counter opponents (primarily military leaders) to the manned programme. Thus, the responsibility for the numerous failures of the late 1960s could be laid on the executors, rather than the makers of space policy. Only after the failure in the moon race, did Brezhnev take a public position, announcing the (new) main direction of the manned space programme.

The post-Khrushchev changes to the political system may have protected space policy from the whims of the party leader, but it did not make for more coherent policy. Rather than review and rationalise manned space policy, the political leadership stuck with the two manned lunar programmes until they failed. The reasons for this "non-decision" are not known, but the available data suggest at least two explanations.

First, the political leadership may have opposed Khrushchev's method of decisionmaking, but most of them did not discount his successes with space policy. The post-Khrushchev Politburo was composed of people that had risen to power during the height of Soviet space successes. To reject the most spectacular, tangible proof of the party's leadership ability might have undermined their own legitimacy. It seems likely that the political leadership believed its own propaganda about the meaning of Soviet space leadership and was unwilling to give it up.

Secondly, a re-examination of manned space policy was not in the interests of Brezhnev or Ustinov. It would have required the application of the rules of collective and scientific decisionmaking. Opening Khrushchev's lunar decrees to a discussion might have undermined Brezhnev and Ustinov's authority in this area and given opponents (especially military "experts") an opportunity to de-rail a favourite programme. Open discussion may also have prevented, or limited, the favouritism of Korolev's bureau. Thus, the August 1964 lunar decrees, inefficient though they might be, may have been preferable to developing a new policy in the immediate aftermath of Khrushchev's ouster.

On the whole, the party leadership may have remained pre-eminent, but that did not put an end to domestic political struggles over manned space policy. In fact, the stability of cadres policy exacerbated this problem. Policy disagreements that had developed during the late Khrushchev period remained "built-in" to the system. Moreover, the leader of the party was unable to resolve them by the usual means of changing personnel.[243] For an issue like space policy, where opinion in the Central Committee was sharply divided, this proved to be a major hindrance.

Rather than developing and debating new proposals, the space policymaking process was mired in struggles over Khrushchev's policies. As TsK Secretary, Ustinov was able to push for enforcement of existing decrees. However, over-riding expert opinion was more difficult given the emphasis that had been put on scientific decisionmaking. Any mistake attributable the political leadership (like the Soiuz 1 disaster) could be used as justification

[243] Or the Stalinist means - intimidation by the security forces.

for less political "interference." This appears to have been true regarding the military as well as technical experts.

The struggles over space policy during this period were not so much a question of party control as they were about which "experts" would be allowed to participate in the policy making process. The role of the party in directing high priority R&D projects had been firmly re-established by Khrushchev in the 1950s. However, the roles and influence of lower level actors were wide open to bureaucratic political struggles - especially between the defence industry and the military. Lower level leaders of the space programme seem to have expended much of their energy in trying to gain decisive control over the manned programme. This was true of the chief designers, the military, and even Ustinov; all of whom seemed inordinately concerned with long-term issues of power and control at the expense of short-term results.

Ustinov's role in the struggles reflected the power of the party and not its weakness. Although he had become TsK Secretary, Ustinov actually represented the interests of the defence industry in the manned space programme. Other experts, both military and scientific, had more influence under the new regime and attempted to use it to drive policy alternatives and choices. However, in the end, Ustinov prevailed. The party still had the advantage; not enough of one to assure Ustinov a quick victory in all arguments, but enough to win eventually. The post-Khrushchev leadership had succeeded in weakening the party leader, but this did not solve the problems in Soviet policymaking.

Chapter 8: Conclusion

"They cannot hide the magnitude of the figure of our Chief Designer (Korolev). His name should be before the names of all our cosmonauts. I am deeply convinced that it will be."

General N. P. Kamanin
Diary, 19 January 1966

Having reviewed the origins and development of Soviet manned spaceflight policy it is now time to summarise the answers to the four central questions of this dissertation: What major space projects did the Soviet Union pursue and how were these authorised? Did the chief designers play an influential role in the promotion, selection, and approval of these projects? What were the overall objectives of the Soviet manned space programme? Finally, what does this tell us about the Soviet political system?

The strength of the conclusions drawn here is constrained by the severe limitations on the availability of consistent evidence. Both at the highest political level, and at the level of the design bureaux, the archives are still closed.[1] Those with privileged access to information have used it to settle old scores and to write (or rewrite) history to suit their own purposes. It is particularly important to note that the role of many of the major figures in the missile and space programmes were deliberately erased by their successors.[2] Nonetheless, careful sifting of the available evidence, combined with an understanding of the political environment, can illuminate much about Soviet manned space policy and how it was made.

Space Projects and the Policy Process

The Soviet space programme, like its Western counterpart, had humble, and dual, beginnings. Scientists and engineers who were space enthusiasts agitated for scientific satellites for quite a long time, before winning approval to build one as part of the

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[1]Fragments, and mentions, of Politburo and Council of Ministers decrees have been revealed in a variety of sources, but there is no way to know if all relevant decrees have been identified. It is also impossible to systematically examine the decrees that are already known. At the "bottom" of the process, the same problems apply to the draft projects (EPs) proposed by the design bureaux.

[2]This began with the "erasure" of Beriia from the missile programme after his execution. The same process was applied to Malenkov, and then Khrushchev. After the mid-1970s, Glushko tried to write himself into space history in the place of Korolev. The revelation of the Soviet lunar programmes (led by Korolev) in 1989 seems certain to be connected with the death, earlier that year, of Chief Designer Glushko.

International Geophysical Year (1957-58). At the same time, many of the same people were engaged in studies to develop a military satellite. Both of these efforts were relatively low priority research projects.

In January 1956 the Soviet space programme suddenly became a high priority. This was when S. P. Korolev convinced Khrushchev to authorise the quick launch of a scientific satellite. In effect, the scientific satellite programme was wedded to the high priority R-7 (SS-6) ICBM programme. The ICBM and the satellite were both political projects, whose primary function was to establish an international strategic balance. The scientific aspects of the satellite project were sacrificed in the interest of being first in space. This subordination of space projects to political ends was also evident during the first years of the space programme, and throughout the manned spaceflight programme.

Soviet space propaganda may have claimed that the early space effort was a major governmental undertaking, but the programme itself was quite thin. After the first three sputniks, the space programme consisted of two main projects: a planetary probe effort, and development of a manned orbital spacecraft (Vostok). The remarkable string of successes in these programmes made a tremendous impression, but there was surprisingly little to the space programme beyond this.

For the first three years the manned space programme was especially shallow. The first human spaceflight took place after Khrushchev had already shifted the emphasis of state policy from ideology and propaganda, to achieving a stronger military. What is truly impressive was the ingenuity of Chief Designer Korolev in coming up with new, politically irresistible ways to use his original spacecraft and rocket. Technologically, the manned programme was static. But for the first several years Korolev was able to create quite the opposite impression.

Ironically, just as the world was coming to recognise the limited nature of the Soviet manned space programme, it was wildly expanded. Development of a completely new spacecraft, primarily for military purposes, was approved in late 1963. In 1964 the first new developments in the "civil" programme were demanded by Khrushchev. The three-man Voskhod assignment served to maintain the appearance of Soviet superiority in manned spaceflight and expanded the aims of the manned programme. This was only the beginning. By the middle of 1964 the Soviet manned programme was directed to the moon. Two separate manned lunar projects were begun in August 1964: a circumlunar mission, and a lunar landing mission. At the time of Khrushchev's ouster the Soviet manned space programme consisted of at least four major projects: Voskhod missions, Soiuz development, and the two lunar projects.

The extremely limited number of manned missions flown after Khrushchev's "retirement" seemed to suggest that the new leadership had repudiated Khrushchev's policy. They did not. Upstaging the US lunar landing programme remained the central space priority of the Soviet leadership. Although the manned programme was delayed by technical difficulties and tragedies, a review of the full test programme for Soviet spacecraft sheds a revealing light on the Soviet manned programme.[3] There were two tests of Soviet manned spacecraft in 1965, three in 1966, eight in 1967, nine in 1968, and ten in 1969.[4] There was a "race to the Moon." It was closer than many people give the Soviets credit for, but not as close as some in the US feared.[5] Development of equipment for the manned lunar programme continued until the mid-1970s, but these projects were allowed to die out.

After failing in the moon race, the Soviet manned space programme was re-oriented toward manned orbital stations. A military orbital space station had been in the works for a number of years, but this project was pre-empted. The military space station design and hardware were turned over for "scientific" use. In later years the military space station would fly three times under the guise of the scientific space station programme. However, this project was concluded by mid-1977. Meanwhile, the "scientific" space station programme settled into a cycle of incremental improvements. This programme survives today as the heart of the Russian manned space programme.

The process by which Soviet manned space policy was made remained surprisingly stable, even after the change of leadership in 1964. In part, this was because space policy itself was largely unchanged. The goal was always to create an impression of Soviet

[3] See Appendix 13.
[4] The 1969 figure includes the Soiuz 6, 7, and 8 "triple" mission at the end of the year. It does not include the attempts to beat the US to the Moon with the unmanned lunar soil return probe.
[5] As noted above, the "moon race" was not as long as many in the West believed. It did not start until 1964.

power, particularly of pre-eminence over the United States. The specific projects used to achieve that goal changed, but process of choosing the projects did not.

The ideas for virtually all Soviet manned space projects were mooted by Korolev and his fellow enthusiasts in the 1950s. Manned spacecraft, space stations, lunar expeditions, winged spacecraft - all of these ideas were inspired by Tsiolkovskii and developed into engineering projects by Korolev, Tikhonravov, and others associated with them. These early projects later served as the foundation for specific proposals by other designers and by the political leadership.

One of the most important continuities of the manned space policymaking process is that the decisions were controlled by the party leadership. New policy initiatives were almost always made formal by a decree from the Politburo. The decisions to cancel a project, or the "non-decisions" to abandon a project were also driven by the party leadership. In this regard, the manned space programme followed the model of weapons R&D.

Having grown out of the ICBM R&D programme, the manned space programme continued to be managed as an extended weapons R&D project. The party leadership had a close hand in authorising each major step in the programme, particularly over the decision to launch missions with cosmonauts on board. Until 1964 these decisions were made personally by Khrushchev. From 1964 to 1970, such decisions were governed by a Politburo consensus that appears to have been led by Brezhnev and Ustinov.

The tight grip of the party on decisionmaking had important consequences for other phases of the policy process. For about two years, 1956-1958, Korolev had been the primary initiator of all space projects. However, by the time that manned space flight began, the party had stifled and channelled initiation of new space projects. From 1961 until 1964 Khrushchev showed very limited interest in manned space projects, except as they served the immediate political and strategic needs of the country. His successors had much the same view.

Party control of decisionmaking also influenced the second phase of the policy process: persuasion. Manned space projects were the domain of a very limited circle of people. Direct personal access to the political leadership was the key prerequisite for playing a role in decisions prior to 1965. After Khrushchev's ouster direct personal access was still a highly valuable asset, but technical experts (both scientific and military) also had formal channels through which they could voice their opinions. However, their influence was limited to items of their particular expertise. Such influence was most often exercised in a negative way - in using their expertise to block a decision or action.

Although the early stages of the policymaking process changed somewhat after Khrushchev's ouster, the implementation of leadership decisions on space programmes was rarely a problem. Only during periods of weak leadership oversight were designers able to get what they wanted by re-defining previously approved projects. For the most part, the early space programme, and especially the manned space programme, were extremely high leadership priorities. The party and government lavished considerable attention on projects that had been ratified by joint decree, and used a number of means to ensure that their policies were implemented. Of particular importance was the party's control over institutional structure (especially the preference for ad hoc organs) and personnel.

The fact that the Soviet Union lost the "race to the Moon" does not show that the political leadership lost control over policy implementation. There was strong opposition to the manned lunar projects from the very beginning. When it served Khrushchev's interests, the military opposition to Korolev's proposals was allowed to strangle the N-1 rocket project.[6] However, once the manned lunar projects were formalised in the August 1964 decree, military opposition was not allowed to hinder the project. Competition between design bureaux after Khrushchev's ouster may have delayed the lunar projects, but this was not a case of loss of political control. It was quite the opposite. The replacement of Chelomei with Korolev was precisely what the new political leadership wanted. Only after the leadership had abandoned their manned lunar objective (in early 1969) did bureaucratic obstructionism begin to significantly affect the lunar programmes. The failures in the race to the Moon were technical, managerial, and ultimately a result of poor policy decisions. They were <u>not</u> a result of the inability of the party leadership to implement its policies.

[6]This was particularly evident in 1963.

The Role of the Chief Designers

For most of the period in question, chief designers and their design bureaux were not able to dominate the policy process, or even parts of it. However, one chief designer, did play an absolutely crucial role in: establishing the Soviet space programme, in beginning and keeping alive the manned space programme, and in setting what turned out to be the long-term agenda for the Soviet manned programme. That designer was Sergei Pavlovich Korolev.

At a crucial moment in history, Korolev was able to capture the attention and trust of Khrushchev. Ruthlessly exploiting his personal connection to the Soviet leader, Korolev turned the ICBM programme to his space dreams. Even though he was a "non-person" after the first Sputnik, his dreams and plans dominated the overblown Soviet space propaganda of the period. In this way, Korolev served as the catalyst of the US manned space programme and, by this indirect means, of the expansion of the Soviet manned space programme in 1964. Korolev's influence on the pace and direction of early space history is impossible to overestimate.

Despite his central role in space history, Korolev actually had extremely limited direct influence on Soviet space policymaking. Within two years of the first sputnik launch, Khrushchev grew disillusioned with Korolev. In 1960 he replaced Korolev as his favoured space designer with Chelomei. With the ouster of Khrushchev, Korolev's influence rose once again, but it never attained the level it once had. Not only were party and government leaders wary of him personally, but there had been important changes to the policy making system.

The changes were, at least partly, a reaction to Korolev's success in creating a Soviet space programme. Khrushchev later noted that he was "not really prepared to carry the burden" of weapons R&D policymaking after Stalin's death, and that:

"Our experience with Korolev is a case in point."[7]

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[7]Nikita S. Khrushchev, Khrushchev Remembers: The Last Testament, ed. and trans. by Strobe Talbott, Boston: Little, Brown & Co., 1974, pp. 45-6.

As with Stalin and the aviation industry in the late 1930s, Khrushchev felt that his trust in his weapons designers had been betrayed. By 1959 Khrushchev understood that Korolev was pursuing his own agenda. The brief period of Korolev's direct influence on policymaking came to an abrupt end.

Thereafter, the party leadership made systematic efforts to reduce and channel the influence of the Chief Designer. This was done through a series of institutional and personnel changes that limited the powers of chief designers and improved party and government oversight of their activity. The institutions that Korolev had used to advance his cause (like the Council of Chief Designers and the Academy of Sciences), were subordinated and controlled. Formal channels of space policymaking were made more effective, and were populated by leaders who were not sympathetic to Korolev.

Of course, there had always been formal channels for making weapons R&D decisions. It was the informal channel, patronage by Khrushchev, that had facilitated Korolev's hijacking of the ICBM programme. After his experience with Korolev, Khrushchev was much more wary of those he favoured. However, he did not completely forsake personal favouritism, he just lavished it on someone who was more amenable to political control - Chelomei.

After Khrushchev's "retirement" his successors tried to set up mechanisms that would further prevent this sort of "subjectivism." The emphasis on scientific decisionmaking actually gave "experts" like chief designers more formal mechanisms to advance their ideas. In some fields this may have had a major effect on policymaking, but in manned space policy it had a more limited effect. The reasons why it had limited effect on manned space policy are related to the continuity of leadership in manned space policy, and the fact that the manned space programme was never fully institutionalised.

General Secretary Brezhnev may not have been willing, or able, to engage in blatant patronage, but that did not stop Ustinov. Ustinov's long experience, direct control over the space policy agenda, and powerful new position as TsK Secretary, limited the role of other players in this field. On occasion, Ustinov's influence waned, but on the whole, he became the "expert" on manned space policy and was able to favour the designers he preferred. The continuity of party leadership, and the importance of the issue to those leaders, helped to keep overall control of manned space policy in their hands.

Another important factor is that the post-Khrushchev leaders had no institutional competitor on the issue of manned space policy. Despite efforts during the course of his entire adult life, Korolev was never able to create an independent institutional basis for the manned space programme. His early attempts in the 1930s (GIRD and RNII) were suppressed by Stalin. In the post-war period, the Academy of Artillery Sciences served only as a temporary home for the space enthusiasts. After Sputnik, it looked as if Korolev might succeed in making the USSR Academy of Sciences the institutional home for spaceflight advocates. But this opportunity was crushed by the political leadership.

Korolev had to settle for a politically weak institutional repository for Tsiolkovskii's vision, his design bureau. OKB-1 remained subordinate to the weapons industry throughout this period. Party oversight and control of this industry had been re-established by the end of 1957. After this, oversight and control was exercised through a variety of institutions, including the VPK and the TsK Secretariat. The actual responsibility for executing policy was not entrusted to OKB-1, but to the State Commissions for Spaceflight. The use of such ad hoc bodies prevented the formal institutionalisation of the manned space programme. There was no single government institution with the standing, or monopoly on expertise, to obstruct party decisions on manned space policy.

The same factors that limited Korolev's direct influence on space policy also affected the other chief designers involved with the space programme. In Iangel''s case this does not seem to have mattered much. He appears to have been completely uninterested in manned space policy. Although his design bureau became involved in space projects of its own, his only connection to the manned space programme appears to have been the result of being drafted into the manned lunar effort. There is no evidence of Iangel' proposing his own manned space projects.

Chelomei was the only chief designer beside Korolev to be a major figure in Soviet manned space policy. At certain times, and on certain types of projects, Chelomei had a substantial influence. From 1960 to 1964 his proposals for manned projects were favoured over Korolev's. After his patron's ouster, Chelomei was still a leading figure in military R&D, including manned military space projects like the Almaz space station.

Yet, Chelomei was never as influential as Korolev had once been. Khrushchev lavished resources and attention on Chelomei's design bureau, but, until 1964, the primary emphasis was on missiles. Chelomei had wanted authorisation for his "space plane" and a number of other manned projects in 1960. These were rejected. Only in August 1964 did Chelomei get authorisation for a manned space project - the circumlunar programme. Yet, after 1964, Chelomei was systematically cut out of the manned space programme by Ustinov. Due to support from the Minister of General (missile and space) Machinebuilding and the military leadership, Ustinov found this harder to do on strictly military projects. However, Ustinov did manage to strip the "space plane" project from Chelomei. It is also worth noting that none of Chelomei's rockets or spacecraft were ever used to launch a cosmonaut. Chelomei promoted many manned projects, but had an extremely limited influence on their approval.

The direct influence on chief designers on manned space policy was never very strong, but they did have influence in several indirect and subtle ways. Of particular note are the impressive persuasive capabilities of the successful chief designers. When given the opportunity for personal contact with top party leaders, the chief designers were often able to win a commitment for at least part of their proposal. This was particularly evident when Khrushchev visited the various design bureaux.[8] Interestingly, there are no records of Khrushchev, or Brezhnev, visiting any of the design bureaux after 1960. Perhaps the party leaders were wary of leaving themselves at the mercy of their technical experts.

After Khrushchev's retirement, personal contact with Ustinov was still influential, but not for chief designers. Brezhnev either ignored, or did not receive, a number of letters and appeals from designers and cosmonauts.[9] However, direct appeals to Ustinov were effective for some people. For example, in 1968 the Soviet Air Force used Ustinov's visit

[8]e.g., Khrushchev's visits to OKB-1 in 1956, to OKB-586 in 1958, and his meeting with Chelomei in April 1960.

[9]This was painfully apparent during the investigation into Gagarin's death. (See: N. P. Kamanin, "Dlia Nego Zhit' - Oznachalo Letat'," Vozdushnyi Transport, Nos. 9-19, 1994.)

to the Cosmonaut Training Centre to secure control over all cosmonaut training. Ustinov also visited the design bureaux, but was apparently much less swayed by their appeals.

The most consistent form of influence for chief designers during the period under study was a result of the nature of their work. As a form of intellectual labour, design work is notoriously difficult to supervise and control. The difficulty for political leaders lay in making sure that the designer was motivated toward the desired ends. Even under the threat of the NKVD, designers had been able to divert their attention to their own missile and space projects. After Beriia's elimination, such "misappropriation" was considerably easier. It appears to have reached its pinnacle in the missile industry with the R-7/Sputnik project.

After 1960 this sort of behaviour was much more limited, but chief designers still had a subtle influence. Khrushchev had tightened supervision in 1957 through the TsK Secretariat, the VPK, and later, through the use of competition. His successors further streamlined and improved central control over R&D through re-creation of the ministry structure in 1965. However, chief designers were still able to influence the space policy agenda by the way they allotted their discretionary efforts. This was evident in the numerous manned spacecraft proposals and predraft projects that Korolev and Chelomei submitted. These proposals increased the policy options for manned spaceflight, at the expense of other possibilities. Yet, as both Mishin and Chelomei learned, there were limits to how far they could go without losing their jobs.

Ultimately, chief designers were pawns in the larger political games. Khrushchev had used Korolev in his effort to gain control of the USSR, to establish his strategic doctrine, and to improve the position of the Soviet Union in the world. He also used Iangel' and Chelomei for similar ends. After Khrushchev's ouster the missile designers were used by different players for domestic political ends. Ustinov used "his" designers, Korolev, Mishin, and Iangel, to gain and maintain his personal control over weapons and space policy. Chelomei served as the military's counter to Ustinov, and to greater party control over military doctrine. In all of the domestic games, the party had strategic advantages, especially in its control over personnel and institutions. Changes of party leadership appear to have caused only temporary disruptions. In the end, chief designers could offer alternatives, but the party did not have to listen.

Objectives and Purposes of the Soviet Manned Space Programme

For a variety of political and ideological reasons the Soviet Union depicted its entire space programme as a well-planned, long-term peaceful scientific endeavour. This was simply not true. Such plans and intentions certainly existed, but they did not dictate space policy between 1953 and 1970.[10] The Soviet space programme was initially an ad hoc project with significant military involvement. Yet, it began primarily for political reasons.

One of the reasons for the political emphasis on the manned programme was the particular ideological salience of human spaceflight. Socialism, as envisioned by the Soviet elite, was "dominated by notions of economic and technological modernity..."[11] The manned space programme symbolised the rapid progress of Soviet technology and the achievement of previously unimaginable futures. The planets, the lands of the future, would be populated by communists. As a popular Soviet song in the early 1960s put it: "There will be apples growing on Mars" - no doubt on a collective farm. Such millennial visions had great political appeal, even after it became evident that they were not likely to be achieved in the near future.

Unlike other aspects of the space programme, the manned effort remained an ad hoc political programme. In reality, the Soviet manned space programme was a series of projects. It was undertaken primarily to advance Soviet prestige at the expense of the United States. Until threatened by US accomplishments the manned programme remained a relatively limited undertaking. Neutralising the US manned lunar programme became a top priority for both Khrushchev, and his successors. Although this effort failed, the political leadership was not willing to part with the programme. Conveniently, the early

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[10] Chief Designer Mishin has stated that the Soviet Union had space plans, but never really a space programme. (G. Salakhutdinov, "Eshche Raz o Kosmose: Beseda s V. P. Mishinym," Ogonek, No. 34, 18-25 August 1990, p. 4.)

[11] Alex Pravda, "Ideology and the Policy Process," in Stephen White and Alex Pravda, eds., Ideology and Soviet Politics, London: Macmillan Press, 1988, p. 230.

Tsiolkovskii-inspired rhetoric served as a way to disguise the failure. Thus, the Soviet manned space programme continued, primarily as a way to maintain political appearances.

The Soviet Union certainly had military space programmes, but through 1970 the manned programme was not specifically military. In fact, there were considerable tensions between the military leadership and the political leadership over this point. Although parts of the military were involved in the manned space programme, and there were even some ardent supporters of the programme in the military, the missions flown prior to 1970 were not flown for military aims. Plans to use manned spacecraft for military aims were eclipsed by the "race to the Moon," and afterward became mired in domestic political struggles.

Implications for the Soviet Political System

In the case of Soviet manned space policy, the locus of decisionmaking remained fundamentally unchanged. Decisions in this area were driven by the party leadership. The party did not exercise complete control at all times, and on all issues, but there was little question that the party leadership would ultimately get its way.

The party had a number of means to assert its preferences in manned space policy during the 1960s. The most obvious of these were the use of the Central Committee Secretariat and the Military-Industrial Commission (VPK) for overseeing the implementation of policy. However, in the long-run the most powerful tools were the party's control over personnel and institutions. Through its control over key appointments, the party could influence the development of policy as well as its execution. In addition, the creation of new institutions, or redefinition of old institutions, had to be approved by the party leadership. Because of the ad hoc nature of the manned space programme, the party had considerable opportunity to use both personnel and institutional change to control the policy process.

There were times and issues during which the party leadership was not immediately able to assert its preferences in missile and space policy. In the mid-1950s control of weapons R&D was part of the succession struggle. After 1964 the party's authority over weapons R&D was not questioned, but the authority of individual leaders over personnel and institutions was deliberately limited. As a result, Brezhnev and Ustinov could not immediately assert control over all aspects of manned space policy.

During the periods of weaker party control lower level bureaucratic politics became particularly important. In space, as in missile policy, this conflict centred around the divisions between industrial ministries, and between the industrialists and the military leadership. The protagonists were the Ministry of Armaments (and its later incarnations), the Ministry of Aviation Industry, and the Ministry of Defence. Ustinov remained committed to this partisan struggle, even after his accession to the party leadership. His attitude, and the powers of the party, largely pre-determined the outcome of the struggles over Soviet manned space policy.

After 1964 these struggles were not about whether the party should be in charge of policy. That issue had been settled in the 1950s. The question for the late 1960s was which experts the party should defer to, and when. Ustinov eventually settled this question in favour of himself.

Returning to the theoretical questions raised in Chapter 1, it is evident that "pluralist" explanations of Soviet politics do not fit the issue of Soviet manned space policy. There was conflict over manned space policy. Bureaucratic politics between the industrial ministries was an important factor in the policy process. However, manned space policy was not an outcome, an accident, or controlled by the ministries. The Communist Party and its leaders, especially Khrushchev and Ustinov, clearly dominated manned space policy in the 1960s. Policymaking in this field, is clearly more in keeping with the findings of Solomon and Gustafson, than those of Whitefield.[12]

There were certainly groups with political interests involved in making Soviet space policy, but that did not make this a case of "interest group" politics. Korolev and other space enthusiasts certainly had a policy objective - to establish a manned space exploration programme. However, the real political struggles were not so much over objectives as

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[12]Peter H. Solomon, Jr., Soviet Criminologists and Criminal Policy, London: Macmillan, 1978; Thane Gustafson, Reform and Power in Soviet Politics: Lessons of Recent Policies on Land and Water, Cambridge: Cambridge University Press, 1981; and Stephen Whitefield, Industrial Power and the Soviet State, Oxford: Oxford University Press, 1993.

power. The "groups" in this case were usually factions centred on an individual. The right of these factions to exist, let alone participate in the policy process, was not universally accepted. In fact, the usual goal of these factions was to crush any opposition or potential competitor, and thereby dominate policy. This type of behaviour was evident at all levels, from party leaders to chief designers.

Perhaps the most important theoretical question is whether manned space policy making was an anomaly in post-Stalin Soviet politics. The answer to this seems to be both yes and no. The manned space programme was certainly unusual in a number of ways. Until 1964, it was a policy field tightly wedded to the party leader. After Khrushchev's ouster space policy was closely associated with two of the country's most important political figures. Brezhnev and Ustinov were committed to having a manned space programme, and were in a position to ensure its survival. They made it a priority and lavished resources on the programme, even in the face of major failures. This level of care and attention was certainly unusual.

However, the simple fact that Brezhnev and Ustinov were able to keep the manned space programme a top priority suggests that space policy was not a complete anomaly. What the manned space programme represented was the ability of individual party leaders to assert their preferred policy in areas that they deemed to be of interest. Previous studies have, in fact, suggested that the Soviet political system was specifically structured to ensure leadership control in areas of particular interest.[13]

In areas neglected by the party leadership, policy was dictated by lower level actors in an anarchic and ruthless struggle over the spoils of control. This appears to explain Whitefield's findings about the power of the industrial ministries. In many cases, there was little, if any, central political control. Many of the industrial ministries may have come to dominate policy in their field of expertise, especially after Khrushchev's ouster. However, it should be noted that the defence and space industries are virtually absent from Whitefield's study. The evidence in these fields suggests a very different conclusion. In

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[13]Ellen Jones, "Defense R&D Policymaking in the USSR," in Jiri Valenta and William Potter, eds., Soviet Decisionmaking for National Security, London: George Allen & Unwin, 1984, p. 130.

manned space policy, a field of particular salience to party leaders, it is clear that the party retained its monopoly on decisionmaking power.[14] In this regard, not much had changed since Stalin's time.

[14] Solomon, Soviet Criminologists and Criminal Policy, p. 161.

Appendix 1
Abbreviations and Acronyms

AN	Academy of Sciences
EP	Draft Project
GAU	Main Artillery Administration (of the Ministry of Defence)
GDL	Gas Dynamics Laboratory (known later as OKB-456)
GIRD	Group for the Study of Reactive Motion (1931-33)
GKAT	State Committee of the Council of Ministers for Aviation Technology (1957-65)
GKKNIR	State Committee for the Co-ordination of Scientific Research Work (1961-1965)
GKNT	State Commission on Science and Technology (1965+)
GKO	State Defence Committee (1941-45)
GKOT	State Committee of the Council of Ministers for Defence Technology (1957-65)
Glavki	Main Administrations (see GU)
Gosekonomkom	State Economic Commission (1955-57)
Gostekhnika	State Commission for the Introduction of New Technology into the National Economy (1947-51 and 1955-57)
GN-TK	State Scientific-Technical Commission (1957-61)
GU	Main Administration
GULag	Main Administration of (forced labour) Camps
GURVO	Main Administration of Reactive (missile) Armaments of the Strategic Rocket Forces
ICBM	Intercontinental Ballistic Missile
IGY	International Geophysical Year (1957-58)
IKI	Institute of Space Research of the USSR Academy of Sciences (1965+)
KB	Design Bureau
KBIu	Iuzhnoe or Iangel' Design Bureau (OKB-586)(1966+)
KGB	Committee for State Security
KPSS	Communist Party of the Soviet Union

MAI	Moscow Aviation Institute
MAP	Ministry of Aviation Industry (1946-57 and 1965+)
MIAN	Mathematics Institute of the USSR Academy of Sciences
MO	Ministry of Defence (1953+)
MOM	Ministry of General Machinebuilding (1955-57: conventional weapons) (1965+: missiles)
MOP	Ministry of Defence Industry (1953-57 and 1965+)
MSM	Ministry of Medium Machinebuilding (1953-63 and 1965+: nuclear weapons)
MV	Ministry of Armaments (1939-53)
MVD	Ministry of Internal Affairs (Security Forces)
MVTU	Moscow Higher Technical School
Narkom	People's Commissar
NII	Scientific Research Institute
NII-1	Scientific Research Institute originally under the Ministry of Aviation Industry
NII-4	Scientific Research Institute for missiles and space under the Ministry of Defence
NII-88	Scientific Research Institute for missiles and space of the Ministry of Armaments/Defence Industry (1946-66)
NIIP-5	Scientific Research and Test Range No. 5 (Baikonur Cosmodrome)
NK	People's Commissariat (pre-1946)
NKVD	Peoples Commissariat of Internal Affairs (Security Forces)
NPO	Science-Production Association
Object D	A scientific satellite (later Sputnik 3)
OKB	Experimental Design Bureau
OKB-1	Korolev Design Bureau (1950-66)
OKB-52	Chelomei Design Bureau (1955-66)
OKB-586	Iangel' Design Bureau (1954-66)
Osoaviakhim	Society for the Promotion of Defence, Aviation, and Chemical Production (1927-48)
PS-1	Simple Satellite number 1 (Sputnik)

PS-2	Simple Satellite number 2 (Sputnik 2)
PVO	Air Defence Forces
R&D	Research and Development
RNII	Reactive (jet/rocket) Scientific Research Institute (1933-1938)
RSFSR	Russian Soviet Federated Socialist Republic (Russian Republic)
RVSN	Strategic Rocket Forces (1960+)
SM	Council of Ministers
TsAGI	Central Aerohydrodynamic Institute
TsIAM	Central Institute of Aviation Motorbuilding
TsK	Central Committee of the Communist Party
TsKBEM	Korolev Design Bureau (OKB-1) (1967-74)
TsKBM	Chelomei Design Bureau (OKB-52) (1967-74)
TsNIIMash	Central Scientific Research Institute for Machinebuilding (NII-88) (1967+)
TsPK	Cosmonaut Training Centre of the Soviet Air Force
TsSKB	Central Specialised Design Bureau (1974+)
TsUKOS	Central Administration for Space Equipment of the Ministry of Defence (1964-70)
TTT	Tactical-Technical Requirement
TTZ	Tactical-Technical Assignment
TU	Technical Conditions
UDMH	Unsymmetrical Di-Methyl Hydrazine (a rocket fuel)
UNRV	Administration of the Commanding General of Reactive Armaments
UZKA	Administration of the Deputy Commanding General of Artillery
VPK	Military-Industrial Commission of the USSR Council of Ministers
VSNKh	All-Union or Supreme Sovnarkhoz (1923-32 and 1963-1965) (the same initials are also used in Soviet sources to identify the All-Russian Sovnarkhoz, 1960-65)
VVS	Soviet Air Force
V-1	German Pulse-jet Winged Missile of the Second World War
V-2	German Ballistic Missile of the Second World War (also known as the A-4)

Appendix 2: Missile, Launcher and Manned Spacecraft Designations (Listed by Design Bureau)

(Does not include all variants and projects)

Korolev: OKB-1

Missiles

Design Bureau	Ministry	US	NATO
R-1	8A11	SS-1	Scunner
R-11M	8K11	SS-1B	Scud A
R-2	8Zh38	SS-2	Sibling
R-3	8A67		
R-3A	?		
R-5	8K51	SS-3	Shyster
R-5M	8Zh51	SS-3	Shyster
R-7	8K71	SS-6	Sapwood
R-9	?	SS-10?	Scrag?
RT-1	8K95?		
RT-2	8K98?		

Launchers

Design Bureau	Ministry	US	Sheldon
R-7	8K71PS	SL-1	A
R-7	8A91	SL-2	A
Luna	8K72	SL-3	A1
Vostok	8A92	SL-3	A1
Voskhod/Soiuz	11A57	SL-4	A2
R-7 (Polet)	11A59	SL-5	A-m
Molniia	8K74?	SL-6	A-2e
R-7?	?	SL-10	A-1-m
N-1	11A52	SL-15	G

Manned Spacecraft

Design Bureau	Ministry	Public
3KA	?	Vostok
3KV / 3KD	?	Voskhod
7K-OK	11F615	Soiuz
7KL-1 (Circumlunar Ship)	?	Zond
7K-LOK (Lunar Orbital Ship)	11F93	(L-3)
LK (Lunar Lander)	11F94	(L-3)
DOS (space station)	17K	Saliut

Iangel': OKB-586

Missiles

Design Bureau	Ministry	US	NATO
R-12	8K63	SS-4	Sandal
R-14	8K65	SS-5	Skean
R-15			
R-16	8K64	SS-7	Saddler
R-21			
R-26	8K66	?	?
R-36	8K67	SS-9	Scarp
MR UR-100	15A15	SS-17	Spanker
R-36M	15A14	SS-18	Satan

Launchers

Design Bureau	Ministry	US	Sheldon
Kosmos (?)	63S1 (11K63)	SL-7	B-1
Interkosmos (?)	65S3 (11K65)	SL-8	C-1
R-36-O (Tsiklon)	8K69 (11K67/69)	SL-11	F-1

Chelomei: OKB-52

Missiles

Design Bureau	Ministry	US	NATO
UR-100	8K84	SS-11	Sego
UR-100N	15A30	SS-19	Stiletto
UR-200	8K81		
UR-500	?		

Launchers

Design Bureau	Ministry	US	Sheldon
UR-500 (Proton)	8K82	SL-9	D
UR-500	8K81K	SL-12	D-1-e
UR-500	8K82K	SL-13	D-1
UR-700	8K83		

Manned Spacecraft

Design Bureau	Ministry	Public
LK-1 (circumlunar craft)	?	
Almaz / OPS (space station)	?	Saliut

Note: The Soviet identities of the missiles designated SS-8 and SS-10 are uncertain.
Source: Appendix 2 compiled by author from numerous Russian/Soviet sources.

Appendix 3
Selected Biographical Data

Afanas'ev, Sergei Aleksandrovich: (1918) Minister. Graduated from MVTU in 1941. Was an engineer in an artillery factory evacuated to Perm during the War. Transferred to one of the Technical Administrations of the Ministry of Armaments in 1946, and was one of the leaders involved in converting the Dnepropetrovsk Automobile Factory into a missile plant in 1952. In 1955 was promoted to head of an Administration in the (renamed) Ministry of Defence Industry. Became the Deputy Chairman (1957) and Chairman (1958) of the Leningrad Sovnarkhoz. In June 1961 was promoted to deputy chairman of the RSFSR Council of Ministers and Chairman of the All-Russian Sovnarkhoz. Named the first Minister of General Machinebuilding 1965-1983. Demoted to Minister of Heavy and Transport Machinebuilding 1983. Retired in 1987.

Babakin, Georgii Nikolaevich: (1914-1971) Chief Designer. During the early post-War period served as a designer of guidance systems of surface-to-air missiles. Worked at the Lavochkin KB from 1950, appointed deputy chief designer in 1960. In 1965 named Chief Designer of the Lavochkin Design Bureau. Under his guidance the organisation developed a broad array of interplanetary probes including: the lunar soil sample return craft, Lunokhod, and various Mars and Venus probes.

Barmin, Vladimir Pavlovich: (1909-1993) Chief Designer. Graduated from MVTU in 1930. Made his name as the designer of the refrigeration system for the Lenin Mausoleum. Head of the "Kompressor" factory, which converted to building Katiusha rockets during World War II. Went to Germany to study missile technology after the War and later became a member of the Council of Chief Designers. As the Chief Designer of the State Specialised Design Bureau he was the developer of launch sites and ground equipment. Elected corresponding member of USSR Academy of Sciences in 1958, Academician in 1966.

Beriia, Lavrentii Pavlovich: (1899-1953) Party Official. Began his career in the secret police in 1921 and, by 1931, was First Secretary of the Georgian Communist Party. Became People's Commissar for Internal Affairs at the height of the purges in 1938 and then Deputy Chairman of the Council of Ministers in 1941. One of the central figures of the Soviet leadership during and after the War. He was the political overseer of the nuclear weapons programme, and through the secret police he oversaw the other post-War weapons development projects. Widely expected to be the major political force in the post-Stalin Soviet Union, he was arrested in a plot organised by Khrushchev. Beriia was executed in 1953.

Biriuzov, Sergei Semenovich: (1904-1964) Military Leader. Joined the Soviet Army in 1922 and rose rapidly during the purges. During the Second World War he served in senior staff positions, such as Chief of Staff to Marshal Malinovskii. After the War he commanded Soviet forces in Bulgaria and then in a variety of military districts, before becoming deputy head of Soviet Air Defence Forces (PVO). In 1955 he was promoted to Marshal of the Soviet Union, became a deputy minister of defence, and Commander-in-Chief of the PVO. He replaced Marshal Moskalenko as Commander-in-Chief of the Strategic Rocket Forces in 1962, and the next year was promoted to Chief of the Soviet General Staff and First Deputy Minister of Defence. In this capacity he planned the Soviet missile deployment to Cuba. He was a full member of the Central Committee from 1961 until his death in an aircraft accident in 1964.

Blagonravov, Anatolii Arkad'evich: (1894-1974) Military Officer and Scientific Leader. Taught in various military academies after the Civil War. Became an Academician of the USSR Academy of Sciences in 1943. From 1946-1953 General-Lieutenant Blagonravov was President, and then Vice President, of the Academy of Artillery Sciences. When this organisation was disbanded in 1953 he moved to the USSR Academy of Sciences as head of Institute of Engineering Science and (in 1957) Scientific Secretary of the

Department of Technical Sciences. He was a member of the Presidium of the Academy of Sciences throughout this period. Blagonravov served as a spokesman for the Soviet space programme to the West, although he was not a direct participant.

Brezhnev, Leonid Il'ich: (1906-1982) Party Leader. After an extremely brief career as an engineer, he began full-time party work in the Ukraine in the late 1930s. Served as a political officer on the Ukrainian front during the War, then began a rapid rise through party leadership positions. He followed Khrushchev to Moscow, becoming a Central Committee secretary in 1952 and served briefly on the Presidium of the Central Committee. After Stalin's death he was demoted to deputy head of the Main Political Administration. A year later he was sent to Kazakhstan to implement Virgin Lands programme as Second, and then First Secretary of Kazakh party. In the wake of the Anti-Party Group purge he became a member of the Presidium and Central Committee Secretary for Heavy and Defence Industry. Moved to Chairman of the Presidium of the Supreme Soviet (President) in 1960, but returned to the Central Committee Secretariat in 1963 after F. R. Kozlov was incapacitated. Became General Secretary of the Communist Party after Khrushchev was ousted in 1964. Served in that position and as President (from 1977) until his death in 1982.

Chelomei, Vladimir Nikolaevich: (1914-1984) General Designer. A brilliant young scientist who rose to prominence at TsIAM during the War. Named chief designer of V-1 analogue effort in 1944. His numerous designs were never put into production and his bureau was handed over to designer A. I. Mikoian in 1953. He convinced Khrushchev to reinstate him as a designer of naval cruise missiles (SS-N-2) in 1955. Hired S. N. Khrushchev in 1958. Named a General Designer in 1959 and in 1960 won approval to begin ballistic missile and space work. Engaged in an extremely broad spectrum of design work, including manned lunar missions. Fell from favour along with his sponsor N. S. Khrushchev just as his efforts (e.g., the Proton launcher and UR-200 missile) were beginning to come to fruition. With the support of Marshal Grechko he continued to engage in military design work (SS-11, SS-19, Almaz space stations (Saliut 2,3,5)). Ustinov attempted to cut off his business, but only succeeded in 1976 after being promoted to Minister of Defence. Chelomei died just twelve days before Ustinov in December 1984. Elected a corresponding member of USSR Academy of Sciences in 1958, and Academician in 1962.

Dement'ev, Petr Vasil'evich: (1907-1977) Minister. Graduate of Zhukovskii Air Force Academy (1931). Worked in aviation industry until 1941 when appointed First Deputy People's Commissar of Aviation Industry. Minister of Aviation Industry 1953-1977 (1957-1965 Chairman of State Committee for Aviation Technology). A Central Committee candidate 1952-1956, and full member from 1956-1977.

Gagarin, Iurii Alekseevich: (1934-1968) Cosmonaut. Completed pilot training in 1957 and was selected in the first group of cosmonaut candidates in 1960. Became the first human to fly in space on 12 April 1961 when he made one orbit around the earth in Vostok. From December 1963 he served as deputy director of the Cosmonaut Training Centre. He had begun training for another space mission when he died in an aircraft accident in 1968.

Glushko, Valentin Petrovich: (1908-1989) General Designer. Began his lifelong career as a rocket engine designer in the Gas Dynamics Laboratory (GDL) after graduating from Leningrad University in 1929. Imprisoned in 1938, he continued to design rocket engines in prison design bureaux until 1944. Part of the Soviet contingent studying rocket technology in Germany after the War. As "Chief Designer of Rocket Engines" (and head of OKB-456) Glushko was a member of the Council of Chief Designers. Elected corresponding member of the USSR Academy of Sciences in 1953, and Academician in 1958. In 1958 he enraged Chief Designer Korolev and became involved in a bitter feud with him. Named General Designer and head of NPO Energiia (a merger of his bureau with the former Korolev bureau) in 1974. Member of Central Committee from 1976. Published under the pseudonym of Professor G. V. Petrovich from the late 1950s until the 1970s.

Grechko, Andrei Antonovich: (1903-1976) Military Leader. Rose rapidly in the ground forces during the Second World War and served alongside Khrushchev. Afterward served as commander of a Military District and then became Commander of the Group of Soviet Forces in Germany until 1957. Was promoted to Marshal of the Soviet Union in 1955. From 1957, First Deputy Minister of Defence and Commander-in-Chief of Ground Forces. He became Commander-in-Chief of Warsaw Pact forces in 1960. Minister of Defence from 1967 until his death in 1976. Central Committee candidate in 1952, and full member in 1961. Member of the Politburo 1973-1976.

Iangel', Mikhail Kuz'mich: (1911-1971) Chief Designer. A party activist from 1931, Iangel' graduated from MAI in 1937. Was part of an aviation industry delegation that visited the United States in 1938. Rose rapidly in the Polikarpov, Mikoian and Miasishchev aviation design bureaux through 1946. Worked at the Ministry of Aviation Industry from 1946 to 1948. Then he spent two years learning missile engineering before going to work as a chief engineer at the Korolev design bureau. He was the lead designer of the R-5 (SS-3) missile. In May 1952 he was promoted over Korolev as head of NII-88. In 1954 he was named Chief Designer of OKB-586 at Dnepropetrovsk in order to develop his storable propellant rocket idea. Developed numerous missiles (SS-4,5,7,9,17,18) and space launchers (Kosmos, Tsiklon). Iangel''s cigarette habit saved him from death in a major testing accident in 1960, but he was in poor health from the late 1950s. Promoted directly to Academician of the USSR Academy of Sciences and candidate member of Central Committee in 1966.

Isaev, Aleksei Mikhailovich: (1908-1971) Chief Designer. Began his career as an aviation engine designer in the 1930s and worked on rocket engines for aircraft during the War. Was one of the team of engineers to inspect German rocket parts found in Poland and later went to Germany after the War. By 1948 he was chief designer of his own section in NII-88, where he developed rocket engines for a number of weapons programs including the R-11 (SS-1B). In February 1959 his design bureau was made independent of NII-88 (as SKB-2) and continued work with medium thrust rocket engines.

Kamanin, Nikolai Petrovich: (1908-1982) Military Officer. Named a Hero of the Soviet Union in 1934 for his part in the legendary rescue of the icebound ship Cheliuskin. Held a number of command positions in the Soviet Air Force thereafter, but wound up in the civil air fleet and DOSAAF after the War. Eventually became Deputy Chief of the Soviet Air Force General Staff and head of cosmonaut selection and training from 1960-1971. General-Colonel Kamanin kept a detailed and extraordinarily frank diary. His son has published numerous extracts of the diaries in the Russian press.

Keldysh, Mstislav Vsevolodovich: (1911-1978) Scientific Leader and President of the USSR Academy of Sciences, 1961-1975. Leading member of a highly accomplished family, Keldysh trained as a mathematician at Moscow State University, graduating in 1931. He began work at the Mathematical Institute of the Academy of Sciences (MIAN), TsAGI, and then also became a Professor at Moscow State University (1937). He won the Stalin Prize in 1942 and 1946 for his research on aircraft design problems. Elected to the USSR Academy of Sciences as a corresponding member in 1943 and as an Academician in 1946. In the late 1940s he joined the Communist Party and also began his long association with S. P. Korolev in missile and space design. In 1953 he became head of MIAN and thereby a member of the Presidium of the Academy of Sciences. Beginning in 1955, he was the ubiquitous chairman of various expert commissions on space and missile programs. Continued his work as the "Chief Theoretician of Spaceflight" after his appointment as Vice President (1960) and then President of the Academy of Sciences. Although weakened by major surgery in 1971 he remained the most influential scientist involved in missile and space programs until his death.

Kerimov, Kerim Alievich: (1917) Military Officer. Enrolled in the Dzerzhinskii Military Artillery Academy in 1942 and graduated a year later with a military engineer-artilleryman diploma. Transferred to the Main Artillery Administration (GAU) to work on missile armaments after the War; eventually rising to Chief of the Central Administration for Space Equipment of the Ministry of Defence (TsUKOS) from 1964-1965. Served on numerous state commissions for missile systems throughout this period. Moved from the Strategic Rocket Forces (RVSN) to the Ministry of General Machinebuilding (MOM) and became Chairman of the State Commission for Soiuz spacecraft in 1965. With the cancellation of the manned lunar programmes this group became "The State Commission" that carried out the manned space programme. General-Lieutenant Kerimov served as Chairman until 1991.

Khrunichev, Mikhail Vasil'evich: (1901-1961) Minister. Rose rapidly in defence industry leadership in the 1930s. By 1938 he was Deputy People's Commissar of Defence Industry and in 1939 assumed the same position in the Commissariat of Aviation Industry. In 1942 he became First Deputy People's Commissar for Ammunition under Vannikov. After the War he served as Minister of Aviation Industry from 1946 until it was merged into the Ministry of Defence Industry in 1953. In July 1953 he became First Deputy Minister of Medium Machinebuilding under Malyshev until 1955. He became First Deputy Chairman of Council of Ministers in 1955. In late 1956 he became Deputy Chairman of the State Economic Commission (Gosekonomkom). Demoted to First Deputy Chairman of Gosplan from 1957-1961. In 1961 he was once again elevated to Deputy Chairman of the Council of Ministers and chairman of State Committee for Co-ordination of Scientific Research Work (GKKNIR). He died within two months of this promotion. He was a member of Central Committee from 1952.

Khrushchev, Nikita Sergeievich: (1894-1971) Party Leader. Began work at the age of 14 and became a party activist shortly thereafter. Rose rapidly in the Moscow party hierarchy during the purges of the 1930s. Served as First Secretary of the Ukrainian Communist Party from 1938-1947. During the War he was a political leader on a number of southern Fronts. Returned to Moscow in 1949 and rose to leadership of the party. After Stalin's death he gradually established party and personal dominance, becoming Party First Secretary (1953) and Chairman of the Council of Ministers (1958). Achieved numerous successes, but his leadership style and snap judgements came to haunt him, especially after 1962. He was removed from his posts in October 1964. In retirement he recorded his memoirs which, in edited form, were smuggled to the West for publication.

Khrushchev, Sergei Nikitich: (1935) Engineer. Only surviving son and confidante of the Soviet leader. (His half-brother was killed during the Second World War while serving as a pilot.) Was hired by ambitious aviation designer V. N. Chelomei in 1958 and advanced Chelomei's plans to become a leading missile and space designer. Sergei frequently visited his father and accompanied him on trips. He became an informal channel for information both to and from his father. After his father's overthrow he continued to work at the Chelomei bureau until July 1968. He apparently helped to edit and smuggle out his father's memoirs. More recently he has written a number of lengthy and more revealing books about his experiences.

Kirilenko, Andrei Pavlovich: (1906-1990) Party Official. Became a party member and enrolled in the Novocherkassk Aviation Industry Institute in 1931, graduating in 1936. From 1936 to 1938 he worked as a design engineer at an aircraft factory. In 1938 he became Second Secretary of the Zaporozhe regional party organisation. Paralleling Brezhnev, he served in Ukrainian party leadership positions until 1942. During the War he served as the State Defence Committee (GKO) supervisor at an aircraft factory. He returned to the Ukrainian party organisation after the War; serving as Brezhnev's deputy for a time. In 1950 he succeeded Brezhnev as First Secretary of Dnepropetrovsk. From 1955 to 1962 he served as First Secretary in Sverdlovsk. Following the Anti-Party Group affair he became a candidate member of the Central Committee Presidium (1957) until the 22nd Party Congress in October 1961. After disappearing from the leadership for six months, he returned to the Presidium as a full member and served as Khrushchev's "right hand man" in the Bureau of the Central Committee for the RSFSR in April 1962. After 1964 he was considered to be one of the top two deputies to Brezhnev. In 1966 when the Bureau of the

Central Committee for the RSFSR was dissolved he moved to the TsK Secretariat with responsibility for personnel. In the late 1970s Brezhnev and Kirilenko apparently fell out. Kirilenko's duties were assumed by Chernenko in November 1978. He was dropped from the Politburo within two weeks of Brezhnev's death in November 1982. Kirilenko was the father-in-law of Iurii Semenov, an engineer in the Korolev design bureau who became President of the S. P. Korolev Space Corporation Energiia.

Kirillin, Vladimir Alekseevich: (1913) State and Party Official. Graduated from the Moscow Energy Institute in 1936. Worked in the electric power industry until the War; when he served in the Navy. In 1952 he became a professor at the Moscow Energy Institute and, in 1953, was elected a corresponding member of the USSR Academy of Sciences (Department of Technical Sciences). Named Deputy Minister of Higher Education in 1954 and then, in 1955, Deputy Chairman of the State Committee on New Technology (Gostekhnika) under Malyshev. Also in 1955 he suddenly moved into the party hierarchy as head of the Central Committee Department of Science, Higher Education and Schools. He did not become a candidate member of the Central Committee until 1961. In 1962 he was promoted to Academician. The next year he left his Central Committee post and became a Vice President of the Academy of Sciences. In 1965 he returned to the government as Deputy Chairman of the Council of Ministers and Chairman of State Committee for Science and Technology (GKNT); a post he held until 1980. He was promoted to full membership of the Central Committee in 1966.

Korolev, Sergei Pavlovich: (1906-1966) Chief Designer. The initiator, and central figure, of the Soviet space programme. He graduated from MVTU in 1929 and began his career as an engineer at TsAGI. A passionate believer in Tsiolkovskii's vision of spaceflight, he was one of the co-founders of GIRD in 1931. He gained military support which led to the merger of GIRD with the Gas Dynamics Laboratory; creating the RNII. Along with most of the RNII leadership, Korolev was arrested in 1938. He was sentenced to the notorious Kolyma labour camp. Later he was rescued from the camps to work in various War-time prison design bureaux; first under Tupolev, then under Glushko. Released from prison in 1944, he began lobbying for new rocket projects. In 1945 he was sent to Germany, and immediately rose to the top of the V-2 engineering team. A year later he was appointed Chief Designer of the Soviet ballistic missile effort. By 1953 he had begun work on an intercontinental missile, become a member of the party, and was elected a corresponding member of the USSR Academy of Sciences. He then created the Soviet space programme on the basis of his design bureau and its R-7 (SS-6) missile/space booster. After the success of Sputnik he was elected a full member of the Academy of Sciences (1958), and became known as the mysterious "Chief Designer of Spacecraft." (After this he also published under the pseudonym Professor K. Sergeev.) He then directed his efforts toward manned space missions. He became a member of the Presidium of the Academy of Sciences in 1960. His aspirations were continually frustrated in the early 1960s, but after Khrushchev's ouster he won control of the manned lunar programmes. He died as a result of a botched surgical operation in January 1966. His deputy Vasilii Mishin succeeded him as head of the Design Bureau.

Kosberg, Semen Arievich: (1903-1965) Chief Designer. Graduated from MAI in 1930 and then began work in the Central Institute for Aviation Engines (TsIAM). Appointed Chief Designer of his own engine design bureau in 1941. After the War he worked on medium thrust rocket engines for a variety of new weapons systems. Worked closely with the Korolev Bureau to develop engines for the upper stages of a number of space launchers. His design bureau survives today as the Design Bureau for Chemical Automatics (KBKhA).

Kozlov, Dmitrii Il'ich: (1919) General Designer. Was one of Korolev's deputies during the post-War missile project and served as the secretary of the party committee at the design bureau. In 1959 he was appointed head of a Korolev spin-off organisation, Filial No. 3 in Kuibyshev. Now known as the Central Specialised Design Bureau (TsSKB), Kozlov is still head of this organisation. This organisation oversaw the development of space booster variants of the R-7 and a number of reconnaissance satellites which shared the basic design of Korolev's manned spacecraft.

Kozlov, Frol Romanovich: (1908-1965) Party Official. Worked as an engineer in a metal factory in Urals city of Izhevsk during the 1930s. In 1939 he moved into party work in the factory, and then the Izhevsk city organisation. From 1944 he worked in the Central Committee apparat until he was sent to Kuibyshev Obkom as the Second Secretary in 1947. In 1949 he moved to Leningrad and quickly rose through the party organisation to First Secretary of the Leningrad Obkom in November 1953. In early 1957 he became a candidate member of the ruling Presidium. His vigorous support of Khrushchev during the Anti-Party Group affair was rewarded with full Presidium membership in June 1957. He also became Chairman of Council of Ministers of the RSFSR in 1957. From 1958-60 he was First Deputy Chairman of Council of Ministers of the USSR. In 1960 he displaced Brezhnev as Central Committee Secretary for Heavy and Defence Industries (including the space industry). He was de facto Second Secretary of the Presidium until he was crippled by a stroke in April 1963. Although Brezhnev took on his duties, Kozlov was not formally relieved of his posts until after the fall of Khrushchev. He died shortly thereafter.

Krylov, Nikolai Ivanovich: (1903 -1972) Military Leader. Joined the Soviet Army in 1919 and rose through the ranks to command artillery units in the Second World War. Then he served as head of a Military District from 1947. In 1961 he was elected a member of the Central Committee. Marshal Krylov was appointed Commander-in-Chief of the Strategic Rocket Forces (RVSN) in 1962. He served in that post until his death in 1972.

Kuznetsov, Nikolai Dmitrievich: (1911-1995) General Designer. Joined the Soviet Army in 1933 and finished the Zhukovskii Air Force Academy in 1938. Was promoted to Chief Designer of a design bureau in 1946. In 1956 he was named a General Designer of aviation engines. Created numerous large jet engines, including those for the Tu-95 (Bear) at his Kuibyshev design bureau. In 1960, after aircraft production was sharply curtailed, he began work on rocket engines for Korolev's moon launcher, the N-1. When the N-1 programme was scrapped in 1974 his rocket engine work was ended. He was elected a corresponding member of the Academy of Sciences in 1968, and an Academician in 1974. His design bureau later became part of NPO Trud.

Kuznetsov, Viktor Ivanovich: (1913-1991) Chief Designer. Graduated from the Leningrad Polytechnic Institute in 1938. Worked as a specialist in gyroscopes for the Ministry of Shipbuilding. After the War he became involved in the missile programme. As the Chief Designer of NII-944 he was one of the original members of Korolev's Council of Chief Designers. He was elected a corresponding member of the USSR Academy of Sciences in 1958 and an Academician in 1968. One of the survivors of the Nedelin disaster in 1960. His design bureau was later known as NII-10. He retired in 1989. His design bureau is now known as NII Applied Mechanics.

Litvinov, V. Ia.: (1910-1983) State Official. Graduated from MAI in 1936. Worked in the aviation industry; eventually becoming director of an aviation factory in Kuibyshev. At the time of the aircraft production cutbacks of the early 1960s he became head of the Kuibyshev Sovnarkhoz. In 1962 he helped to organise the space industry in Kuibyshev that supported Korolev's proposals. From 1965 until 1973 he served as Deputy Minister in charge of the lunar programme at the Ministry of General Machinebuilding.

Makeev, Viktor Petrovich: (1924-1985) Chief Designer. Graduated from MAI in 1948. Employed at the Korolev design bureau as an engineer for two years before switching to Komsomol work. Apparently one of the Komsomol leaders fired after the poor performance of the Soviet Olympic team in Helsinki, he returned to the Korolev bureau in 1952. In 1955 the thirty year old Makeev was named Chief Designer of a new affiliate set up in Miass to put the naval version of R-11 (SS-1B) into production. Makeev was reportedly favoured by Khrushchev, because as a youngster he had tied a Pioneer scarf around Khrushchev's neck during an encounter in the 1930s. His bureau developed a number of naval missiles and variants of the R-11. This organisation is now known as KB Mashinstroeniia imeni Makeeva.

Malenkov, Georgii Maksimilianovich: (1902-1988) State and Party Leader. Studied at MVTU from 1921-1925. Then went directly to work in the Central Committee. By the end of the 1930s he was a Secretary of the Central Committee. In 1941 he became a candidate member of the Politburo and later a member of the State Defence Committee (GKO) where he had responsibility for the aviation industry. Was one of Stalin's top post-War deputies; serving as Deputy Chairman of the Council of Ministers and a member of the Politburo. Was also ostensibly head of the post-War missile programme as chairman of Special Commission No. 2. After the death of Stalin he was the heir apparent and became Chairman of the Council of Ministers. In quick order, Malenkov was pushed out of the leadership by Khrushchev; losing his Council of Ministers post in 1955, and membership in the Presidium (Politburo) in the Anti-Party Group affair. He was demoted to manager of a power station in 1957.

Malinovskii, Rodion Iakovlevich: (1898-1967) Military Leader. After joining the Soviet Army in 1919 he served as a cavalry officer through the late 1930s. Rose to be one of the top military commanders during the Second World War. After the War he was sent to the Far East as a military district commander. He became a candidate member of the Central Committee in 1952 and a full member in 1956. Was appointed Commander-in-Chief of Ground Forces in 1956. In late 1957 he replaced Zhukov as Minister of Defence; a post he retained until his death in 1967. Marshal Malinovskii was one of the key opponents of the manned space programme.

Malyshev, Viacheslav Aleksandrovich: (1902-1957) Minister. Graduated from MVTU in 1934 and served as a designer and engineer in a locomotive factory before his meteoric rise to industrial leadership positions. By 1939 he was a member of the Central Committee and People's Commissar of Heavy Machinebuilding. He was Commissar of Tank Industry during the War and then served as head of a number of ministries and a science planning organ (Gostekhnika) in the post-War period. He was appointed a deputy chairman of the Council of Ministers in 1947 and was briefly a member of the Presidium between October 1952 and March 1953. After Stalin's death he became the first Minister of Medium Machinebuilding (MSM), and thereby the supervisor of all advanced weapons programmes. He was a Deputy Chairman of the Council of Ministers for most of the period from 1947 to 1956. With the fall of his patron, Malenkov, he was removed from the MSM in 1955. He returned to planning organs as head of a re-constituted Gostekhnika and as First Deputy Chairman of Gosekonomkom until his death.

Miasishchev, Vladimir Mikhailovich: (1902-1978) General Designer. Graduated from MVTU in 1926. Worked as an aircraft designer and was purged along with his mentor, Tupolev, in the late 1930s. Continued aviation design work during and after the War. In 1951 he was appointed a General Designer and given his own bureau to develop a very ambitious intercontinental bomber project. This, and a series of other radical designs, were never authorised for production. In 1960 his bureau (OKB-23) was handed over to Chelomei. Miasishchev became head of TsAGI, and after Khrushchev's ouster was given a small design bureau of his own.

Mishin, Vasilii Pavlovich: (1917) Chief Designer. Studied at MAI in the 1930s, then went to work as an aviation designer. Fell under a cloud because his father had been arrested in the purges. Became involved with the analysis of captured V-2 rocket fragments during the War and by 1946 was one of Korolev's deputies. Was the lead designer on the R-11 (SS-1B) project in the early 1950s. Elected a corresponding member of the USSR Academy of Sciences in 1958 and an Academician in 1966. After Korolev's death in 1966 Mishin became Chief Designer of the design bureau; overseeing the development of Soiuz, Saliut, and the lunar programmes. In 1974 he was removed as Chief Designer and the bureau was merged with Glushko's engine design bureau. Mishin became a professor at

MAI. After Glushko's death in 1989 he began to reveal details of the previously secret manned lunar programme.

Moskalenko, Kirill Semenovich: (1902-1985) Military Leader. Joined the Soviet Army in 1920 and served as an artillery officer. During the Second World War he was the commander of various tank armies. In 1948 he was appointed commander of Moscow Air Defence Forces (PVO). He was one of the officers who arrested Beriia in 1953. Shortly thereafter he became Commander of the Moscow Military District. In 1957, Zhukov and Malinovskii advocated his removal, but Khrushchev refused to fire him. From 1960-1962 he was Commander-in-Chief of the Strategic Rocket Forces (RVSN). Marshal Moskalenko was "retired" to the Chief Inspectorate of the Ministry of Defence in 1962.

Mozzhorin, Iurii Aleksandrovich: (1920) Head of a Scientific Research Institute (NII). Studied at MAI in the late 1930s and was transferred to the newly formed Moscow Aviation Technological Institute. The Germans invaded while he was taking his final examinations. Sent to the front, he was wounded and ended up at the Zhukovskii Air Force Academy. After completing the course in 1944 he returned to the front as an aviation engineer. After the War he was put to work in Germany gathering and translating V-2 documents. After being demobilised he was hired as an engineer at NII-4. In 1955 he became deputy head of NII-4, where he was in charge of developing the tracking and control network used for the R-7 tests and the first satellite launches. In 1961 he became head of NII-88 (later TsNIIMash). Under his direction this organisation became the lead institute responsible for the field of missile and space R&D. He served in this post for nearly thirty years, until 1990.

Mrykin, Aleksandr Grigor'evich: (1905-1972) Military Officer. Was a teacher at the Military Academy of Chemical Defence until 1934, when he went to work in a laboratory on the development of rocket fuel. Served in the Main Artillery Administration (GAU) during the War. Went to Germany after the War to work on missile projects and returned in 1946 to work in the 4th Administration of the GAU. Served as deputy and first deputy of the Main Administration of Rocket Weapons (GURVO) and its predecessors from 1955-1965. Mrykin was a member of most missile State Commissions, and narrowly missed death during the Nedelin disaster in 1960. In 1961 General-Lieutenant Mrykin was named a Hero of Socialist Labour in connection with the first manned spaceflight. While remaining on active duty he was transferred to the Ministry of General Machinebuilding in April 1965. He retired in March 1972 and died shortly thereafter.

Nedelin, Mitrofan Ivanovich: (1902-1960) Military Leader and first Commander-in-Chief of the Strategic Rocket Forces (RVSN). Joined the Soviet Army in 1920; serving as an artillery officer. Participated in the Spanish Civil War. Served with distinction as an artillery commander during the Second World War. Became the key military leader of missile development after he was appointed Chief of Staff of Artillery in 1946. He then alternated between top procurement and operational posts and thereby established the place of ballistic missiles in the Soviet military. In 1952 he became a candidate member of the Central Committee. Named Commander-in-Chief of the RVSN when it was formed in December 1959. Marshal Nedelin was killed less than a year later when the first test version of the R-16 (SS-7) ICBM exploded on launch pad No. 41 at Baikonur on 24 October 1960.

Nesmeianov, Aleksandr Nikolaevich: (1899-?) President of the USSR Academy of Sciences, 1951-1961. An organic chemist, he was elected a corresponding member of the Academy of Sciences in 1939 and an Academician in 1943. In 1951 he became the first member of the Communist Party to be elected President of the Academy of Sciences. Was one of the leading proponents of the re-organisation of the Academy of Sciences. He was apparently disappointed and surprised by the effects of the re-organisation when it came in 1961. He was then replaced as President by M. V. Keldysh.

Novikov, Vladimir Nikolaevich: (1907) Government Official. After training as an Army engineer he worked in the defence industry. He became deputy in the Commissariat of Armaments immediately after Ustinov took charge. Novikov served as Ustinov's deputy from 1941-1948 and 1954-1955. From 1955-1957 he was the First Deputy Minister of General Machinebuilding; a conventional armaments ministry that only existed for those two years. Novikov then became as Chairman of the Leningrad Sovnarkhoz for a year before becoming deputy chairman of the RSFSR Council of Ministers and head of Gosplan for the RSFSR in 1958. In 1960 he moved up to the USSR Council of Ministers as deputy chairman and Chairman of Gosplan for the USSR. Novikov was elected to the Central Committee in 1961. He was removed from Gosplan in July 1962 and put in an obscure economic post, although he retained the status of Minister. He briefly took charge of the Supreme Sovnarkhoz (VSNKh) from Ustinov in March 1965. When that organisation was abolished in October 1965 he became Deputy Chairman of the Council of Ministers with responsibility for engineering. He retired in December 1980.

Pashkov, Georgii Nikolaevich: (1911) State Official. After graduating from the Military Mechanics Institute he went to work in Gosplan and served as head of the military department there throughout the Second World War. He went to Germany in 1945 and got to know Korolev. In 1946 he was named head of the missile department in Gosplan. By 1954 he had moved to a similar position in the apparat of the Council of Ministers. There he supported early proposals for a Soviet reconnaissance satellite. He was named a Hero of Socialist Labour for the first satellite, Sputnik. At some point he returned to Gosplan and became the director of the Cosmonautics Department while apparently remaining deputy chairman of the VPK for missiles. He stayed in these posts until 1975. He bitterly resented the encroachments of Chelomei into the missile and space field.

Pervukhin, Mikhail Georgievich: (1904-1978) Party and State Official. Began his working career in the electrical industry. During the purges he was promoted to People's Commissar of Energy, and then Deputy People's Commissar of Heavy Industry. When this Commissariat was divided in 1939 he became Commissar of Electrical Stations and the Electrical Industry. He was also elected to the Central Committee that year and, in 1940, became Deputy Chairman of the Council of People's Commissars. During and after the War (1942-1950) he served as Minister of the Chemical Industry, and was one of the top officials in the nuclear weapons programme. He became a member of the Presidium of the Central Committee in 1952, and was one of the few new additions who kept his membership after Stalin's death. In the post-Stalin re-organisation he became Minister of one of the "super ministries" (Electrical Stations). A major proponent of improved state planning, in 1955 he became First Deputy Chairman of the Council of Ministers and Chairman of Gosekonomkom. When Khrushchev's overly ambitious economic policies failed, Pervukhin made a bid to become economic overlord in December 1956. At about the same time he gained control of strategic military programmes by becoming Minister of Medium Machinebuilding. Within six months Khrushchev had outmanoeuvred him with the Sovnarkhoz reforms and stripped him of his posts in the Anti-Party Group affair. He was demoted to candidate member of the Presidium (a position he held until 1961) and sent as Ambassador to the GDR. He returned from Germany in 1962 and spent the rest of his life working at Gosplan.

Petrov, Boris Nikolaevich: (1913-1980) Academician. Graduated from the Moscow Energy Institute in 1939. He then worked in an Institute of the Academy of Sciences and taught at MAI. A specialist in the theory of control systems, he was elected as a corresponding member of the Academy of Sciences in 1953. Petrov conducted important research for the space programme and was a member of the State Commission for Spaceflight. He became an Academician in 1960.

Petrov, Georgii Ivanovich: (1912-1987) Academician. A specialist in mechanics, Petrov was elected a corresponding member of the Academy of Sciences in 1953. He became deputy chairman of the Co-ordinating Committee on Interplanetary Communications of the Astronomy Council of the Academy of Sciences when it was created in 1954. (Academician Sedov was the Chairman.) He was elected to full membership in the Academy of Sciences in 1958 along with other leaders in the space programme. In 1965 he became the first head of the Institute for Space Research (IKI) of the Academy of Sciences. He retained this post until 1973, when he was replaced by R. Z. Sagdeev.

Piliugin, Nikolai Alekseevich: (1908-1982) Chief Designer. Graduated from MVTU in 1935 and worked in the field of aircraft design. A specialist in control systems, he was part of the team that analysed V-2 fragments during the War. After the War he went to Berlin and later served as chief designer in a research institute (NII-885) developing control systems for Soviet missiles. He was one of the original members of Korolev's Council of Chief Designers and is said to be the founder of the science of inertial navigation in the USSR. Elected a corresponding member of the Academy of Sciences in 1958, and an Academician in 1966. In 1963 he moved to his own institute. He also took Korolev's place on the Presidium of the Academy of Sciences in 1967.

Riabikov, Vasilii Mikhailovich: (1907-1974) State Official. Graduated from the Leningrad Military-Naval Academy in 1937. From 1937-1939 he was the party organiser at the Bolshevik armaments plant; the same plant that Ustinov directed. He was one of the initial deputy commissars of Armaments in 1939, and by 1940 he was First Deputy Commissar of Armaments. It is unclear whether Riabikov remained in this post after Ustinov was appointed Commissar in June 1941. In any case he served as deputy minister from 1946 to 1951. In 1951 he moved to "responsible work at the Council of Ministers;" possibly as head of the Third Main Administration charged with developing the Moscow Air Defence system. He became a candidate member of the Central Committee in 1952. In 1953 he became a deputy minister of the newly formed Ministry of Medium Machinebuilding and Chairman of Special Commission No. 2 (missile policy). He held these posts until 1955. From 1955-1957 he was chairman of an un-named committee of the Council of Ministers. In March 1958 he became deputy chairman of the RSFSR Council of Ministers. He was the first chairman of the State Commission for the testing of the R-7, but was replaced during the summer of 1957. He later chaired the State Commission for the launch of the first sputniks through 1958. From 1960-1961 he also served as Chairman of the All-Russian Sovnarkhoz. He was one of only two members of the State Commission for Spaceflight not to be named a Hero of Socialist Labour for the first Vostok flight in April 1961. In 1961 he became a full member of the Central Committee and First Deputy Chairman of Gosplan. During the period of the VSNKh (1963-1965) Riabikov served as First Deputy to Ustinov, but moved back to Gosplan (as First Deputy again) in 1965 when the VSNKh was abolished. He served in this capacity as head of the defence department of Gosplan until his death.

Riazanskii, Mikhail Sergeevich: (1909-1987) Chief Designer. Graduated from the Moscow Energy Institute in 1935. Worked in the radio industry and became a radar specialist during the War. After the War he was named Chief Designer of radio systems for missiles and head of NII-885. He was one of the original members of the Council of Chief Designers. In 1952-54 he served in a ministerial post, but returned to design work. In 1958 he was elected a corresponding member of the USSR Academy of Sciences. Unlike his fellow members of the Council of Chief Designers he did not receive a second Hero of Socialist Labour medal for the Vostok flight in 1961 and was not elected an Academician until 1974. Brezhnev is said to have been opposed to him.

Rudenko, Sergei Ignat'evich: (1904-1990) Military Leader. Joined the Soviet Army in 1923, trained as a pilot and graduated from the Zhukovskii Air Force Academy in 1932. He then served in a variety of Soviet Air Force command positions. By 1950 he was commander of long-range aviation and deputy Commander-in-Chief of the Soviet Air Force. In 1953 Marshal Rudenko became head of the Air Force General Staff and First Deputy Commander-in-Chief of the Soviet Air Force. He was the senior Air Force member of the State Commission for Spaceflight and was involved in overseeing cosmonaut selection and training. Rudenko was a candidate member of the Central Committee from 1961-1966. In 1968 he became head of an Air Force Academy, and was further demoted to the Chief Inspectorate in 1973.

Rudnev, Konstantin Nikolaevich: (1911-1980) Minister. After graduating from the Tula Mechanics Institute in 1935 he worked in the armaments industry until 1948. During World War II he was head of a munitions factory. He became head of NII-88 in 1950 and then First Deputy Minister of Armaments in 1952. He served as Ustinov's deputy in charge of missile programmes until Ustinov was promoted. In 1958 Rudnev moved up to fill Ustinov's ministerial post as the Chairman of the State Committee for Defence Technology (GKOT) (the new title for the Ministry of Armaments). He was simultaneously Chairman of the State Commission for Spaceflight until June 1961. Following Khrunichev's death Rudnev became Chairman of the State Committee for the Co-ordination of Scientific-Research Work (GKKNIR) and Deputy Chairman of the Council of Ministers. Later that same year (1961) he became a member of the Central Committee. When the GKKNIR was replaced by the State Committee on Science and Technology (GKNT) in 1965, Rudnev became Minister of Instrumentbuilding, Means of Automatisation and Systems of Control. He held this office until his death in 1980.

Saburov, Maksim Zakharovich: (1900-1974) Party and State Official. A leading planning official, he served as head of Gosplan from 1941-1944 and again from 1949-1953. After the War he was deputy head of the Soviet military administration in Germany. He became head of Gosplan again when Voznesenskii was purged. He also served as head of the Scientific-Technical Council for Radar development; a post vacated by Malenkov in 1947. He was chosen as one of the new members of the Presidium in 1952 and was one of the few to retain this position after Stalin's death. He also became Minister of one of the "super-ministries" (Machinebuilding) at this time. In 1954-1955 he supported Khrushchev's emphasis on heavy industry, thus contributing to the fall of Malenkov. From May 1955 Saburov was head of Gosplan again, although the function of this organisation was then limited to long-range planning. He was purged from the leadership in 1957 as a member of the Anti-Party Group.

Sedov, Leonid Ivanovich: (1907) Scientist. Graduated from Moscow State University in 1931 and worked at TsAGI and as a professor at Moscow State. A gas dynamicist, Sedov was elected a corresponding member of the Department of Technical Sciences of the USSR Academy of Sciences in 1946. In 1947 he started work at TsIAM. He became a full member of the Academy of Sciences in the 1953 elections. In 1954 he was selected as the Chairman of the Academy of Sciences' Interdepartmental Commission on Interplanetary Communications. He served as one of the public "faces" of the Soviet space programme. In 1955 he made the official response to the US announcement of plans to launch a satellite while he was at a conference in Copenhagen.

Serbin, Ivan Dmitrievich: (1910-1981) Party Official. Graduated from Moscow State University in 1935, and remained as a graduate student for a year in a Scientific Research Institute attached to the University. From 1936-1942 he served in a variety of supervisory and party positions in industry. He moved to the Central Committee apparatus in 1942 to supervise the defence industry. He rose to become head of the Defence Industry Department of the Central Committee in 1958. In 1961 he was elected a candidate member of the Central Committee. His son Vladimir was the Chief Designer of the Red Star design bureau; at one point a part of the Chelomei aerospace complex. Serbin remained head of the Defence Industry Department until his death in 1981.

Serov, Ivan Aleksandrovich: (1905-1990) State Security Official. Joined the Red Army in 1923 and then the NKVD in 1939. Serov was the head of the NKVD in the Ukraine until 1941, during which time Khrushchev was First Secretary of the Republic. In 1941 Serov became First Deputy People's Commissar of the NKGB. As one of Beriia's top deputies, he was deputy head of SMERSH and Deputy Supreme Commander of Soviet Forces in Germany from 1945-1947. Serov was intimately involved in early Soviet missile efforts: he drew up the plans for moving German scientists to the Soviet Union in 1946, appears to have run Special Commission No. 2 in 1947, and personally supervised missile tests at Kapustin Iar. Through his connection with Khrushchev he managed to survive the purge of the security organs following Beriia's downfall in 1953. In 1954 Khrushchev appointed him head of the re-organised and re-named Committee for State Security (KGB). After playing a crucial role in saving Khrushchev during the Anti-Party Group affair, he was removed eighteen months later. In December 1958 he was replaced by Shelepin and moved to command of military intelligence (GRU). He held this post until 1963 when he was removed, apparently in connection with Penkovskii espionage case. He was expelled from the Party in 1965 for crimes committed under Stalin and Khrushchev.

Slavskii, Efim Pavlovich: (1898) Minister. Began his working life as a miner in the Donbass and then served in the Soviet Army until 1928. He studied at the Moscow Institute of Non-ferrous Metals and Gold; finishing in 1933. Then he spent the rest of the 1930s and the war years working in the metal production industry. In 1945 he was named Deputy People's Commissar of Non-ferrous Metallurgy. Within a year he became a deputy to B. L. Vannikov, in the First Main (nuclear weapons) Administration and later became the first director of the Soviet nuclear weapons facility known as Cheliabinsk-40. From 1953-1957 he served as First Deputy Minister of Medium Machinebuilding. After the demotion of Pervukhin in 1957, he was named Minister and remained in that position until 1986. Slavskii was a member of the Central Committee from 1961.

Smirnov, Leonid Vasil'evich: (1916) State Official. Worked as an electrician until the mid-1930s when he enrolled in the Novocherkask Industrial Institute. After completing the Institute in 1939, he began his career in the Ministry of Armaments in an artillery factory near Perm. In June 1952 he was named director of the new missile factory in Dnepropetrovsk. He made a big impression on Khrushchev when visiting the plant in the summer of 1959. In February 1961 he was named deputy chairman of the State Committee for Defence Technology (GKOT). In June 1961 he became Chairman (Minister) of the GKOT, head of the State Commission on Spaceflight, and later in the year, a member of the Central Committee. In late 1962 he forfeited his State Commission post. When Ustinov was promoted (March 1963) Smirnov replaced him as Deputy Chairman of the Council of Ministers and Chairman of the Military-Industrial Commission (VPK). Smirnov retained this position until the rise of Gorbachev in 1985.

Tikhonravov, Mikhail Klavdievich: (1900-1974) Scientist and Designer. Graduated from the Zhukovskii Air Force Academy in 1925. He was one of the founders of MosGIRD and head of the design team that developed the first Soviet liquid fuelled rocket - the one launched by Korolev on 17 August 1933. Tikhonravov was a member of the team from NII-1 that investigated the captured German V-2 fragments during the War. He developed the first serious post-War Soviet proposals for satellites and manned spaceflight. After working with Korolev on these ideas he eventually transferred from his post in a military institute (NII-4) to Korolev's design bureau in 1956. There he was placed in charge of the department developing satellites, manned spacecraft, and interplanetary probes. He apparently left, or was removed from, the space industry around 1960. From 1962 he served as a professor at MAI.

Tiulin, Georgii Aleksandrovich: (1914-1990) State Official. Graduated from Moscow State University in 1941 and then distinguished himself as an officer in Katiusha rocket units during the War. By 1944 he was Chief of Staff of the 3rd Army Katiusha Operations Group and became involved in the analysis of German V-2 fragments. He was one of the first people to arrive in Berlin to search for German rocket technology. While in Germany he served as the military deputy to the missile research project. Tiulin also became reacquainted with Korolev, whom he had met briefly when he was a student. They became close friends. He served as deputy, then head of NII-4 from 1946-1959. In 1960 he moved from the Ministry of Defence to the GKOT when he was named director of NII-88. He was then promoted to First Deputy Chairman of the GKOT in mid-1961 and in October 1962 took over the Chairmanship of the State Commission on Spaceflight from the Chairman of the GKOT, L. V.. Smirnov. He served as head of the State Commission for the final two Vostok flights and for the two Voskhod missions. He later served as head of the State Commission for Circumlunar (L-1) Programme. In 1976 he was removed from his position as First Deputy Minister of General Machinebuilding when he had a run-in with his Minister, S. A. Afanas'ev, over the Apollo-Soiuz mission. He spent the rest of his life as a professor at Moscow State University.

Ustinov, Dmitrii Fedorovich: (1908-1984) Party and State Leader. A native of Kuibyshev, he completed the Leningrad Military-Mechanics Institute in 1934 and subsequently served as an engineer in an artillery research institute. During the purges he made a meteoric rise to become head of the "Bolshevik" arms plant in Leningrad in 1938. He became Commissar of Armaments in June 1941 and served as head of that organisation (and its successors) until 1957. In this position he was the top government leader, and advocate, of Soviet missile programmes. After the Anti-Party Group affair (1957) he was promoted to Deputy Chairman of the Council of Ministers and Chairman of the Military-Industrial Commission (VPK). In 1963 he was further promoted to First Deputy Chairman of the Council of Ministers and Chairman of the All-Union Sovnarkhoz (VSNKh). From this position he supervised virtually all Soviet industry until the recreation of the ministry system in 1965. Ustinov then became Central Committee Secretary for Defence Industry and Space and a candidate member of the Presidium (later Politburo). He became a full member of the Politburo in 1976, and after the death of Marshal Grechko a month later, was also named Minister of Defence. Although he eventually gave up his post on the Secretariat, he nevertheless maintained personal control over the space programme through his ministerial and Politburo positions until his death in December 1984.

Vannikov, Boris L'vovich: (1897-1962) State Official. After joining the Party in 1919 Vannikov studied at MVTU while simultaneously involved in "responsible work" for a government commissariat. In 1926 he became a factory director in Tula and later moved to a similar position in Perm. During the purges he rose to Commissar of Armaments and membership in the Central Committee in 1939. Just prior to the outbreak of the War he was imprisoned as the result of a dispute with Stalin. After his release, he was given charge of the Commissariat of Munitions in 1942. In 1946 he took control of the nuclear programme as head of the First Main (nuclear weapons) Administration. After the arrest of Beriia he was made First Deputy Minister of Medium Machinebuilding. He held this post until 1958 when he retired, ostensibly for reasons of ill health. He was removed from the Central Committee in 1961 and died in early 1962.

Vozniuk, Vasilii Ivanovich: (1907-1973) Military Officer. One of the early supporters of the development of missile weaponry, Vozniuk was named head of the first Soviet missile test range at Kapustin Iar in 1946. Colonel-General Vozniuk held that post until his death twenty seven years later. During this time he also served as chairman of numerous State Commissions for missile tests and satellite launches. He was also chairman of the State Commission that selected the site for an ICBM test range in the 1950s; this site is now known as Baikonur Cosmodrome.

Zaveniagin, Avraamii Pavlovich: (1901-1956) Minister. Joined the Party in 1917 and worked as a Party leader throughout the 1920s. After completing studies at the Mining Academy in 1930, he worked in the metallurgical industry; serving as director of the Magnitogorsk Metallurgical Combine from 1933-1937. He became a candidate member of the Central Committee in 1934. After a year as First Deputy People's Commissar of Heavy Industry, he was sent to supervise construction of the Norilsk Metallurgical Combine starting in 1938. He was dropped from the Central Committee in 1939. In 1941 he became a leader in the security forces as Deputy People's Commissar of Internal Affairs. After the War he retained this post, simultaneously serving as Vannikov's deputy at the First Main (nuclear weapons) Administration. In 1952 he returned to the Central Committee as a candidate member. He was named Deputy Minister of Medium Machinebuilding in 1953. In 1955 he replaced Malyshev as Deputy Chairman of the Council of Ministers and Minister of Medium Machinebuilding. He finally became a full member of the Central Committee at the Twentieth Party Congress in 1956, but died of a heart attack at the end of the same year.

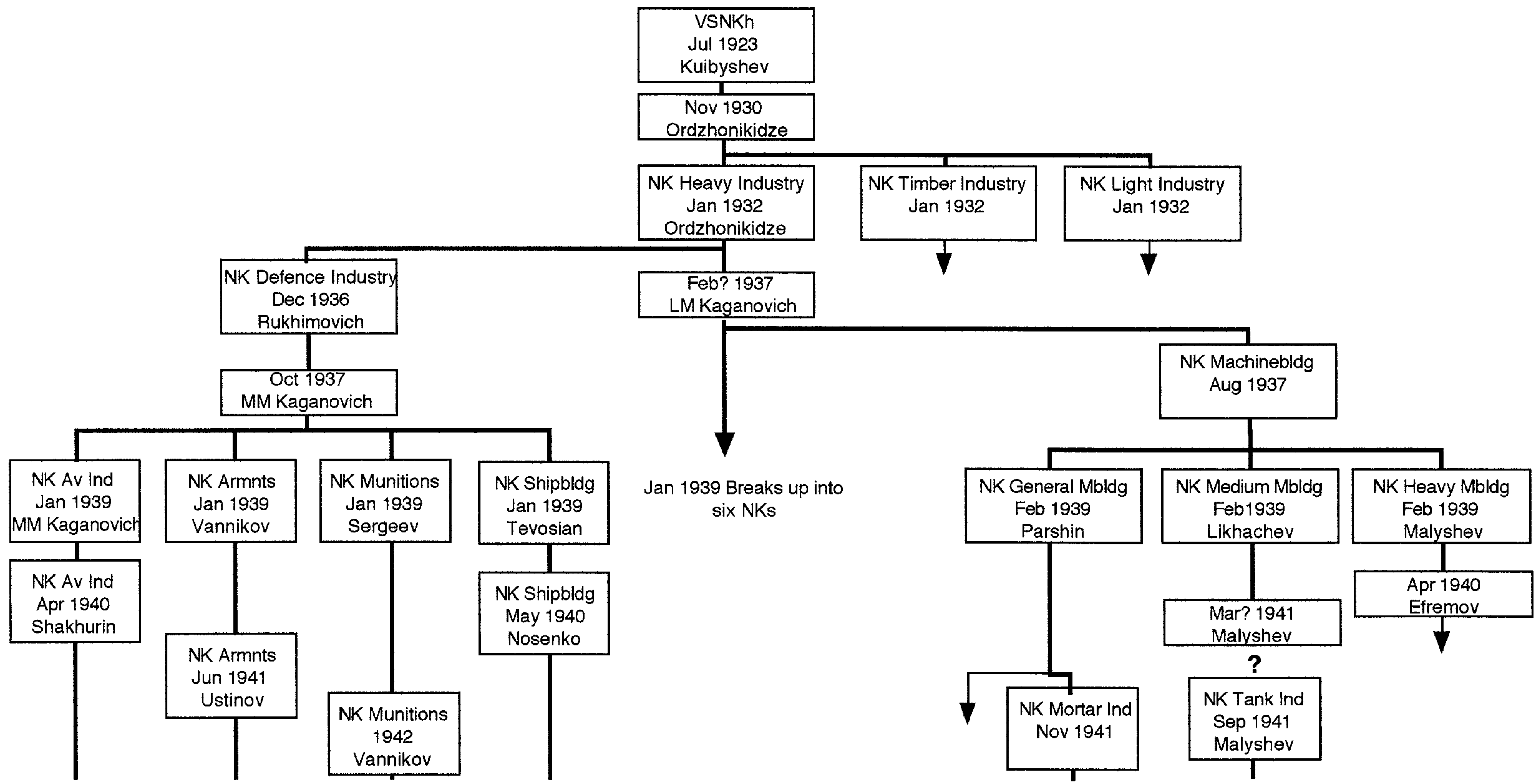
Zverev, Sergei Alekseevich: (1912) Minister. Graduated from the Leningrad Institute of Precision Mechanics and Optics in 1936. He worked as an engineer, designer, chief engineer and factory director in defence industries until 1947. That year he was promoted to the Ministry of Armaments, serving as head of a Main Administration in the Ministry and Deputy Minister. From 1958-1963 he was deputy, then First Deputy Chairman of the GKOT. When Smirnov was promoted, Zverev became Chairman of the GKOT in 1963. In the March 1965 re-organisation he retained the leadership of the reduced and renamed Ministry of Defence Industry. He became a member of the Central Committee in 1966.

Source: Appendix 3 compiled by the author from numerous Soviet/Russian and Western sources.

Appendix 4: Evolution of the Defence Industrial Ministries

(with selected leaders)

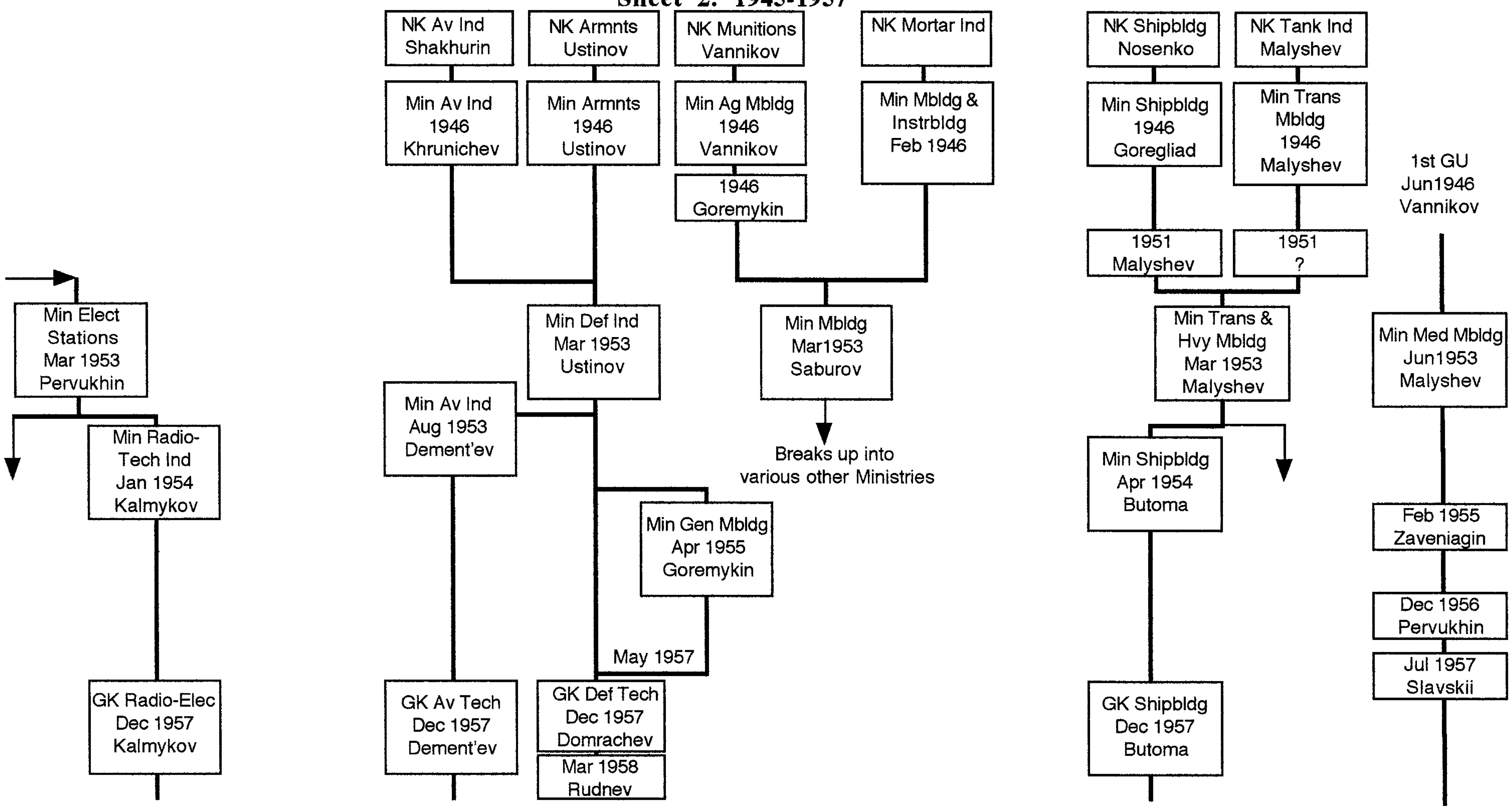
Sheet 1: 1923-1945



Appendix 4: Evolution of the Defence Industrial Ministries

(with selected leaders)

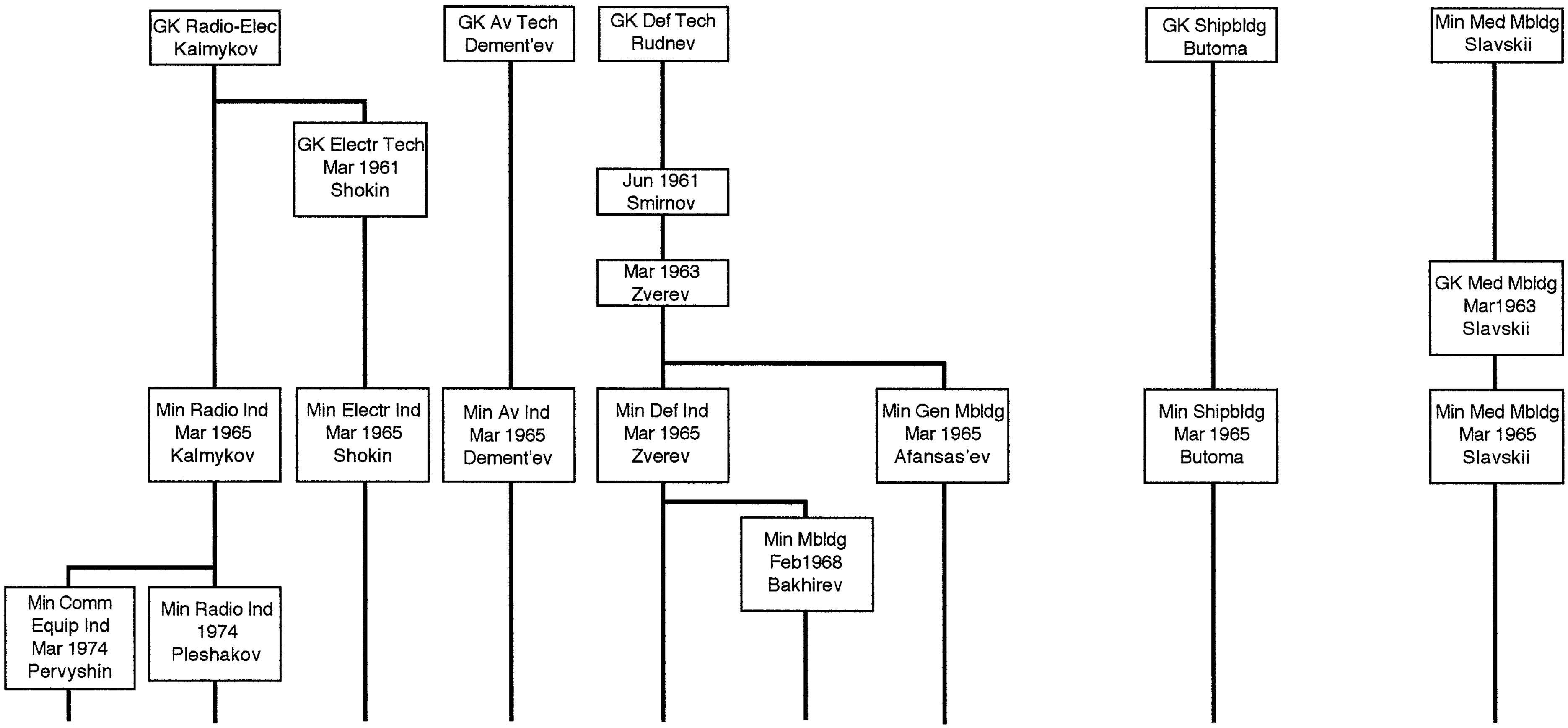
Sheet 2: 1945-1957



Appendix 4: Evolution of the Defence Industrial Ministries

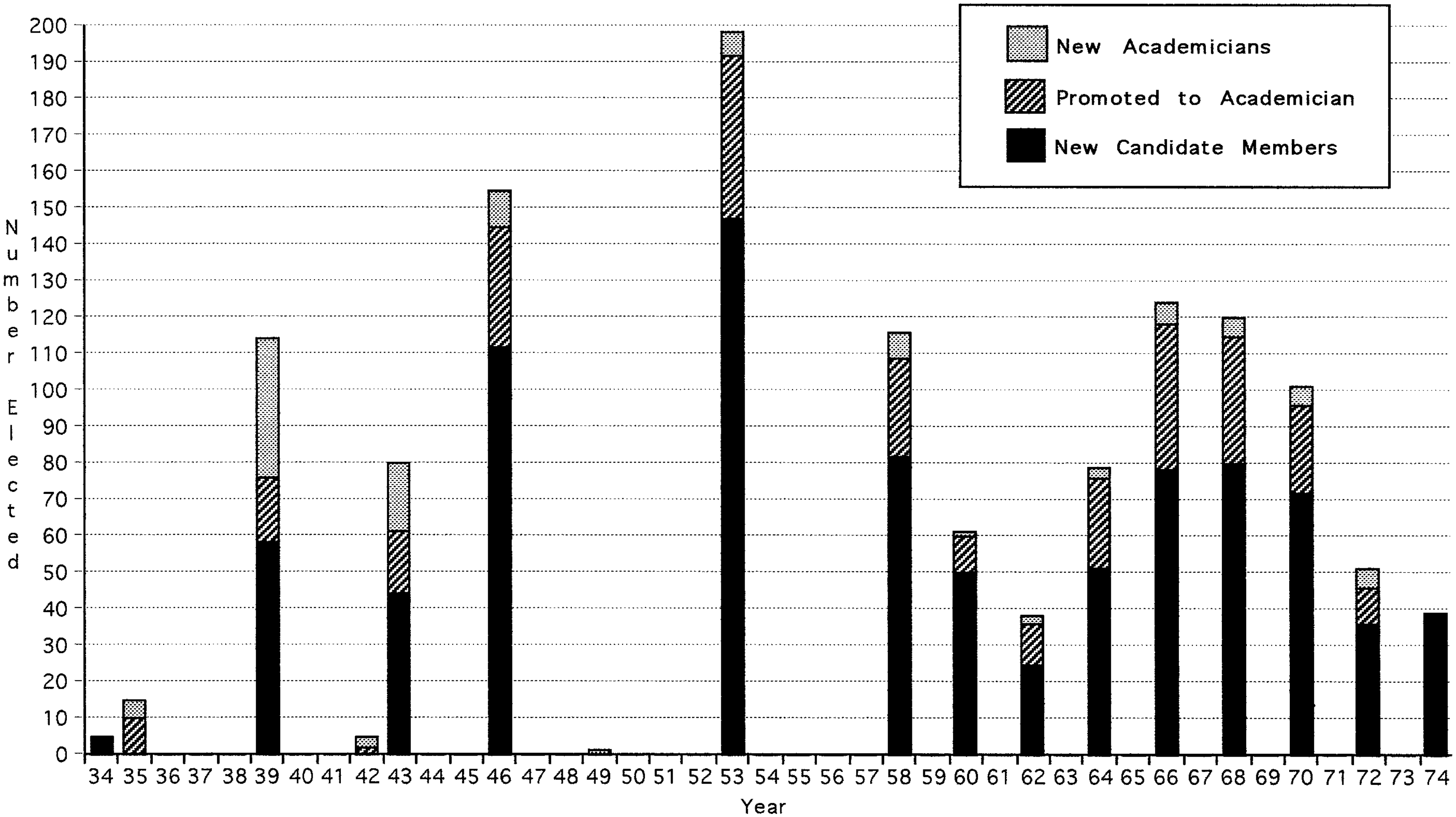
(with selected leaders)

Sheet 3: 1957-1974



Source: Appendix 4 developed by the author from numerous Soviet/Russian and Western sources.

Appendix 5: USSR Academy of Sciences Elections, 1934-1974



Source: Compiled by the author based on data in Skriabin, ed., Akademiia Nauk SSSR: Personal'nyi Sostav, Book 2: 1917-1974.

Appendix 6
Known Decrees Affecting the Soviet Missile and Space Programmes
Sheet 1

Year	Date	Political Organ(s) Acting (see notes)	Number (if known), and Title or Subject	Design Bureau(x) Affected
1946	May 13	SM	No. 1017-419ss: "Questions of Reactive Weapons"	
1951	May 9	SM	"About transfer to the Ministry of Armaments of the Dnepropetrovsk Automobile Factory..."	
1953	Feb 13	?	Decree on creation of an ICBM.	Korolev
	Feb 13	SM	Transfer of design work on R-12 missile to design department at factory 586	Korolev
1954	Apr 10	SM	Creation of OKB-586 (Iangel' Bureau) at the Dnepropetrovsk Missile Complex	Iangel'
	May 20	TsK&SM	On creation of an ICBM	Korolev
1955	Feb 2	SM	No. 292-181 on location and building of NIIP-5 (Baikonur)	
	Aug	TsK&SM	Creation of OKB-52 (Chelomei Bureau) in Ministry of Aviation Industry	Chelomei
	Aug 13	SM	"About the creation and preparation of missile R-12"	Iangel'
1956	Jan 30	TsK & SM	About the exploration of space (including launch of the 1st satellite)	Korolev
	Dec 17	SM	"About creation of Intercontinental Ballistic Missile R-16"	Iangel'
1957	Jan 11	SM	No. 61-39 on the creation of the "Angara" system. (Beginning of Plesetsk)	
1958	Jul 2	SM	About development of R-14 missile	Iangel'
	Aug 28	SM	Acceleration of the R-16 missile programme	Iangel'
	Dec 3	SM	About cessation of work on R-15 and development of the R-21 naval missiles	Iangel'
1959	May 13	SM	To accelerate work on R-14 and R-16 OKB-586 freed from work on naval missiles. Work by OKB-1 on this theme also stopped	Iangel', Korolev
	May 19	SM	On the R-16 and R-9 missiles.	Iangel', Korolev
	Jun 4	VPK	Creation of Filial No. 2 of OKB-1 at Krasnoiarsk	Korolev
	Dec 17	TsK&SM	Point 6 of TsK protocol No. 254 and SM decree No. 1384-615: About the creation of the Strategic Rocket Forces.	
	Dec	?	Comprehensive decree on space research.	Korolev
1960	Jan 2	SM	No. 15-5 about Plestsk (see 16 Sep 1960)	
	May 23	SM	Development of R-26 Missile	Iangel'
	May 30	?	About the silo-basing of all strategic missiles.	

Year	Date	Political Organ(s) Acting (see notes)	Number (if known), and Title or Subject	Design Bureau(x) Affected
1960 (cont)	Jun 23	TsK&SM	"About the creation of powerful rocket launchers, satellites, spaceships and the opening of space between 1960-67"	Korolev, Chelomei
	Aug 8	TsK&SM	"About the creation of carrier rocket 63S1 (Kosmos) on the basis of the military missile R-12, and development and launch of 10 small satellites"	Iangel'
	Sep 16	SM	No. 999-347 about the creation of a satellite research proving ground on the basis of the Plesetsk launch site	
	Oct 11	TsK&SM	Authorization for a manned spaceflight in December 1960	Korolev
1961	Apr 3	TsK	"The launch of the Satellite/Spacecraft"	Korolev
	Apr 3	TsK&SM	"About measures to improve the coordination of scientific-research work in the country and the activities of the Academy of Sciences of the USSR"	
	Apr 24	SM	R-14 missile accepted into inventory	Iangel'
	May 13	?	Second decree on N-1 launcher	Korolev
	Oct 31	TsK&SM	"About creation of space booster 65S3" (Interkosmos) on the basis of the R-14 missile and development of 3 satellites	Iangel'
	Dec	?	OKB-1 Filial No. 2 (Krasnoiarsk) made independent (OKB-10)	Korolev
1962	Apr 13	?	3rd decree on N-1. Work curtailed	Korolev
	Apr 16	SM	"About the creation of ICBMs (R-36) and Global missiles (R-46), and heavy space launchers (R-56)"	Iangel'
	Apr 29	SM	About creation of the UR-500 ballistic missile	Chelomei
	Jul 9	SM	Cessation of work on the R-26 missile	Iangel'
	Sep 24	TsK&SM	Approval of the modified N-1 project	Korolev
1963	Jun 15	SM	The surface-based version of the R-16 missile accepted into inventory	Iangel'
	Jul 15	SM	Silo-based R-12U, R-14U, and R-16U accepted into inventory	Iangel'
	Dec 3	TsK	"On creation of the Soiuz space complex"	Korolev
1964	Jun 19	SM	Work on heavy space launcher R-56 terminated	Iangel'
	Aug 3	TsK & SM	SM No. 655-268 "On work on exploring the moon and space"	Korolev, Iangel', Chelomei
1965	Aug 24	SM	"About creation of a space launcher on the basis of R-36 missile"	Iangel'
	?	TsK&SM	On orbital stations for the military	Chelomei

Year	Date	Political Organ(s) Acting (see notes)	Number (if known), and Title or Subject	Design Bureau(x) Affected
1966	Apr 27	VPK	No. 101: On creation of the L-1 (circumlunar Soiuz) spacecraft	Korolev
	Jun 15	VPK	No. 144: About preparation of crews for the earth orbital version of Soiuz	
	Nov	VPK	About failures in fulfilling the 3 Aug 1964 decree on lunar exploration (Designates lunar work as a "special state assignment")	Korolev, Chelomei
1967	Feb 4	TsK&SM	About failures in fulfilling the 3 Aug 1964 decree on lunar exploration (Designates lunar programmes as "objectives of national importance")	Korolev, Chelomei
	Jul 21	TsK&SM	R-36 (SS-9) ICBM accepted into inventory	Iangel'
	Jul 21	SM	"About creation of space system of ocean reconnaissance ... and launcher based on R-36"	Iangel'
1968	May 6	SM	About crews for first four Soiuz missions	
	May	TsK&SM	About commemorating Gagarin and Seregin	
	Jul	VPK	On Soiuz missions for the rest of the year	Korolev
	Nov 19	SM	R-36 (orbital missile version) accepted into inventory	Iangel'
	Nov 28	TsK&SM	SM Res. No. 932-331. On the causes of Gagarin's death	
1969	Jan 8	TsK&SM	SM Res. No. 19-10. "About the work plans for research of the Moon, Venus, and Mars by automatic stations (unmanned probes)"	Lavochkin
	Sep 2	SM	"About development and preparation of rocket complex R-36M (SS-18)	Iangel'
	Oct	SM	Decree on cessation of development of the RT-20P	Iangel'
1970	Feb	TsK&SM	About transfer of Almaz space station design from Chelomei KB to Korolev KB to build space stations for the Academy of Sciences	Chelomei, Korolev

Notes

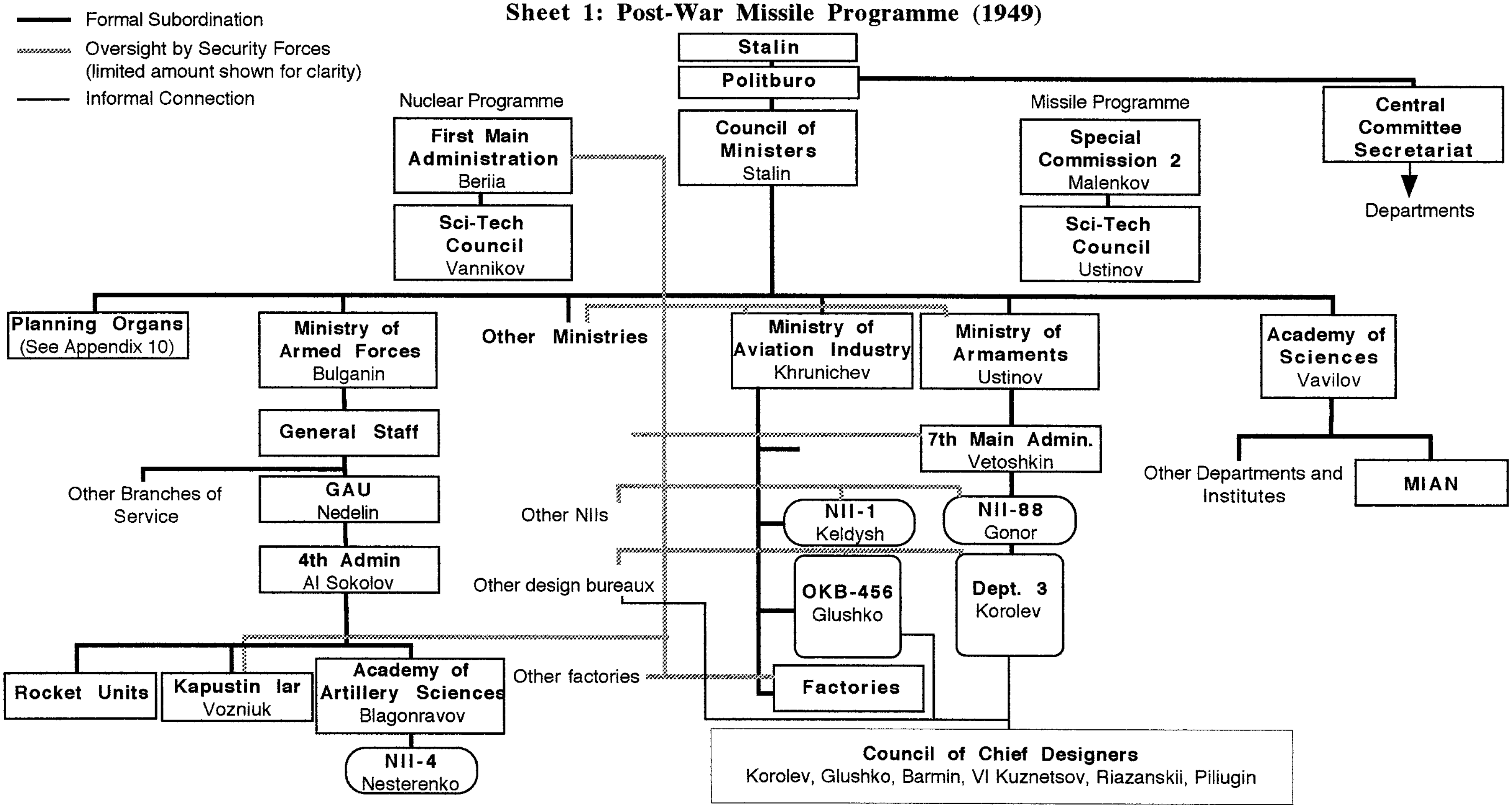
1. Political Organs: SM = Council of Ministers; TsK = Central Committee; VPK = Military-Industrial Commission
2. Only those Political Organs specifically cited in sources are listed here. It is likely that in some cases both the TsK and SM issued joint or re-inforcing decrees, but only one of the actors has been noted. Thus, distinctions listed here should not be taken as authoritative.
3. In cases where the reference is to a "government decree" this has been construed as a decree by the Council of Ministers (SM). A "?" indicates reference to a "decree" without specification of the organ issuing the decree.

Source: Appendix 6 compiled by the author from numerous Soviet/Russian sources.

Appendix 7: General Relationship of Institutions Involved in the Soviet Missile and Space Programmes

(with selected leaders)

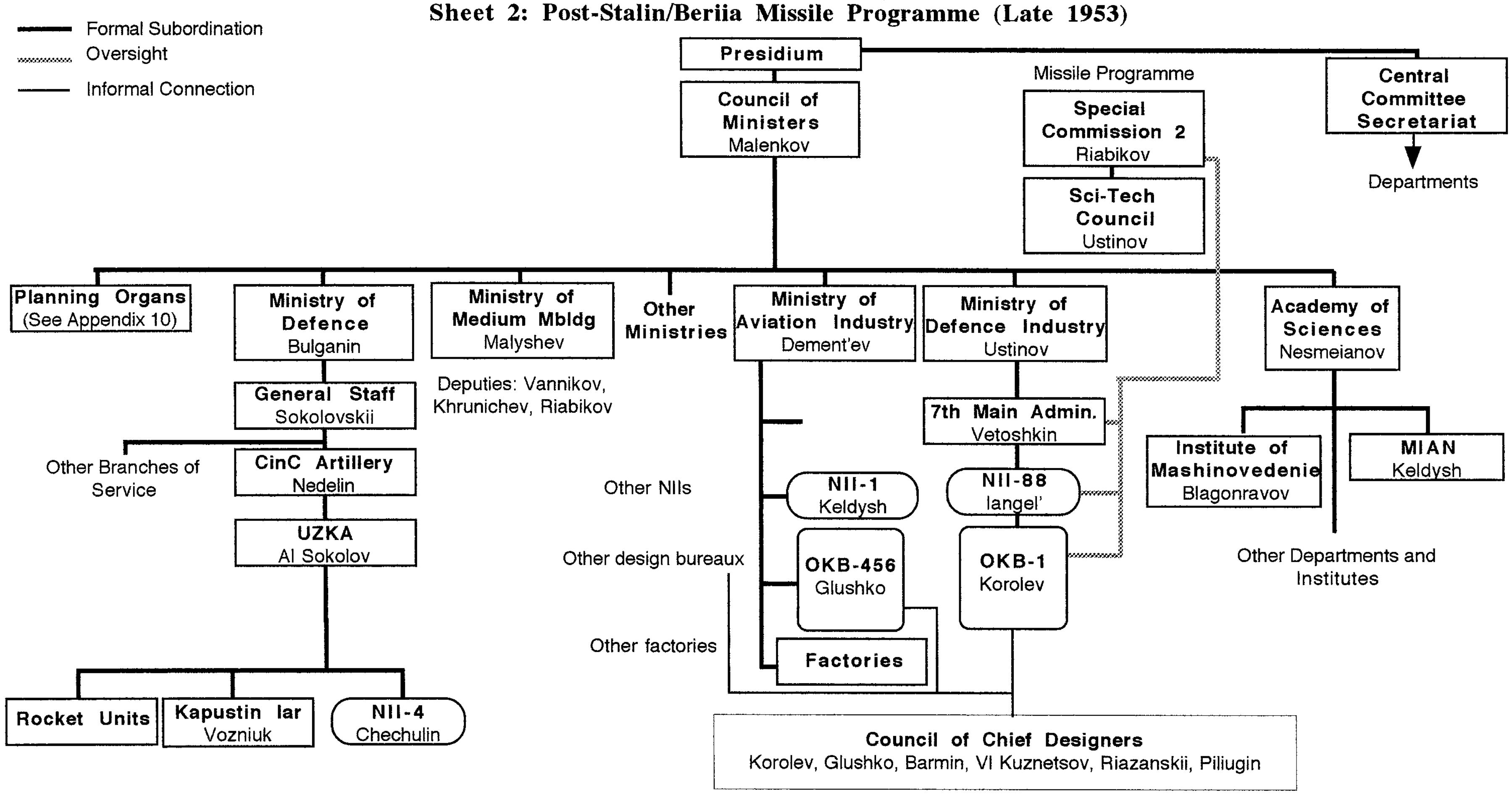
Sheet 1: Post-War Missile Programme (1949)



Appendix 7: General Relationship of Institutions Involved in the Soviet Missile and Space Programmes

(with selected leaders)

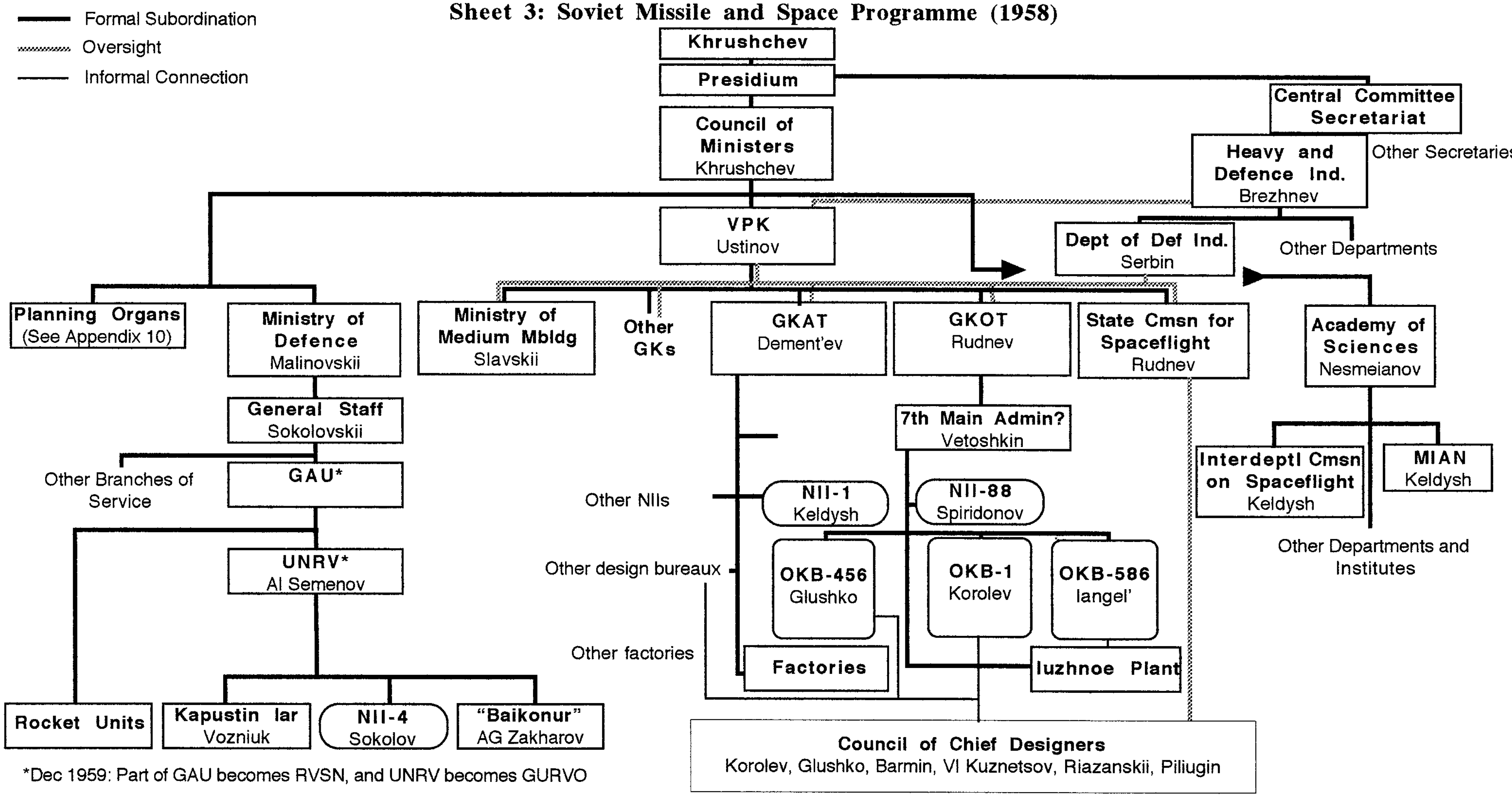
Sheet 2: Post-Stalin/Beriia Missile Programme (Late 1953)



Appendix 7: General Relationship of Institutions Involved in the Soviet Missile and Space Programmes

(with selected leaders)

Sheet 3: Soviet Missile and Space Programme (1958)

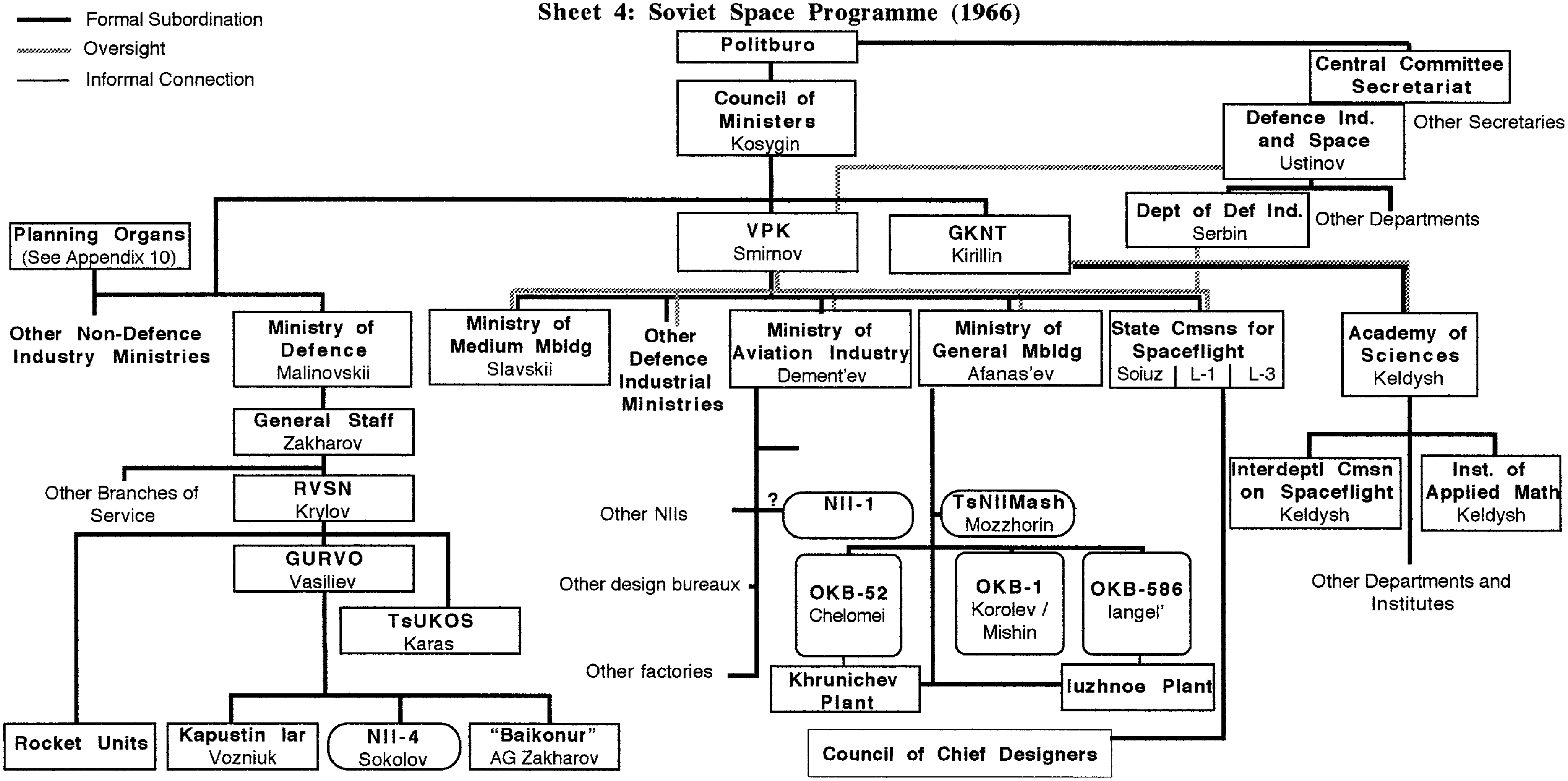


*Dec 1959: Part of GAU becomes RVSN, and UNRV becomes GURVO

Appendix 7: General Relationship of Institutions Involved in the Soviet Missile and Space Programmes

(with selected leaders)

Sheet 4: Soviet Space Programme (1966)



Source: Appendix 7 developed by the author from numerous Soviet/Russian and Western sources.

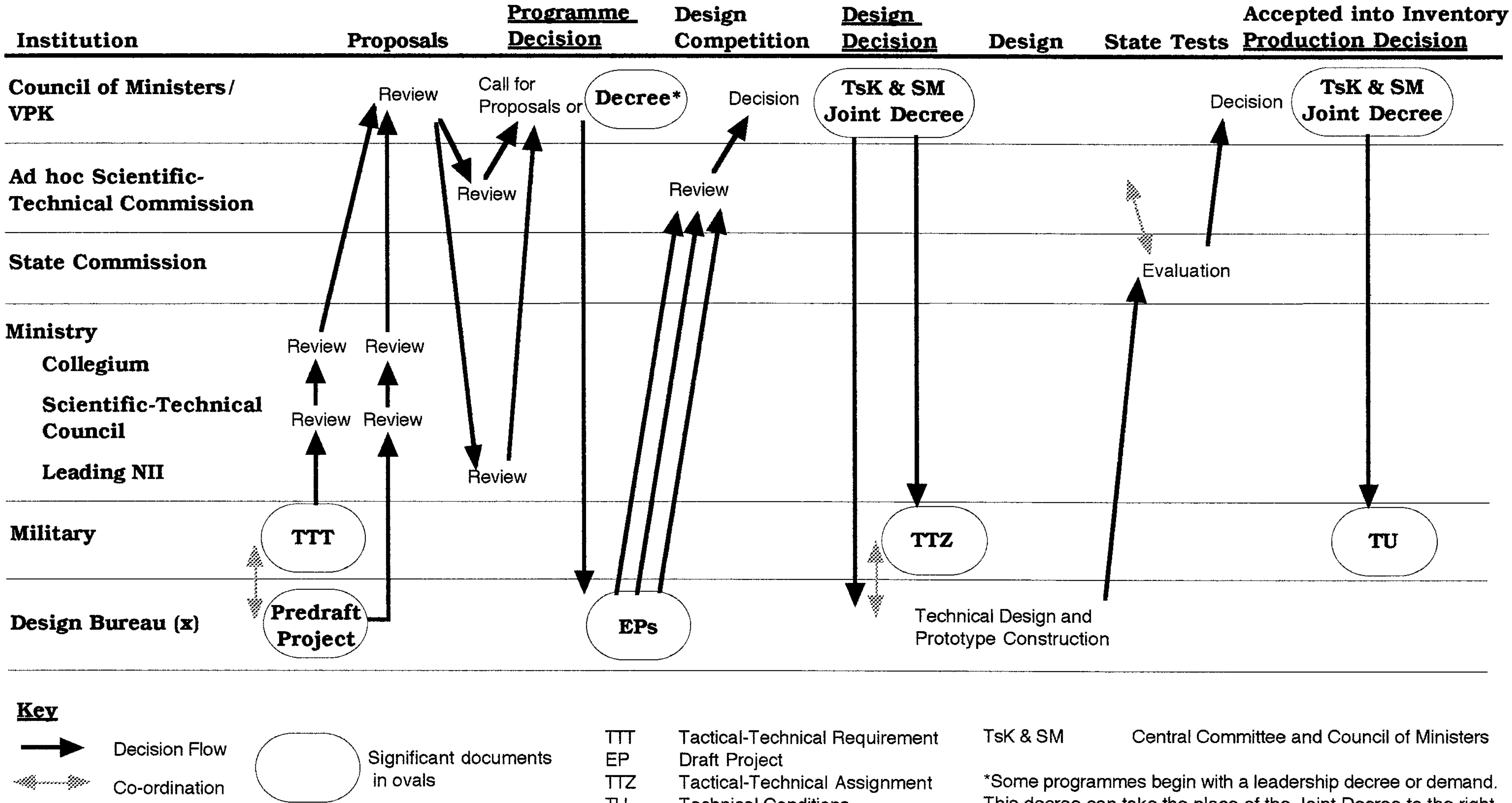
Appendix 8: The Council of Chief Designers

Prior to 1953

Chief Designer	Institution	Product	Ministry
S. P. Korolev	NII-88 / OKB-1	Long-range Missiles	Armaments
V. P. Glushko	OKB-456	Rocket Engines	Aviation Industry
V. I. Kuznetsov	NII-944	Gyro Instruments	Shipbuilding Industry
N. A. Piliugin	NII-885	Internal Control Systems	Means of Communication
M. S. Riazanskii	NII-885	Radio Control Systems	Means of Communication
V. P. Barmin	State Specialized Design Bureau (GSKB)	Ground Equipment	Machine and Instrumentbuilding

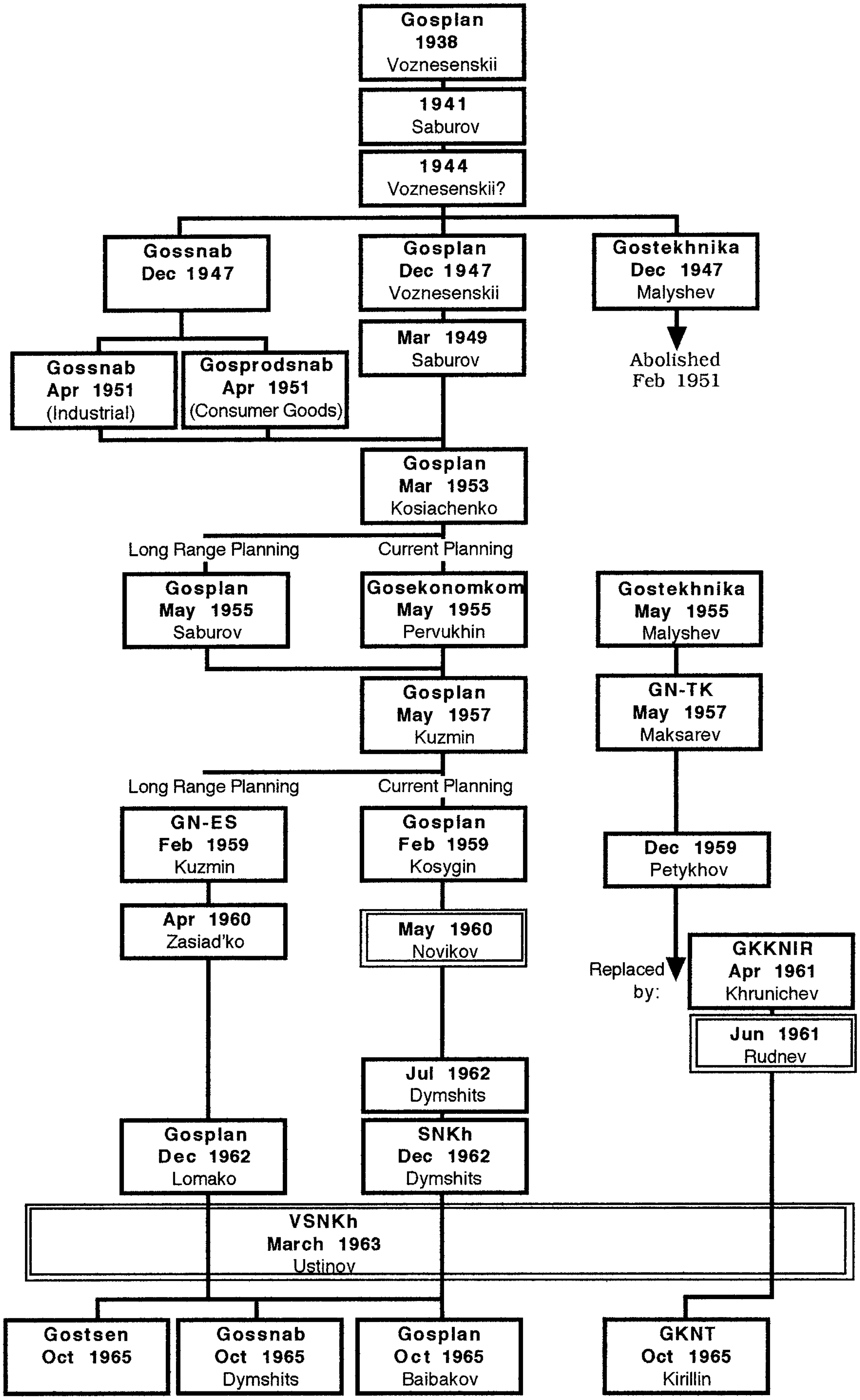
Source: Compiled by the author from data in Mozzhorin, ed., Dorogi v Kosmos, and other Russian sources.

Appendix 9: The Soviet Weapons Research and Development Process



Source: Developed by the author from a diagram in US Central Intelligence Agency, The Soviet Weapons Industry: An Overview, p. 18. Modified and expanded based on numerous Soviet/Russian and Western sources.

Appendix 10: Evolution of the Central Planning Organs

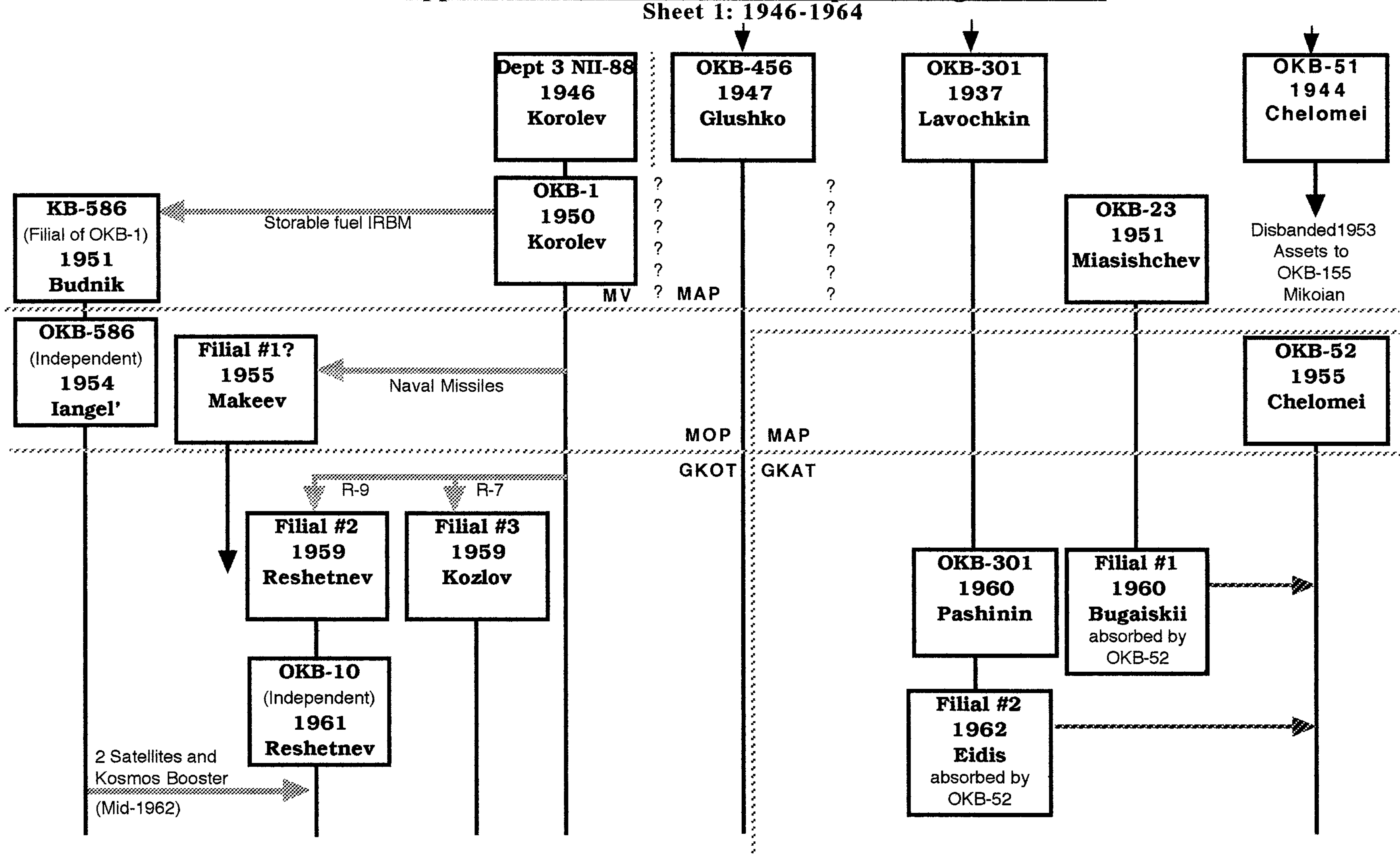


(Organisations in double boxes headed by person with known connections to the missile industry)

Source: Developed by the author from numerous Soviet/Russian and Western sources.

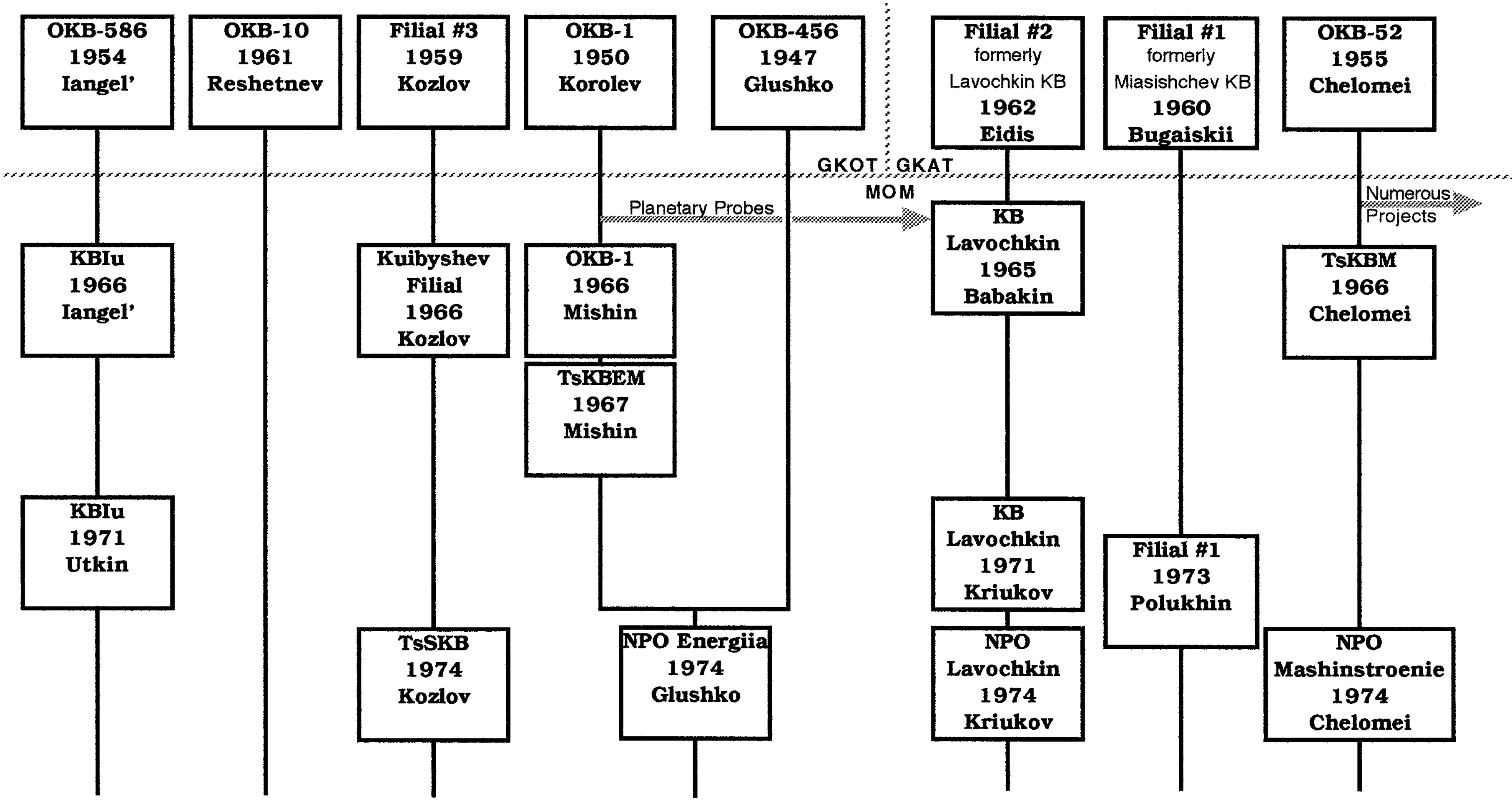
Appendix 11: Evolution of the Space Design Bureaux

Sheet 1: 1946-1964



Appendix 11: Evolution of the Space Design Bureaux

Sheet 2: 1965-1974



Source: Appendix 11 developed by the author from numerous Soviet/Russian sources.

Appendix 12: Soviet Space Programme 1957-64 (All Known Launches)

Sheet 1

Launch Date		Soviet Designation (note 1)	Design Bureau (notes 2,3) K	Ia	Ch	Failure Type (note 4) Launch	Mission	Manned Programme	Comments (note 5)
1957	Oct 4	Sputnik	X						1st artificial satellite
	Nov 3	Sputnik 2	X						1st animal, a dog, in space (Laika)
1958	Apr 27	(Sputnik)	X			X			Scientific satellite attempt
	May 15	Sputnik 3	X						Scientific satellite
	Sep 23	(Luna)	X			X			Lunar probe attempt
	Oct 12	(Luna)	X			X			Lunar probe attempt
	Dec 4	(Luna)	X			X			Lunar probe attempt
1959	Jan 2	Luna 1	X				X		Lunar probe, passed within 5,500 km of Moon
	Jul 18	(Luna)	X			X			Lunar probe attempt
	Sep 12	Luna 2	X						1st object to impact Moon
	Oct 4	Luna 3	X						1st photos of far side of Moon
1960	Apr 15	(Luna)	X			X			Lunar photo probe attempt
	Apr 16	(Luna)	X			X			Lunar photo probe attempt
	May 15	Korabl'-Sputnik 1	X				X	X	Vostok test - deorbit failed
	Jul 28	(Korabl'-Sputnik)	X			X		X	Vostok test, launch abort, 2 dogs (Chaika, Lisichka)
	Aug 19	Korabl'-Sputnik 2	X					X	Vostok test, 2 Dogs (Belka, Strelka)
	Oct 10	(Mars)	X			X			Mars probe attempt, originally planned for 26 Sep, delayed
	Oct 14	(Mars)	X			X			Mars probe attempt
	Dec 1	Korabl'-Sputnik 3	X				X	X	Vostok test, recovery failed, re-entry too steep, 2 dogs lost (Pchelka, Mushka)
	Dec 22	(Korabl'-Sputnik)	X			X		X	Vostok test, pre-orbit abort, 2 dogs recovered (Shutka, Kometa)
1961	Feb 4	Heavy Sputnik	X				X		Venus probe attempt
	Feb 12	Venera 1 & Heavy Sputnik	X				X		Venus probe attempt, 1st use of parking orbit, radio contact lost 27 Feb, passed 1 million km by Venus
	Mar 9	Korabl'-Sputnik 4	X					X	Vostok test, mannequin and 1 dog (Chernushka)
	Mar 25	Korabl'-Sputnik 5	X					X	Vostok test, mannequin and 1 dog (Zvezdochka)
	Apr 12	Vostok	X					X	1st human spaceflight (Gagarin)

Appendix 12: Soviet Space Programme 1957-1964 (All Known Launches)

Sheet 2

Launch Date		Soviet Designation (note 1)	Design Bureau (notes 2,3)			Failure Type (note 4)		Manned Pro-gramme	Comments (note 5)
			K	Ia	Ch	Launch	Mission		
1961	Aug 6	Vostok 2	X					X	1st "day" in space (Titov)
(cont.)	Oct 27	(Kosmos)		X		X			1st Kosmos attempt, payload DS-1
	Dec 11	(Kosmos)	X			X			Zenit reconnaissance satellite
	Dec 21	(Kosmos)		X		X			Failed to orbit, DS-1 backup
1962	Mar 16	Kosmos 1		X					1st in Kosmos series, DS-2, particle & radiation measurement?
	Apr 6	Kosmos 2		X					Particle & radiation measurement?
	Apr 24	Kosmos 3		X					Particle & radiation measurement?
	Apr 26	Kosmos 4	X						Zenit reconnaissance satellite, 1st announced Kosmos recovery
	May 28	Kosmos 5		X				X?	Radiation research?
	Jun 1	(Kosmos)	X			?			Zenit reconnaissance satellite
	Jun 30	Kosmos 6		X					Radar calibration for Missile Defence Forces
	Jul 28	Kosmos 7	?						Reconnaissance satellite
	Aug 11	Vostok 3	X					X	1st "dual" flight (Nikolaev)
	Aug 12	Vostok 4	X					X	1st "dual" flight (Popovich)
	Aug 18	Kosmos 8		?					Micrometerorites & atmospheric density research?
	Aug 25	(Venera)	X				X		Unannounced Venus probe, failed to leave earth orbit
	Sep 1	(Venera)	X				X		Unannounced Venus probe, failed to leave earth orbit
	Sep 12	(Venera)	X				X		Unannounced Venus probe, failed to leave earth orbit
	Sep 27	Kosmos 9	?						Reconnaissance satellite
	Oct 17	Kosmos 10	?						Reconnaissance satellite
	Oct 20	Kosmos 11		?					Ions and atmospheric density research?
	Oct 24	(Mars)	X				X		Unannounced Mars probe, failed to leave earth orbit
	Oct 25	(Kosmos)		X		X			Unknown
	Nov 1	Mars 1	X				X		Mars probe, lost radio contact on 21 Mar 1963
	Nov 4	(Mars)	X				X		Unannounced Mars probe, failed to leave earth orbit
	Dec 22	Kosmos 12	?						Reconnaissance satellite

Appendix 12: Soviet Space Programme 1957-1964 (All Known Launches)

Sheet 3

Launch Date		Soviet Designation (note 1)	Design Bureau (notes 2,3) K	Ia	Ch	Failure Type (note 4) Launch	Mission	Manned Programme	Comments (note 5)
1963	Jan 4	(Luna)	X				X		Lunar landing probe, failed to leave earth orbit
	Feb 3	(Luna)	X			X			Lunar landing probe, failed to reach orbit
	Mar 21	Kosmos 13	?						Reconnaissance satellite
	Apr 2	Luna 4	X				X		Lunar probe, missed Moon by 8500 km
	Apr 6	(Kosmos)		X		X			Scientific satellite
	Apr 13	Kosmos 14		X					Tested electromechanical stabilization
	Apr 22	Kosmos 15	?						Reconnaissance satellite
	Apr 28	Kosmos 16	?						Reconnaissance satellite
	May 22	Kosmos 17		X					Particle & radiation measurements?
	May 24	Kosmos 18	?						Reconnaissance satellite
	Jun 1	(Kosmos)		X		X			Scientific satellite
	Jun 14	Vostok 5	X					X	2nd "dual" flight (Bykovskii)
	Jun 16	Vostok 6	X					X	2nd "dual" flight - 1st Woman in Space (Tereshkova)
	Jul 10	(Kosmos)	?			X			Reconnaissance satellite, exploded on launch pad
	Aug 6	Kosmos 19		X					Cosmic radiation & atmospheric density research?
	Aug 22	(Kosmos)		X		X			Scientific satellite
	Oct 18	Kosmos 20	?						Reconnaissance satellite
	Oct 24	(Kosmos)		X		X			Scientific satellite
	Nov 1	Polet 1			X				Anti-satellite testbed, first manoeuvrable Soviet satellite
	Nov 11	Kosmos 21	?				X		Planetary probe?, failed to leave earth orbit
	Nov 16	Kosmos 22	?						2nd generation reconnaissance satellite
	Nov 28	(Kosmos)	?			X			Reconnaissance satellite
	Dec 13	Kosmos 23		X					Tested electromechanical stabilization
	Dec 19	Kosmos 24	?						Reconnaissance satellite
1964	Jan 30	Elektron 1&2	X						Double payload on one launcher, geophysical observatories
	Feb 19	(Venera)	X			X			Venus probe attempt

Appendix 12: Soviet Space Programme 1957-1964 (All Known Launches)

Sheet 4

Launch Date		Soviet Designation (note 1)	Design Bureau (notes 2,3) K	Ia	Ch	Failure Type (note 4) Launch	Mission	Manned Pro-gramme	Comments (note 5)
1964 (cont.)	Feb 27	Kosmos 25		X					Cosmic radiation research?
	Mar 18	Kosmos 26		X					Magnetic field research?
	Mar 21	(Venera)	X			X			Venus probe attempt
	Mar 27	Kosmos 27	X				X		Venus probe, failed to leave earth orbit
	Apr 2	Zond 1	X				X		Venus probe, lost radio contact 14 May, passed 100,000 km by Venus on 19 July
	Apr 4	Kosmos 28	?						Reconnaissance satellite
	Apr 12	Polet 2			X				Anti-satellite testbed
	Apr 20	(Luna)	X			X			Lunar landing probe - failed to orbit
	Apr 25	Kosmos 29	?						Reconnaissance satellite
	May 18	Kosmos 30	?						Reconnaissance satellite
	Jun 4	(Luna)	X			X			Lunar probe - failed to orbit
	Jun 6	Kosmos 31		X					Military radar calibration
	Jun 10	Kosmos 32	?						Reconnaissance satellite
	Jun 23	Kosmos 33	?						Reconnaissance satellite
	Jul 1	Kosmos 34	?						Reconnaissance satellite
	Jul 10	Elektron 3&4	X						Double payload, orbiting geophysical observatories
	Jul 15	Kosmos 35	?						Reconnaissance satellite
	Jul 30	Kosmos 36		X					Military radar calibration
	Aug 14	Kosmos 37	?						Reconnaissance satellite
	Aug 18	Kosmos 38, 39 & 40		X					1st Soviet triple payload, 1st use of Interkosmos booster, new launcher at Baikonur, possible navigation satellites
	Aug 22	Kosmos 41	X				X		"Molniia" communication satellite - antenna did not deploy
	Aug 22	Kosmos 42 & 43		X					1st double Kosmos payload, navigation or communication satellites
	Aug 28	Kosmos 44		X					"Meteor" meteorological satellite

Appendix 12: Soviet Space Programme 1957-1964 (All Known Launches)

Sheet 5

Launch Date		Soviet Designation (note 1)	Design Bureau (notes 2,3)			Failure Type (note 4)		Manned Pro-gramme	Comments (note 5)
			K	Ia	Ch	Launch	Mission		
1964	Sep 13	Kosmos 45	?						Reconnaissance or meteorological satellite
(cont.)	Sep 24	Kosmos 46	?						Reconnaissance satellite
	Oct 6	Kosmos 47	X					X	Voskhod Test, 1st use of Soiuz booster & Kosmos designator for a manned programme mission
	Oct 12	Voskhod 1	X					X	1st Multiperson Crew (Komarov, Feoktistov, Egorov)
	Oct 14	Kosmos 48	?						Reconnaissance satellite
	Oct 23	(Kosmos)		X		X			Possible multiple satellite launch attempt
	Oct 24	Kosmos 49		?					Magnetic fields, IR & UV radiation research?
	Oct 28	Kosmos 50	?				X		Reconnaissance satellite, exploded on 8th day of orbit
	Nov 30	Zond 2	X				X		Mars probe, lost communications, passed Mars on 6 Aug 1965
	Dec 1	(Kosmos)		X		X			Scientific satellite
	Dec 9	Kosmos 51		?					Luminosity of stellar background?

Notes
1. Designations in parentheses are attributed by the author based on analysis of a variety of sources.
2. Design Bureaux: K = Korolev/OKB-1; Ia = Iangel'/OKB-586; Ch = Chelomei/OKB-52
3. "?" indicates probable, but uncertain connection with a given design bureau. These are based primarily on launcher and satellite type. By the end of this period there were at least seven designers developing satellites (Korolev, Iangel', Chelomei, Kozlov, Reshetnev, Iosifian, Babakin). Some of these designers may have served as the "prime contractor" even though the satellite was launched on a Korolev or Iangel' booster. This was known to be the case with Chelomei's "Polet" satellites. (This information courtesy of Asif Siddiqi, correspondence, 21 August 1995.)
4. Failures are indicated only in cases where there is reasonable evidence of a failure. The absence of a "Failure Type" does not necessarily mean that the mission was a success.
5. The purpose of many missions is still not clear - question marks indicate doubt about the given explanation. For manned missions, crewmember name(s) shown in parentheses in the Comments column.

Source: Appendix 12 successful launch data based on Thompson, ed., TRW Space Log 1957-1987, Vol. 23. Additional data compiled by the author from numerous Russian and Western sources.

Appendix 13: Soviet Manned Space Programme 1960 -1970

Sheet 1

Year	Launch Date	Soviet Designation	Programme	Major Objective	Results
1960	May 15	Korabl'-Sputnik 1	Vostok	Unmanned Vostok spacecraft test	De-orbit failure
	Jul 28	(Korabl'-Sputnik)	Vostok	Unmanned Vostok spacecraft test	Launch failure
	Aug 19	Korabl'-Sputnik 2	Vostok	Unmanned Vostok spacecraft test	First successful recovery of animals from orbit
	Dec 1	Korabl'-Sputnik 3	Vostok	Unmanned Vostok spacecraft test	Re-entry too steep, craft destroyed
	Dec 22	(Korabl'-Sputnik)	Vostok	Unmanned Vostok spacecraft test	Launch failure
1961	Mar 9	Korabl'-Sputnik 4	Vostok	Unmanned Vostok spacecraft test	Successful
	Mar 25	Korabl'-Sputnik 5	Vostok	Unmanned Vostok spacecraft test	Successful
	Apr 12	Vostok	Vostok	First Human Spaceflight	Successful (Gagarin)
	Aug 6	Vostok 2	Vostok	First "Day" in space	Successful (Titov)
1962	Aug 11	Vostok 3	Vostok	Dual Flight with Vostok 4	Successful (Nikolaev)
	Aug 12	Vostok 4	Vostok	Dual Flight with Vostok 3	Successful (Popovich)
1963	Jun 14	Vostok 5	Vostok	Dual Flight with Vostok 6	Successful (Bykovskii)
	Jun 16	Vostok 6	Vostok	First Woman in Space, Dual Flight with Vostok 5	Successful (Tereshkova)
1964	Oct 6	Kosmos 47	Voskhod	Unmanned Voskhod spacecraft test	Successful
	Oct 12	Voskhod	Voskhod	First multiperson space crew	Successful (Komarov, Feoktistov, Egorov)
1965	Feb 22	Kosmos 57	Voskhod	Unmanned test for Voskhod 2	Exploded during second orbit
	Mar 18	Voskhod 2	Voskhod	First Space "Walk"	Successful despite difficulties (Beliaev, Leonov)
1966	Feb 22	Kosmos 110	Voskhod	Unmanned test for Voskhod 3	Successful, but follow-on mission cancelled
	Nov 28	Kosmos 133	Soiuz	Unmanned Soiuz spacecraft test (and docking?)	Multiple in-flight failures, landing outside USSR - so intentionally destroyed on re-entry.
	Dec 14	(None)	Soiuz	Unmanned Soiuz spacecraft test	Launch pad explosion following launch cancellation

Appendix 13: Soviet Manned Space Programme 1960 - 1970

Sheet 2

Year	Launch Date	Soviet Designation	Programme	Major Objective	Results
1967	Feb 7	Kosmos 140	Soiuz	Unmanned Soiuz spacecraft test	Orientation system failure, on re-entry hole burned through craft, sank in Aral Sea
	Mar 10	Kosmos 146	L-1	Unmanned spacecraft test	Apparently successful
	Apr 8	Kosmos 154	L-1	Unmanned circumlunar spacecraft test	Failure of Blok D, stuck in Earth orbit
	Apr 23	Soiuz 1	Soiuz	Docking and crew transfer with second Soiuz	Multiple inflight failures - second Soiuz launch cancelled. Parachute failure. (Komarov killed)
	May 17	Kosmos 159	L-1	Unmanned communications test using Luna-type probe	Purpose and results unclear
	Sep 28	(None)	L-1	Unmanned circumlunar test	Launch failure
	Oct 27	Kosmos 186	Soiuz	Unmanned docking test with Kosmos 188	First successful automatic docking
	Oct 30	Kosmos 188	Soiuz	Unmanned docking test with Kosmos 186	First successful automatic docking
	Nov 22	(None)	L-1	Unmanned circumlunar test	Launch failure
1968	Mar 2	Zond 4	L-1	Unmanned test of circumlunar spacecraft (not intended to circle moon)	Attitude control system failure. Destroyed when clear it would not land in USSR
	Apr 14	Kosmos 212	Soiuz	Unmanned docking test with Kosmos 213	Successful
	Apr 15	Kosmos 213	Soiuz	Unmanned docking test with Kosmos 212	Successful
	Apr 22	(None)	L-1	Unmanned test of circumlunar spacecraft (not intended to circle moon)	Launch failure
	Aug 28	Kosmos 238	Soiuz	Unmanned test of Soiuz	Successful
	Sep 15	Zond 5	L-1	Unmanned circumlunar test	Orientation system failure. But successfully recovered in the Indian Ocean.
	Oct 25	Soiuz 2	Soiuz	Unmanned docking target for Soiuz 3	See below
	Oct 26	Soiuz 3	Soiuz	Docking test with Soiuz 2	Failed to dock with Soiuz 2 (Beregovoi)
	Nov 10	Zond 6	L-1	Unmanned circumlunar test	Spacecraft de-pressurized on re-entry

Appendix 13: Soviet Manned Space Programme 1960 -1970

Sheet 3

Year	Launch Date	Soviet Designation	Programme	Major Objective	Results
1969	Jan 14	Soiuz 4	Soiuz	Docking and crew transfer with Soiuz 5	Successful (Shatalov)
	Jan 15	Soiuz 5	Soiuz	Docking and crew transfer with Soiuz 4	Successful (Volynov, Khrunov, Eliseev)
	Jan 20	(None)	L-1	Unmanned circumlunar test	Launch failure
	Feb 21	(None)	L-3	Unmanned test of N-1 lunar booster, payload intended to circle moon	Launch failure
	Jul 3	(None)	L-3	Unmanned test of N-1 lunar booster, payload intended to circle moon	Launch failure
	Aug 8	Zond 7	L-1	Unmanned circumlunar test	Successful
	Oct 11	Soiuz 6	Soiuz	Film docking of Soiuz 7&8, welding experiments	First "Triple Flight" but only partially successful (see below) (Shonin, Kubasov)
	Oct 12	Soiuz 7	Soiuz	Dock with Soiuz 8	First "Triple Flight" but failed to dock (Filipchenko, Gorbatko, Volkov)
	Oct 13	Soiuz 8	Soiuz	Dock with Soiuz 7	First "Triple Flight" but failed to dock (Shatalov, Eliseev)
	Nov 28	(None)	L-1?	Possible unmanned alternate mission for extra L-1 craft	Apparent launch failure
1970	Jun 1	Soiuz 9	Soiuz	Long duration orbital record	Set new world space endurance record (Nikolaev, Sevastianov)
	Oct 20	Zond 8	L-1	Unmanned circumlunar mission	Successfully recovered in the Indian Ocean
	Nov 24	Kosmos 379	L-3	Unmanned test of lunar landing craft	Apparently successful
	Dec 2	Kosmos 382	L-3	Lunar orbiter test in earth orbit	Apparently successful

The 28 Nov 1969 mission made use of an extra L-1 craft by replacing life support equipment with other instruments. It does not appear that this mission was still considered part of the manned spaceflight programme.

Source: Appendix 13 successful launch data based on Clark, The Soviet Manned Space Programme, pp. 178-179. Additional data compiled by the author from numerous Russian and Western sources.

Appendix 14: Circumlunar (UR-500K/L-1) Programme Summary

Year	Launch Date	Soviet Designation	Major Objectives	Results
1967	Mar 10	Kosmos 146	Spacecraft test flight	Apparently successful
	Apr 8	Kosmos 154	Circumlunar test flight	Blok D failed, stuck in Earth orbit
	May 17	Kosmos 159	Communication test with Luna-type probe	Unclear
	Sep 28	(None)	Circumlunar test flight	Launch failure
	Nov 22	(None)	Circumlunar test flight	Launch failure
1968	Mar 2	Zond 4	Test flight	Not aimed at Moon, attitude control failure, destroyed when clear it would not land in USSR
	Apr 22	(None)	Circumlunar test flight	Launch failure
	(July)			Blok D explosion on launch pad during launch preparation.
	Sep 15	Zond 5	Circumlunar test flight	Successfully circled Moon, but attitude control failure led to landing in Indian Ocean
	Nov 10	Zond 6	Circumlunar test flight	Successfully circled Moon, but craft de-pressurized on re-entry
1969	Jan 20	(None)	Circumlunar test flight	Launch failure
	Aug 8	Zond 7	Circumlunar test flight	Successful
	Nov 28	(None)	Possible alternate mission for extra L-1 craft	Apparent launch failure
1970	Oct 20	Zond 8	Circumlunar flight	Successful - end of circumlunar programme

Zond 1 and Zond 2 were planetary probes (Venus and Mars respectively) launched in 1964. Zond 3 had photographed the moon in 1965. The L-1 tests began with Zond 4, implying that they were part of the same planetary probe series, rather than a new manned programme.

The 28 Nov 1969 mission made use of an extra L-1 craft by replacing life support equipment with other instruments. It does not appear that this mission was still considered part of the manned spaceflight programme.

Source: Compiled by the author from numerous Russian sources.

Appendix 15: Lunar Soil Return Programme Summary

Year	Launch Date	Soviet Designation	Major Objectives	Results
1969	Jun 14	(None)	Return Lunar Soil to Earth	Blok D failed, did not reach earth orbit
	Jul 13	Luna 15	Return Lunar Soil to Earth	Crashed on moon, 21 July 1969
	Sep 23	Kosmos 300	Return Lunar Soil to Earth	Blok D failed, stuck in earth orbit
	Oct 22	Kosmos 305	Return Lunar Soil to Earth	Blok D failed, stuck in earth orbit
1970	Feb 6	(None)	Return Lunar Soil to Earth	Launch failure
	Sep 12	Luna 16	Return Lunar Soil to Earth	Successful
1971	Sep 2	Luna 18	Return Lunar Soil to Earth	Crashed on moon, 11 Sep 1971
1972	Feb 14	Luna 20	Return Lunar Soil to Earth	Successful
1974	Oct 28	Luna 23	Return Lunar Soil to Earth	Failed to leave moon to return sample
1975	Oct 16	(None)	Return Lunar Soil to Earth	Blok D failed, did not reach earth orbit
1976	Aug 9	Luna 24	Return Lunar Soil to Earth	Successful

Source: Compiled by the author from numerous Russian sources.

Appendix 16: Lunar Landing (N-1/L-3) Programme Summary

Year	Launch Date	Soviet Designation	Major Objectives	Results
1969	Feb 21	(None)	First Test of N-1 Booster	Failed 69 seconds after launch
	Jul 3	(None)	Second Test of N-1 Booster	Fell back on launch pad and exploded
1970	Nov 24	Kosmos 379	Lunar Lander Test in Earth Orbit	Apparently successful
	Dec 2	Kosmos 382	Lunar Orbiter Test in Earth Orbit	Apparently successful
1971	Feb 26	Kosmos 398	Lunar Lander Test in Earth Orbit	Apparently successful
	Jun 27	(None)	Third Test of N-1 Booster	Control malfunction. Began to break up 48 seconds after launch
	Aug 12	Kosmos 434	Lunar Lander Test in Earth Orbit	Apparently successful
1972	Nov 23	(None)	Fourth Test of N-1 Booster	Explosion in first stage 107 seconds after launch

N-1 development programme cancelled in 1974 before the fifth planned test.

Source: Compiled by the author from numerous Russian sources.

Select Sources and Bibliography: Soviet Manned Space Policy
Soviet/Russian

Russian Archives

As noted in Chapter 1 the most important archives on Soviet missile and space policy are closed. There are numerous other space archives in the former Soviet Union. Each of the design bureaux have their own archives, but circumstantial evidence suggests that such organisational holdings are incomplete. Military and economic archives may also hold important data. The following is a list of the more politically significant archives investigated by the author in July 1994, with explanatory notes.

Archive of the President of the Russian Federation, Korpus 1, pod'ezd 7, Kremlin, Moscow, 103073. Phone (095) 224-06-82. Said to contain all Politburo records, records of sessions of the Politburo and Secretariat (1965-86), personal papers of many political leaders, and TsK and SM decrees. This is the crucial archive for gaining a full picture of the Soviet space programme, but it is open only to certain Russian historians.

Pioneers of Space Technology Section, Institute for the History of Natural Sciences and Technology, Russian Academy of Sciences. Staropanskii per., 1/5, Moscow, 103012. Phone: (095) 921-08-68. This small office, headed by Dr. Viktor Nikolaevich Sokolskii, is the essential starting point for research on space history in Moscow. The office contains a remarkable collection of sources and also serves as a hub for space historians (many of them retired participants in the Soviet space programme). Finding aids for the Academy of Sciences archives are maintained at the office. The Academy of Sciences archives include the personal papers of numerous Soviet scientists, however the finding aids show no holdings on space and missile scientists/designers dated after 1953.

Russian Scientific-Research Centre for Space Documentaion, Ul. Profsoiuznaia, 82, Moscow, 1176393. Phone: (095) 335-00-95. Their brochure claims that they are the repository of all "technical documentation" on the space programme and that they are "opened completely for research." However, when I asked to see specific documents (e.g.: draft projects (EPs)) the atmosphere turned remarkably cold. The staff was willing to discuss the sale of photographs (most of which had already appeared in the Soviet press), but categorically refused my requests for access to finding aids or documents of any kind.

State Archive of the Russian Federation, Bolshaia Pirogovskaia, 17, Moscow, 119817. Phone: (095) 245-81-52. Deputy Director A. I. Barkovits was very helpful, however there were no space programme documents in the open finding aids. The head of the "Spetsotdel" informed me that all missile and space documents remain classified.

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