The Voskhod 2 mission revisited

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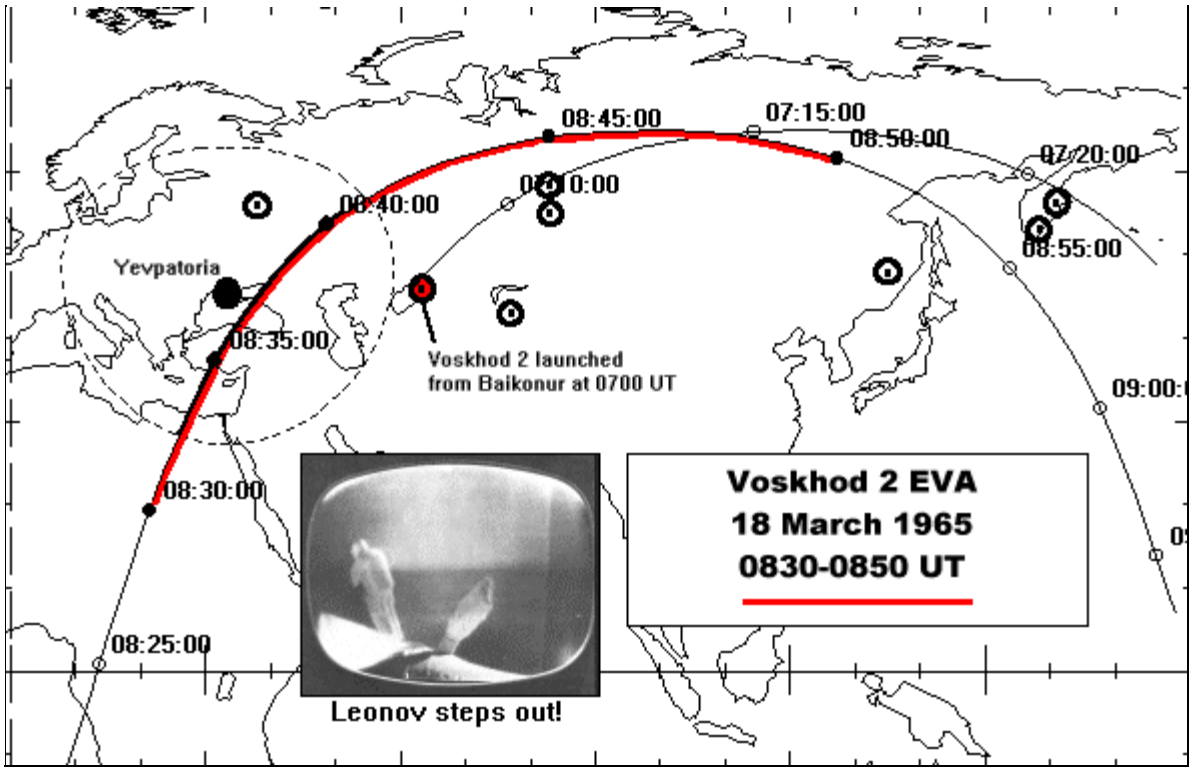
17 March 1965 - Rumours in Moscow

The **Kosmos-57 spacecraft** was launched on 22 February 1965 to test the airlock. It was destroyed due to a procedural error by ground stations, but the data gathered on the functioning of the airlock was sufficient to clear the way for a manned launch in the period 15-20 March. This success created the first wave of rumours on 24 February about an upcoming manned space launch **(6)**. Kosmos-59, a Zenit reconnaissance satellite, was launched on 7 March verifying that the airlock attachment ring would not affect re-entry and landing **(1)**. The State Commission met on 16 March to decide that the launch would take place on 18 March at 0700 UT. Obviously, the results of the State Commission meeting was leaked, perhaps deliberately, to media in Moscow, because on 17 March 1965 intense rumours were circulating in Moscow about the imminent launch of a manned spacecraft, called a "space bus" in the rumours **(5)**.

18 March 1965 - Launch and exit into space

Leonov's EVA

The Voskhod 2 spacecraft carrying Pavel Belyayev and Alexei Leonov was launched at 0700 UT from Baikonur and put into a 169-473 km orbit at 64.8 degree inclination and a period of 90.9 minutes. News agencies cabled the news to the world at 0754 UT. By that time Alexei Leonov had already made his exit into space and was back inside the spacecraft (see map below). The exit into space took place just before reaching the radio horizon of the ground station at Yevpatoria in the Crimea. It was this station that picked up the TV image of Leonov "swimming" in space that TV viewers all over the world could see later that day. Of course we now know about all the difficulties Leonov had to squeeze himself back into the inflatable airlock. It took Leonov 10-12 minutes to re-enter the airlock and he got back inside just in time for the spacecraft's pass over the ground stations in the Soviet Far East.



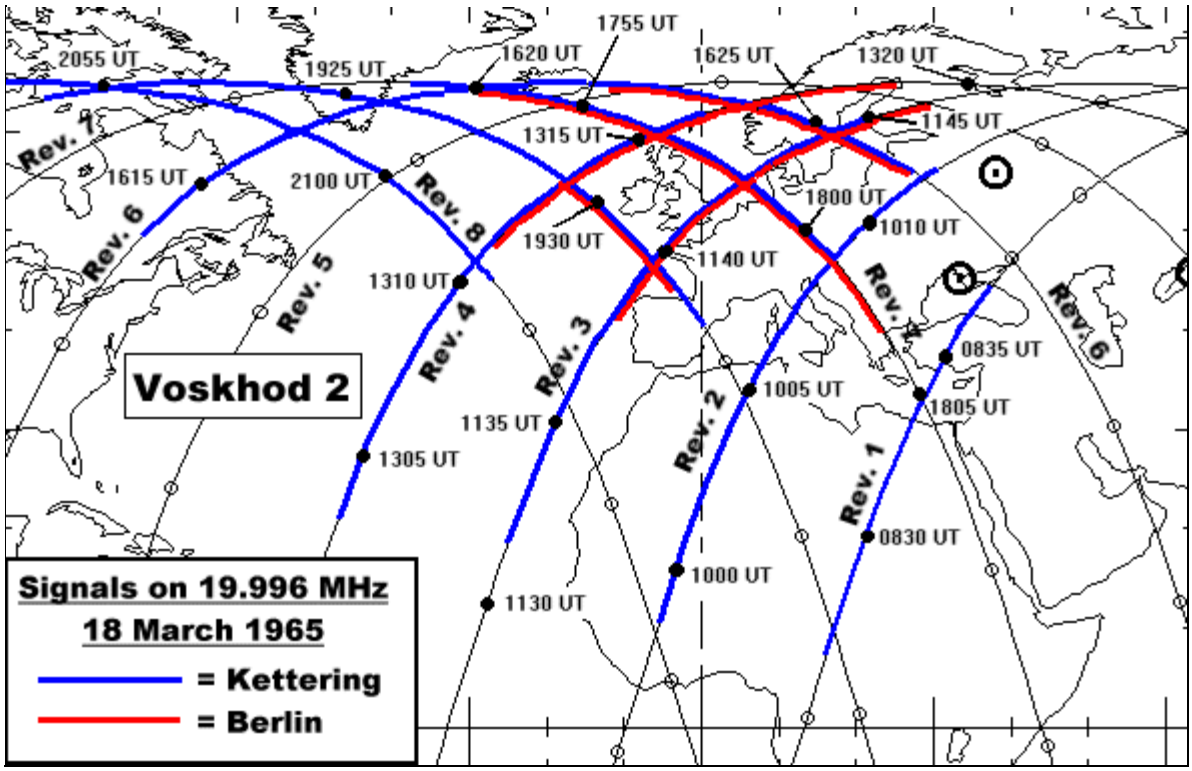
Short-wave Telemetry Monitoring in the West

Voskhod 2 was announced by TASS as transmitting voice on 143.625 MHz, 18.035 MHz and 17.365 MHz and having a "Signal" beacon transmitter on 19.996 MHz. Of course the 143.625 MHz FM transmissions were used for line-of-sight communications with ground stations while the short-wave frequencies were used to communicate with the spacecraft when it was far from Soviet territory. It also seems that 18.035 and 17.365 MHz was used in the simplex mode, i.e. the ground stations used the same frequencies for their calls to the crew in space.

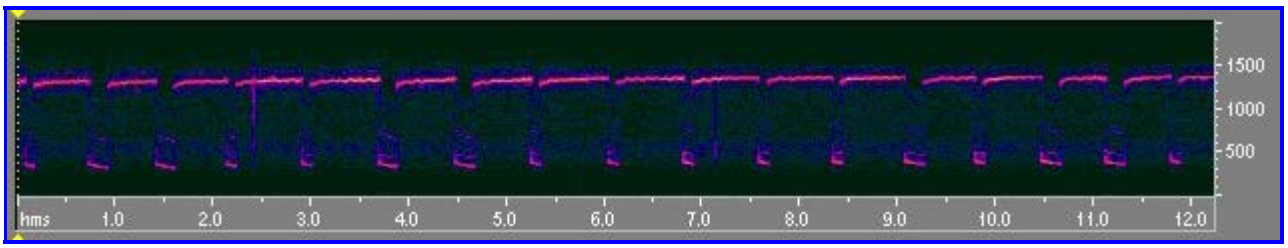
Plenty of short-wave signals were indeed picked up in Western Europe and the United States during 18 March 1965. The monitoring post at Kettering Grammar School run by Geoff Perry certainly received the "Signal" radio beacon on shortwaves throughout the day and the same was true at the **"Junge Welt" (Young World) listening post** of the East German Astronautical Society (Deutsche Astronautische Gesellschaft) in Berlin headed by Karl-Heinz Neumann. The receptions of these stations are summarized in the table on the right and in the map below.

Rev nr	Kettering	East Berlin
1	0827-0839	-
2	0958-1012	-
3	1132-1145	1138-1146
4	1303-1316	1311-1319
5	-	-
6	1613-1627	1622-1627
7	1753-1801	1755-1803
8	1919-1934	1929-1933
9	2051-2103	-

The the "Signal" telemetry was transmitted on 19.996 MHz and consisted of a frequency-shift-keyed carrier where the pulses at the lower frequency represented heart rate (pulse frequency) and respiration (pulse duration) in the manner explained in **"Biomedical telemetry".**



The short piece of signal shown in the graph below was recorded in Kettering on rev 7 and one can see that the heart rate is approximately 86 beats per minute and the respiration rate is 20 per minute (Click **here** to see the respiration signal plotted). Click on the **graph below** to listen to the signal. (mp3 file)



Biomedical telemetry on 19.996 MHz as picked up by the Kettering Grammar School on rev 7 just before 1800 UT on 18 March 1965. (Ordinate = frequency in Hz, Abscissa = Time in seconds)

Short-wave Voice Monitoring in the West

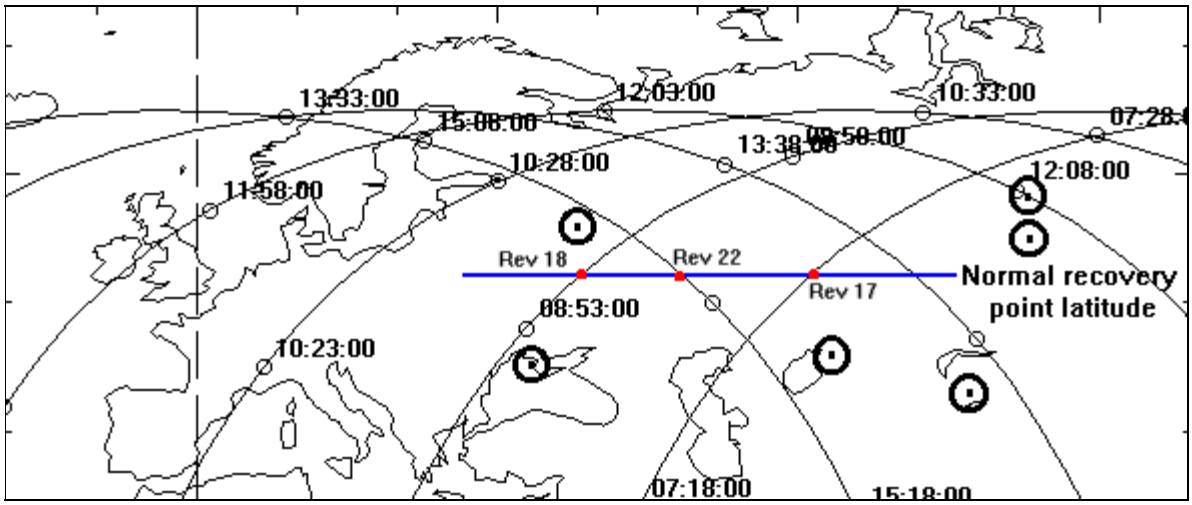
Voice from Voskhod 2 was picked up in Sweden by the telecommunication administration's spectrum monitoring station in Enkoping at 1316-1318 UT on 17.365 MHz. The SOHIO Research Center in Cleveland, Ohio picked up voice from Voskhod 2 on 18.035 MHz on rev 6 and 7.

19 March 1965 - going an extra orbit and landing in the taiga

As the spacecraft came within range of the Soviet VHF ground stations in the far East on revolution 13 the crew reported the pressure in the air bottles had dropped from 75 to 25 atmospheres **(1)**. This was a potential threat to the mission but the pressure stabilized at 25 atmosphere as the crew could report on the following revolution.

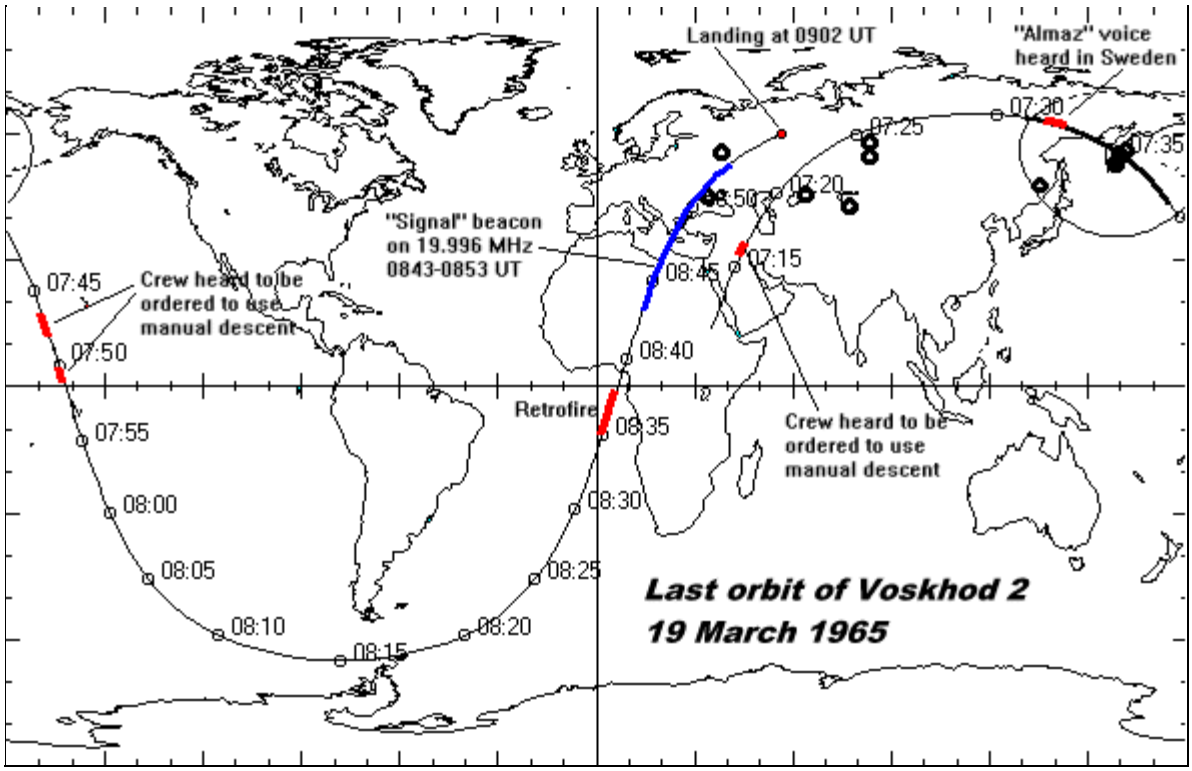
Failure of the automatic descent system

During the 16 th revolution the automatic landing system was programmed from the ground by sending commands, probably from tracking stations in the Far East. Command "number 6" did not go through reportedly due to a fault in the solar orientation system **(3)**. It is unclear when the decision to go to the manual descent system was taken because orders to the crew to use the manual descent system kept being sent as the craft came in over Africa at the beginning of the 17 revolution, quite some time after the intended retrofire point.



Orders for manual descent issued on shortwaves

Belyayev was ordered to use manual procedures for orienting the ship and firing its retrorockets on either the 18th or 22st revolution. The intended landing points were probably all located at about 52 degrees North where most recoveries of Soviet recoverable satellites took place (See map above). At 0716 UT on 19 March 1965 Western space listeners could **hear the ground station Vjezna 3 (Spring 3) tell the crew (Almaz) to use manual descent**. ***"Almaz, Almaz, this is Vjezna-3, this is Vjezna-3. The circuit for the automatic descent orientation system has been (shall be?) switched off (deactivated) and the system to control the descent manually is (shall be?) switched on."*** The **crew responded** on the same voice frequency (17.365 MHz) and was asked to also respond by Morse code.It is interesting that the ground informs the crew at this point, when retrofire should have occurred. Probably the commands to program the retrofire were supposed to have been uplinked from the stations in Kamchatka, but that the commands did not go through. As can be seen from the map below the short-wave call went out only about five minutes before the craft would come into VHF range of ground stations in the Soviet Union. The message was indeed urgent! At 0732 UT voice from Voskhod 2 was again heard by the Swedish monitoring station at Enkoping and at 0747 UT and again at 0750 UT the German monitoring station at Bochum could hear the ground order manual descent but no reply from the crew could be heard! The spacecraft was over the Pacific (See map below).



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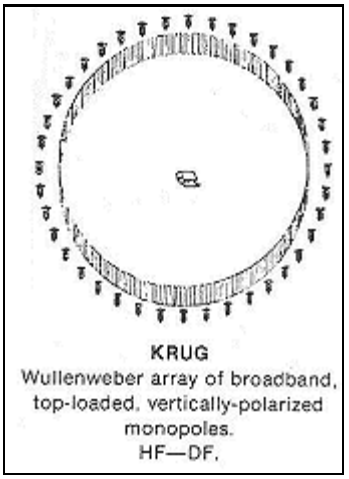
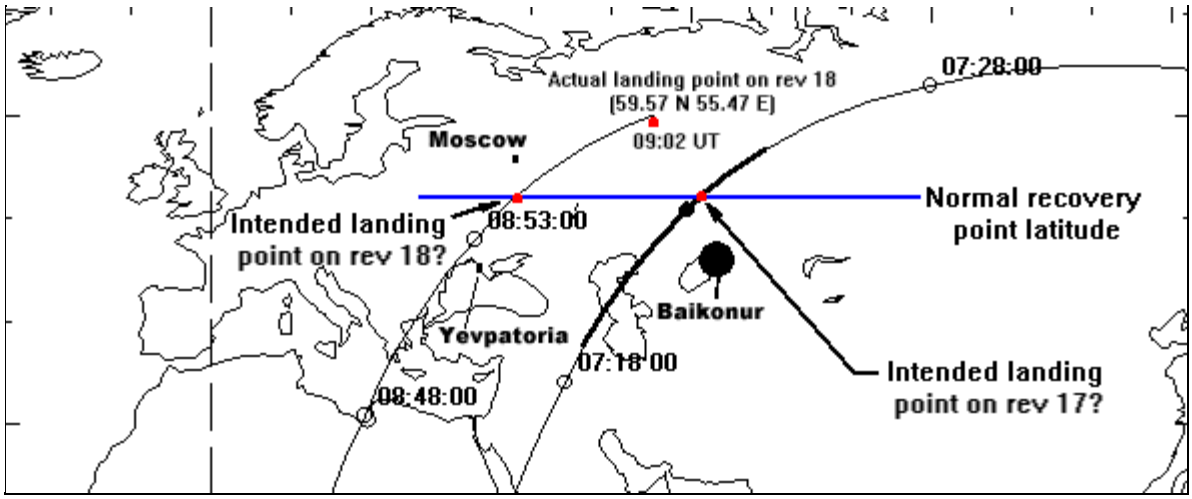
At 0840 UT the beacon on 19.996 MHz was again picked up by space listeners in Western Europe and they faded out at 0853 UT. The crew used the Vzor to orient the craft but this kept them out of their seats which delayed retrofire by 46 seconds, which (coupled with an incorrect attitude...?) led to a 2000 km overshoot in the landing point location. According to some sources the service module failed to separate completely until connecting wires burned through during re-entry. The craft finally landed in Ural mountains at 59:34 N 55:28 E at 09:02 UT.

General Kamanin described the landing phase in his diary (7):

*"We received the first report of the spacecraft's descent rather quickly, from Odessa and Saransk [both directly under the path of the spacecraft. Saransk located at 54 deg 12 min North, 45 deg 10 min East. S.G], but we had no reliable information as to the condition of the crew for four long hours. True the '**Krugi**' radio stations had located the craft, and Alma-Ata has received a telegrapgh code several times via HF channel: 'VN...VN...VN' (this was a signal from the crew, meaning 'everything normal' [vsyo normalno]). It was nice to have the radio fix and the 'VN' signals, but we wanted more convincing data as to the condition of the cosmonauts. Finally, to the joy of everyone, came the long-awaited report of the commander of one of the search helicopters: 'On the forest road between the villages of Sorokovaya and Shchuchino, about 30 kilometers southwest of the town of Berezniki, I see the red parachute and the two cosmonauts. there is deep snow all around.....'...."*


KRUG
Wullenweber array of broadband, top-loaded, vertically-polarized monopoles.
HF—DF.

"**KRUG**" is the code name for a Soviet direction finding circular antenna array ("Krug" means "Circle" in Russian). See picture on the right from page 263 of the 1976-77 issue of the International Countermeasures Handbook. The frequency of the beacon that the Krug antennas picked up was probably 10.003 MHz (8). The beacon system was called "Peleng" or P-37(8).



The landing announced and the return of the crew to civilization

Throughout midday Radio Moscow was broadcasting music and interrupted the music several times as if to make an announcement. At first, just after the the expected landing time, the music was quite jolly, but gradually the music became more sombre (including Tjajkovsky's first piano concerto) as if preparing listeners for bad news **(4)**. Finally, at 1344 UT, news of the landing was **broadcast by the famous announcer Yuri Levitan** on Radio Moscow.

The spacecraft had landed in deep snow wedged between two fir trees **(2)**. The first recovery helicopter spotted them around 1300 UT (just 45 minutes before the announcement by Levitan) and could confirm that they were alive and well **(1)**. The helicopter could not land because of the thick forest. Around 1700 UT a helicopter was able to land about 5 km from the capsule, but a search party could not reach the crew. Warm clothes and supplies were air dropped to the crew. The crew spent the night in the woods, surrounded by wolves (some say). The next morning at 0430 UT a team of rescuers were dropped 1.5 km from the capsule but it took another 4 hours for them to reach the Voskhod 2 crew. It was considered too risky to lift the crew to a hovering helicopter, so the crew had to spend another night in the taiga, in the company fo some 20 rescuers. A helicopter landing zone was cleared at 1.7 km from the capsule and another at 5 km distance. By 0500 UT the following morning (21 March) the cosmonauts skied to nearest landing zone, were airlifted to the second spot and from there flown in a big helicopter to the Perm airport where they were reached by a phone message from Leonid Brezhnev. They then boarded a plane and reached Baikonur at 1430 more than 48 hours after the landing!

References

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2. **Harford, James**, "Korolev - how one man masterminded the Soviet drive to beat America to the Moon", John Wiley & Sons, 1997, pp 185-186
3. **Romanov, A.** "Spacecraft Designer, the story of Sergei Korolev", Novosti Publishing House, Moscow, 1976, p.97.
4. **Perry, Geoff,** Personal communication, 16 January 1999.
5. **Stockholms-Tidningen** (Swedish daily newspaper published in the morning), Thursday 18 March 1965, under the headline "Space Bus ready for launch"
6. **Svenska Dagbladet** (Swedish daily newspaper published in the morning), Thursday 25 February, under the headline "Space Rumours"
7. **Sovetskaya Rossiya**, "Pages from a Diary. He soared freely above the earth: On the 25 th Anniversary of the Flight of Pilot-Cosmonauts P.I. Belyayev and A. A. Leonov in the Voskhod-2 and the First Spacewalk", 17 March 1990, p. 6
8. **N.P. Kamanin**: Diary Entry for 9 March 1961. Translated by C.M. van den Berg.

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