

Transcripts give new perspective to Vostok-6 mission

The first woman in Earth orbit

Part 2

by Asif A. Siddiqi

Valentina Tereshkova's condition seemed to deteriorate into her third day in orbit. Perhaps the most disturbing aspect of her performance was her fumbled attempt to orient the spacecraft at the beginning of her third day in orbit, an exercise she was originally scheduled to perform early in the mission on the second orbit. She tried to perform attitude control twice (apparently on the 38th orbit) and openly admitted that she was not able to orient along the pitch axis. Not surprisingly, this made controllers on the ground anxious since, if for some reason she had to manually control attitude during the descent, then a failure on her part could seriously jeopardise her return. In part two of this article, we join Tereshkova at 1737 hours on her 37th orbit, as she acknowledges a message from Gagarin instructing her on how to carry out the attitude control experiment on the following orbit.

Chayka [Tereshkova]: [Repeating Gagarin's instructions:] On the 38th orbit carry out manual orientation for landing. Continue work with photometer. If [I] don't get orientation, then turn the ship to roll. I understood you. Switch off orientation after the turning ship passes over our territory. I [need to] turn on the UKV [VHF]-regime during passage into our territory.

Less than two hours later, at 1908 hours on her 38th orbit, Tereshkova reported directly to Korolev.

Chayka [Tereshkova]: Am not getting the photometer to work. I've attempted several times. Chayka oriented the ship with the photometer on an airplane... [Rest garbled] 120 atmospheres, so that I have another possibility to fully orient the ship for landing. Temperature 10 - quite well. I'm not turning on the ventilator, because [it's] rather cold, and it's warm, fine without the ventilator.



Tereshkova and Andriyan Nikolayev with their daughter Alyona.

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There's a pause in the audio at this point.

Chayka [Tereshkova]: Orientation already speeding up... [garbled]. Don't worry, I'll do everything. Don't worry about me. Another pause.

Chayka [Tereshkova, speaking to Zarya-6]: Communicate to 20th [Korolev] that I'm starting to orient for landing [mode]. Let there be no worry, don't worry.

Another pause.

Chayka [Tereshkova]: At the 20th parallel, I carried out the calibration of [the] Globus and [garbled]... [Pause] At six hours 26 minutes you gave me data for the correction of Globus [instrument], the number of correction is 524, longitude [or length] 273, start up time 7 ... [garbled]. On the 47th orbit calibrate Globus.

According to Chertok, Tereshkova's failure to carry out her attitude control experiment "didn't bother" the ground controllers that much "but it really annoyed Korolev" [13]. In the transcripts, after a pause, we hear Tereshkova speak at 2038 hours on her 39th orbit, addressing Korolev directly, who had been concerned after a long period when

she wasn't responding to calls from the ground.

Chayka [Tereshkova]: 20th [Korolev], I fell asleep ... [but am] already woken up.

Kamanin noted in his diaries that despite her failure to carry out the attitude control experiment, Tereshkova tried to reassure the ground: "Don't worry, I'll do everything in the [next] morning," ie, near the end of her third day in space [14].

According to Kamanin, the plan was to have ground controllers (specifically cosmonauts Gagarin, Titov and Nikolayev, as well as OKB-1 department chief Boris Raushenbakh, responsible for the Vostok attitude control system) pass on a precise set of instructions to Tereshkova in case she needed to carry out manual orientation for re-entry. These instructions were to be communicated on her 45th orbit.

Around this time, Tereshkova hinted at her condition.

Chayka [Tereshkova, to Zarya-6]: I'm drinking a lot. [I feel] nauseous from the sweets, so the sweets aren't satisfactory. Don't be concerned about my health - I feel fully well. Completely well. I want [some] potatoes, onions and black bread...

According to Kamanin, on the night of June 18-19, despite Tereshkova's condition, she

Part 1 of this article appeared in the January 2009 issue of Spaceflight.



News Conference on successful completion of the Vostok-5 and Vostok-6 missions. Pictured (from left) are: Pavel Popovich, Yuri Gagarin, Valentina Tereshkova, Mstislav Keldysh (president of the USSR Academy of Sciences), Valery Bykovsky, Adrian Nikolayav, and Major General Nikolay Kamanin. RIA Novosti

(and Bykovskiy) slept peacefully and were well-rested for the next day [16]. And, as the following confirms, on her 47th orbit (on the morning of June 19), Tereshkova finally performed some attitude control exercises with the Vostok-6 spacecraft for about 20 to 25 minutes.

Chayka [Tereshkova]: From seven hours 40 minutes until eight hours five minutes [I] oriented the ship... Everything's in order. Did the rotation on roll.

There's a pause.

Chayka [Tereshkova]: Roger, take a tablet, check the catapult toggle switch, the locks of the harness... What did you say in connection to the ship?

Chayka [Tereshkova] [to Vesna-2]: [Please] communicate to Zarya-1 that on the 47th orbit, I oriented the ship in the landing [mode] for a full 20 minutes along all three axes. Turned the ship. Did everything as one should.

Kamanin confirms as such in his diaries, noting that Tereshkova carried out the attitude control in the 'landing' mode, although his notes suggest that she kept the vehicle in correct mode for about 15 minutes rather than the 20-25 reported by Tereshkova. According to Kamanin, Tereshkova was 'delighted' to report on the results of her piloting. Korolev and other members of the State Commission were also satisfied (at least at the time) with her performance and believed that if the automatic system failed, Tereshkova would be able to manually orient the vehicle for re-entry [17].

Re-entry

Transcripts from the landing phase are illuminating. Kamanin notes that at 0939 hours 40 seconds on June 19, the command was issued (from the ground) to begin the

automatic cycle for landing Vostok-6. After a few seconds, ground control learned that the command passed successfully.

Kamanin writes in his diary that Tereshkova did not convey any information on several mission events. These included the switching on of the solar orientation system; the functioning of the Vostok-6 retro-rocket engine; and the separation of the two modules of the spaceship, the re-entry module and the instrument section. Ground control learned significantly later about the success of all these events, and Kamanin laments that everybody on the ground desperately wanted to hear confirmations from Tereshkova herself, but apparently she remained silent.

The following indicates that Tereshkova's reports to the ground during this critical phase were via telegraph key, ie, she did not report on direct voice communications to the ground about any of her actions. As a result, ground control had to hear about her re-entry from other indirect sources.

Chayka [Tereshkova] [to Vesna-2]: At nine hours 42 minutes Spusk-I [ie, re-entry instruction no. 1] was turned on [18]. Burn aperture on KRU. Index passed. Ready for descent. Loose equipment fastened.

Chayka [Tereshkova]: nine hours 47 minutes. This is Chayka. Locks checked. Catapult toggle switch 'On'. At nine hours 51 minutes Spusk-II was turned on. The first command passed.

Chayka [Tereshkova]: 39 minutes. Re-entry. Vesna-4, over. The ship is turning, turning quite fast, turning, starting to burn. In [my] field of vision I see the burning ship. Such reddish light, reddish. The ship is turning and

burning. Like a pendulum it's turning and burning, burning. It's swinging, swinging, burning in [my] field of vision. It's burning vigorously. It's burning vigorously. Swinging around the axes, swinging around the axes. It's shaking, it's shaking. Crackling.

The transcript tapes reveal that through these last comments, Tereshkova's voice was unusually restrained, sounding very fatigued, and not all excited. A few minutes after her main parachute opened, the Vostok-6 re-entry module was located via a beacon, and coordinates of the landing point were precisely identified.

Both Vostok-5 and Vostok-6 evidently landed two degrees north of the computed point, an error that some claimed was due to imprecision in issuing the backup command for re-entry, a suggestion that Kamanin dismissed. Instead, he suggested that the off-course landing was due to failures and errors in the work of the communications and search services.

Ground control had no word on the health of the cosmonauts for several hours after landing. Tereshkova called with word of her safety via ground communications systems who reported on Tereshkova's safe return. The commander of an aviation division which flew over the landing site and saw Bykovskiy did the same for the Vostok-5 pilot.

Tereshkova landed at 1120 hours Moscow Time on June 19 about 620km northeast of Karaganda in Kazakhstan after a two day 22 hour 50 minute flight. Her descent was not trouble-free. After she safely ejected from her capsule at 6.5km altitude, while she was parachuting down, in violation of the training procedures, she looked up to the side of the parachute



These are a series of stills from the documentary Multi-day Joint Spaceflight showing Tereshkova from suit-up all the way to the launch of her 8K72K rocket carrying the Vostok-6 spacecraft.

canopy at the upper line of the pressure suit's helmet, when a piece of metal hit her straight on the nose. State Commission Chairman Georgiy Tyulin later remembered that for the following two days, Tereshkova had to powder her nose a "a little more than usual" to hide the injury [19].

Both cosmonauts spent the night of June 19 near their landing sites. Bykovskiy was in Kustanay while Tereshkova was in Karaganda. On the morning of June 20, both flew separately to Kuybushev to debrief members of the State Commission who flew in from Moscow. Film footage from her plane trip to Kuybushev clearly shows the injury on her nose.

At Kuybushev, Bykovskiy and Tereshkova formally reported on the completion of their assignments, first to State Commission chairman Tyulin, and then to Korolev (who she gave a bouquet of flowers). Hundreds of people gathered around her and there was an emotional meeting with Bykovskiy; both cosmonauts walked around as a flock of cameramen swarmed around them. At 1300 hours, there was an official meeting of the State Commission presided by Tyulin at which Bykovskiy and Tereshkova gave formal reports (which were recorded) on their experiences.

Postflight analysis

During Bykovskiy's lengthy report, he admitted that, despite his attempts, he did not see Vostok-6 with the naked eye. Tereshkova's report, as included in an edited version in Kamanin's diaries is reproduced below.

Tereshkova's report

The launch of Vostok-6 was excellent. Communications were good, and I heard all the commands. The g-loads were light, and less than five. I saw the Earth with the Vzor and lateral illuminator [porthole]. With the right illuminator [porthole] I saw the third stage [of the launch vehicle]. During transition to weightlessness there were no unpleasant sensations. I worked according to the [flight] programme.

Communications with Yastreb were established [while] in the shadow of the Earth. I saw a star about three times brighter than [the star] Vega, which I took for Vostok-5. During switch-on of the orientation [system], I heard a crack similar to the blow of an empty can.

The first [time I] wasn't able to do the orientation. I was warned that on the 38th orbit 20th [Korolev] would talk to me about the manual orientation. On the 45th orbit

[sic] for 20 minutes I manually oriented the spaceship. I think that there was no failure in the orientation system. Working with the equipment was difficult: I could not stretch to [reach] Globus and other instruments...

I took movie films of cities, clouds and the Moon... To shoot and record what you took was very difficult. I did not carry out the biological experiments - I wasn't able to reach the objects. The dosimeter remained at zero. The sanitary napkins had been moistened poorly and were very small. Need to have something to clean teeth. I carried out observations with light filters. On the horizon there is a luminous belt. Over South America I observed storms. At night time, the cities were easily identified. The lunar illumination of the Earth and clouds were very beautiful. It was difficult to identify the constellations. I did not see the solar corona.

On the first day, I didn't feel the [SK-2] spacesuit. On the second day, there was a nagging pain in my right shin, and on the third day this was already worrisome. The helmet obstructed [me], and pressed against my shoulder. The earpiece pressed against my left ear. The sensors mounted around the waist belt did not bother me. [However] the sensor on my head gave me itches and headaches. During the whole time, the air conditioning system worked well. During launch, the temperature in the ship's cabin was 30 degrees, and at the end of the first flight day 23 degrees, and at the start of the second day it lowered down to 12 degrees and then maintained this level.

Radio communications worked well. During switch-on of the UKV [VHF] there were disturbances. The best communications were in the second communications zone. At the equator, there were many disturbances. Vesna-1 and Vesna-4 were heard well in the extreme south. On the first day of the flight, communications with Yastreb were excellent and in the first part of the second day were satisfactory, and then [I] had no communications with him, but I heard transmissions to him from Earth. I was very happy to realise that I was flying alongside Yastreb.

Weightlessness did not arouse unpleasant sensations. My arms floated and you want to out them away under the harness system. During physical exercises, I wanted to lean against the seat. The bread was very dry, and so I didn't eat it, I wanted some black bread, potatoes and onions.

The cold water was pleasant. The juice and the cutlet were pleasing. I threw up once but this was due to the food, and not due to

a vestibular disorder. Making use of the ASU [human waste disposal system] was easier in space than on Earth. The psychological tests were no different [than it was] on Earth. With the photometer I did two measurements. Both pencils broke, and there was nothing to write with.

[The lack of pencils - absurdly so - apparently prevented Tereshkova from writing much in her onboard journal].

I carried out all the preparations for re-entry and reported on my preparations. Already, [when I was] in the Earth's shadow, the solar orientation was activated. The ignition of the TDU was heard only barely.

I transmitted the passage of the command by telegraph. [I flew] with my back to the Earth. There was a jolt during the separation of the compartments. The ship was stable at first, but then rocked back-and-forth. The g-loads were no more than eight. When the ship's coating burned, flakes flew by the illuminator. After operation... the [ejection] seat separated from the ship very smoothly and quickly. After the parachute opened, [I could] see the ship below [me]. The ship, the [ejection] seat and I landed in each other's vicinity.

It's necessary to control the parachute's cupola since I landed on my back. People came running and helped me. The ship was located 400m from me. After an hour, an airplane and two parachutists landed [near me]. After three hours I reported to N. S. Khrushchev by telephone on the satisfactory completion of the flight. [20]

Tereshkova's health

As regards to Tereshkova's state and performance during the mission, it is clear that opinion was divided. The most vociferous critic of her was Soviet Air Force physician Vladimir Yazdovskiy, one of the leading space biomedicine specialists in the Soviet Union. On the morning of June 25 at 0900 hours, academician Mstislav Keldysh (president of the Academy of Sciences), Georgiy Tyulin (chairman of the State Commission), and Kamanin arrived at Korolev's office to discuss the impending formal press conferences of Bykovskiy and Tereshkova planned for later that day [21].

The plan was for the two cosmonauts' presentations to be preceded by short statements from Keldysh, Yazdovskiy, and academician Anatoliy Blagonravov. Yazdovskiy's report included a paragraph on the "poor state of Tereshkova in space, on her great emotional suffering, fatigue and the sharp drop in her working ability".

All at the morning meeting rejected



Still from a documentary showing Tereshkova writing place and time of landing in the mission logbook. The woman on the right is often identified as a fellow woman cosmonaut but may also be the doctor Lyubova Maznichenko.
RIA Novosti

Yazdovskiy's plan to include this paragraph in the public briefing, and it was never included. Kamanin wrote in his diary that he reminded those in attendance that Tereshkova had the assignment for only a one day flight, and that the continuation of her flight to a second and third day was taken without her agreement. He noted that, "Tereshkova, without doubt, felt some fatigue, especially at the end of the first and second days of [her] flight... but she found in herself the strength to continue the flight and complete the maximum schedule". [22]

At the actual press conference, there was no hint of any troubles on the Vostok-6 mission. Speaking of communications, for example, Tereshkova noted that conversing with Bykovskiy over the shortwave channel was like talking in the same room. About her time in space, she added that "I endured the state of weightlessness well. I quickly got accustomed to it". [23]

Yazdovskiy's own presentation at the press conference provided no details of any possible problems faced by Tereshkova [24]. The official Soviet report on the Vostok-5 and Vostok-6 mission submitted by the Academy of Sciences to COSPAR was similarly non-committal about any problems although careful scrutiny of the text shows that while Bykovskiy is singled out for praise for his performance (including with medical experiments), Tereshkova isn't [25].

There continued to be concerns about Tereshkova's performance in the weeks after her mission. Kamanin notes that on July 2, Air Force doctors Aleksandr Babiychuk, Vladimir Yazdovskiy and several others met with Tereshkova to "clarify" how she was feeling during her spaceflight.

Tereshkova continued to claim that she

felt well throughout the flight, maintaining full working capacity without difficulties. She said that on the morning of her third day, she had small pirozhki (pies) with sprat and lemon which made her feel nauseous and eventually throw up. She didn't eat all that was planned for her during the mission but she claimed that she ate no less than 60 per cent of the standard level stipulated for three days.

Kamanin appeared to be on Tereshkova's side in this debate, noting that Yazdovskiy and other doctors "for some reason" believed that Tereshkova had experienced significant difficulties during her mission and was still not revealing everything to them. According to rules, she should have reported on her bout with nausea in orbit but she didn't report that event to the ground-the State Commission only knew about it after she landed.

What neither side could deny was that right after landing, contrary to specific instructions, she divvied up her remaining food rations to local residents. As a result, doctors were deprived of the possibility of objectively evaluating her food intake during the mission [26].

About this incident, Chertok has his own unique perspective. In his memoirs, he writes that: "I have kept a rare photograph. A correspondent had showed up at Tereshkova's landing site before the colonels and generals who were responsible for her safety. Tossing aside all medical instructions, she made short work of the local foodstuffs that had been conveniently laid out on a parachute. During her three days in space, Chayka had had no appetite." [27]

A Soviet-era journalist described the scene: "The cameramen filmed Tereshkova



A unique line-up of cosmonauts (from left): Yuri Gagarin, German Titov, Andriyan Nikolayev, Pavel Popovich, Valery Bykovsky, Valentina Nikolayeva-Tereshkova, Konstantin Feoktistov, Vladimir Komarov, Boris Yegorov, Pavel Belyaev and Alexei Leonov. RIA Novosti

drinking fresh milk from a bottle as she stood beside her spacecraft in the steppe. People from neighbouring kolkhozes [collective farms] surrounded the metallic sphere [of the descent module] and peered in through the hatch. They asked Valentina about her flight and offered her cheese, lepushki (flat cakes), kumiss (fermented mare's milk), and bread. From every direction, herdsmen on horsemen came galloping up to see the spaceship. [28]

Yazdovskiy also later commented on Tereshkova's post-landing behaviour: "In the area where Tereshkova landed, our [institute] employee-doctor, world record holder in parachuting Lyubova Maznichenko [also] landed. She objected to Valentina Tereshkova in connection with her violation of the established regime of the cosmonaut at the landing site.

"Tereshkova took all the onboard reserve of food products from the cosmonaut's rations and divvied them up to local inhabitants who were surrounding her. She wrote in the cosmonaut's onboard journal hurriedly at the landing site and not in flight [apparently finishing her notes on the ground because her pencils broke in orbit]. Some hygienic procedures were directed in the ship after landing. This action distorted the true picture of the landing on the ground. Scientists were prevented from the possibility of objectively evaluating Tereshkova's condition and the condition of the inside of her vehicle. [29]

In a statement of clarification about the food that she ate during her mission, Tereshkova noted to training personnel at the Cosmonaut Training Centre (TsPK) on July 16, exactly a month after her launch, that the bread was like "rubber" and the meat was very "tough" [30].

Curiously, the documentary film *Multiday Joint Spaceflight* puts a very different spin on the post-landing food incident. The footage shows Tereshkova soon after landing sitting next to the Vostok-6 descent module, speaking to a woman doctor from the recovery team and looking rather happy. The doctor examines her briefly while Tereshkova appears to be complaining about discomfort on her left shoulder.

As further members of the rescue team arrive, Tereshkova is seen picking out food products from her flight kit (in the form of toothpaste containers) and handing them out to local farm people who were gathered around the descent module. In other words, Tereshkova's distribution of food from her capsule appears to have been done in the

presence of several rescue team workers, including doctors and military officials who clearly could have forbidden her to do so.

Kamanin admits that he could not forgive her for her apparent post-landing violation of instructions as well as her obvious reluctance to reveal details of her experience to the doctors. He believed, with some justification, that Tereshkova's furtive nature on this issue may have had to do with the cosmonauts' general guarded relations with doctors in general. As with their American counterparts, Soviet cosmonauts had a very strained relationship with doctors, since physicians had the power to take them off flight status for the most minor of infractions.

It is clear that if Tereshkova initially weakly defended her performance in the light of accusations from Yazdovskiy, she became more firm later on. Kamanin notes that "after a number of careless and unintelligible reports from Prof Yazdovskiy... claiming that Tereshkova felt poorly during the flight (very tired and lost her working ability), Valya decided to defend herself". She gave herself a very high and positive evaluation for her work in orbit, albeit much higher than was reflected in the flight record [31].

The controversy over Tereshkova's flight continued and eventually involved chief designer Korolev himself, who wanted to personally clarify the ambiguities about her performance. Korolev evidently had been very worried by Yazdovskiy's statement on Tereshkova's poor condition on the 32nd and 42nd orbits, on her vomiting, poor appetite, and "weak cardiac activity".

Yuri Gagarin (left), Valentina Nikolayeva-Tereshkova, Andriyan Nikolayev, Valery Bykovsky and Pavel Popovich at the Kremlin wall in Red Square on 7 November 1963. RIA Novosti



According to Kamanin, Korolev continually spoke about his wishes to 'open the doors' to space for ordinary simple people [32]. At some point, a few weeks after the mission (probably on July 13), Tereshkova visited Korolev's OKB-1 design bureau to debrief the attitude control system designers about the system's performance as well as to convey her impressions about her own experience using the system.

Chertok reported that Tereshkova arrived at the Moscow suburb of Kaliningrad (now Korolev), escorted by Korolev's personal assistant and was received by about a dozen senior engineers at OKB-1, including Chertok and Raushenbakh, the two men responsible for Vostok's attitude control system. Chertok remembers that before she had a chance to candidly reveal her experience, Korolev walked in and interrupted the proceedings and asked to privately talk to Tereshkova for ten minutes. When the private conversation, which lasted about half-an-hour, ended, Korolev first exited the room, and "after glancing at the assembled crowd, he flashed a devilish smile and quickly left".

Tereshkova emerged several minutes later and could not conceal her teary eyes and state of dejection. The engineers half-heartedly tried to begin their own interrogations of her, but when they realised that Tereshkova was about to burst into tears they quickly let her go. Chertok added that "none of us had any idea why [Korolev] needed to reduce Tereshkova to tears" [33].

Since he has been the most senior and persistent critic of Tereshkova for decades, Yazdovskiy's position requires some clarification. Unlike many others, he has been unwilling to moderate his comments and his authority in the space medicine field in the Soviet Union (and later Russia) has ensured that his opinions have significantly influenced the discussion of Tereshkova's performance.

In his own memoirs, published in 1996, he provides a devastating critique of the first woman cosmonaut. He notes that after the selection of the first women candidate cosmonauts, the Institute of Aviation and Space Medicine (where Yazdovskiy was a senior official) ranked the five women in the following order based on medical analysis and theoretical preparations - Ponomareva, Solov'yeva, Kuznetsova, Sergeychik (née Yerkina) and Tereshkova.

In other words, Tereshkova ranked last. Yazdovskiy claims that with Khrushchev's "intervention" and the "silent agreement" of Korolev, Keldysh and Kamanin, "contrary to



The Frunze health resort in Sochi. Pictured (front from left): Valentina Gagarin (Yuri's wife), Yuri Gagarin, Valentina Tereshkova and Andrian Nikolayev.

RIA Novosti the conclusions" of the medical commission, Tereshkova was chosen to fly first, apparently because of her social background. Yazdovskiy adds that "this was, of course, not the best variant of the selection" [34].

As far as Tereshkova's actual performance on the mission, Yazdovskiy contrasts it with Bykovskiy's performance: "During orbital flight cosmonaut Bykovskiy completed the whole volume of flight assignments and scientific experiments."

Yazdovskiy's comments from 1996 on Tereshkova's mission are worth reproducing in full: "Tereshkova's orbital flight was planned [to last] three days. Based on telemetry data and television monitoring, Tereshkova carried out her flight for the most part satisfactorily. [She carried out] communications with ground stations sluggishly. She acutely limited her movements. [She] sat almost immobile. She had a clearly noted health changes of a vegetative nature. She did not complete part of her assignment and work in her ship, which forced the technical flight leader Korolev to assign Raushenbakh to put together additional instructions for Tereshkova on work connected with the ship's systems.

"The deterioration of Tereshkova's condition and reduction of her working ability were connected with the adverse effects of weightlessness. When I proposed for her to take a meprobromat tablet (a sedative) from the pharmacy, Tereshkova responded in the negative and replied: 'Doctor, don't worry, I'll carry out the assignment fully.' Korolev, seeing the television image of Tereshkova, sitting immobile and not fully carrying out her

assignments, demanded from the State Commission [that it] terminate the flight and begin re-entry of the Vostok-6 ship to Earth.

"The chairman of the State Commission L. V. Smirnov [sic] replied that the question of terminating the flight on medical evidence is the prerogative of the chief of the medical programme [35]. I considered the pros and cons [of the situation] and took a decision to ask the State Commission to continue the flight.

"Thus, I took on myself the full responsibility for continuing Tereshkova's spaceflight to three days. To Sergey Pavlovich's retort [criticising] the quality of selection and preparation of cosmonauts I responded that we were now reaping the fruits of the interference of Korolev, Keldysh and Kamanin in a matter in which they were not competent [ie, in the selection of Tereshkova as the prime candidate].

"The flight continued and Tereshkova's condition and working ability did not improve. After sleep, [her] emotional stress reduced and Tereshkova's working capacity increased only marginally. Her pulse varied between 58 and 84 per minute. There were significant fluctuations in the frequency of heart rates in short time intervals, [and] breathing frequency ranged from 16 to 22 per minute."

As a comparison, Yazdovskiy noted Bykovskiy's vital signs: "Cosmonaut Bykovskiy's pulse in flight varied between 46 and 80 per minute, and frequency of breathing [varied] between 12 and 22 per minute. The daily variation in frequency of heart contractions was similar to data recorded in extended ground experiments." [36]

The numerical data that Yazdovskiy provides actually shows not much variation with that of Bykovskiy. Possibly the most impartial evaluation of Tereshkova's flight performance was issued by the Institute of Aviation and Space Medicine and published in 2001 in a book on the history of the institute. In describing the Vostok-6 mission, the authors (all prominent Soviet space biomedicine specialists) provide a little detail on the special nature of Tereshkova's pre-mission training.

"In the process of preflight training, an examination of the level of Tereshkova's physical preparedness showed underdeveloped strength capability, physical working ability and motion coordination. Because of these [factors], an individual programme was developed for her which envisaged training for the development of the muscles of the upper shoulder zone, abdominal press and lower extremities, and also for increasing endurance to extended physical stresses and training the vestibular analyser. The accomplishment of this programme allowed Tereshkova to achieve a sufficiently high level of physical preparedness and training."

As far as her mission performance, the authors noted that: "Tereshkova subjectively evaluated her condition in flight as good. However, from a certain point of time, in the majority of the communications sessions her face appeared lost in concentration, her facial expressions were minimal, [and] head movement was noticeably limited.

"While listening to radio conversations, [her] slow speech and slurred words were noted, especially at the end of communications; [her] replies were monosyllabic, speech was somewhat monotonous. [Her] appetite during the flight was reduced, as testified by the low use of food stuff from the onboard [stores]. She herself mentioned [her] lack of appetite for sweet foods... and desire for savoury food."

The authors noted that Tereshkova's heart rate rose to a peak of 192 beats per minute during re-entry, peaking again right before catapulting at 172 beats per minute. By comparison, Bykovskiy's figures were 174 and 157 respectively. Yet, unlike many of her sharpest critics (including Yazdovskiy), the authors ended on an upbeat note.

"Despite the above-mentioned peculiarities, Tereshkova successfully fulfilled the flight assignment, [and] showed that extended spaceflight was possible not only for men but also for women." [37]

Over the years, Tereshkova herself has made hardly any direct comment on the



This unusual picture shows Valentina Tereshkova in a Voskhod EVA suit and probably dates from the 1965-66 period when several of the women cosmonauts trained for an EVA mission.

specific claims of her less than stellar performance. Yet, there are those who still believe that she was unfairly maligned.

In her own memoirs, fellow cosmonaut Valentina Ponomareva writes emphatically that: "[By the time of her postflight mission report] we already knew that Valya didn't feel that well during her flight, after all, from telemetry, we knew she was not able to fulfil all the items on her flight assignment.

"I think that she made a mistake by not saying so directly and earnestly. The press then announced victoriously - the job was done completely, the cosmonaut feels good, but some things filtered out, rumours began to emerge, [and as they always do, there] there were various fantasies..."

"I would argue that Tereshkova did all that was required of her. For those that flew first, it was [only] to know what would happen to humans [in space]. There was no more important task for the first six cosmonauts... All other research which was

carried out in flight did not have critical significance, although of course, they were also very important." [38]

Similarly, Tereshkova's backup Irina Solov'yeva remained generous to Tereshkova. Writing on the 35th anniversary of the Vostok-6 mission in 1998, she noted: "Due should be given to Valentina - even in uncomfortable conditions she continued her flight, continued to perform the necessary operations.

"Moreover, with vivaciousness, she sang songs, with a clear voice communicated with the commander of the Vostok-5 spaceship, Valeriy Bykovskiy. The results of her flight added to the storehouse of knowledge on the influence of weightlessness on the human organism. Valentina Tereshkova proved her right to the flight not only with its results but in all her future work. After the flight, she was drawn to help hundreds of people, especially women." [39]

Gender discrimination

The newly accessible mission transcripts (as well as the other primary source information) provide a fairly substantial account of Tereshkova's Vostok-6 mission. Clearly, the two main points of contention, each connected the other, related to her condition during the mission and her performance during the flight.

On the first issue, it's clear that Tereshkova felt reasonably well during the early portion of the mission but began to feel bad by the end of her second day and was generally unwell on her last day in orbit. She appears to have felt well after landing, and there is no evidence to suggest that she landed in terrible condition.

On the second issue, her performance appears to have been affected by her deteriorating condition. Yet, her inability to conduct the orientation experiments on the first day, remains unexplained. It is possible that nervousness affected her judgment. More plausibly, during the latter part of the mission, her second attempt to carry out the orientation exercise can be explained by her unwell condition.

Yet it is important to note that she managed to perform the experiment successfully just prior to re-entry, ie, in the end, she carried out the experiment. And, in fairness to her, it is clear that the pilot-control panel interface on the Vostok was poorly designed. Bykovskiy also complained of not being able to easily reach the controls on the main control panel.

Tereshkova's suit also appears to have been poorly designed, affording her very poor comfort. The designer of the suit, Factory No. 918 (now known as NPP



An official portrait of Tereshkova with many of her medals and honours. This picture is probably from the late 1970s. NASA

Zvezda) admitted in their 'official' history that, "in their debriefs after their long-term flights, both Bykovskiy and Tereshkova... noted that sitting in the same posture for several days caused discomfort and pain due to suit element and medical sensor pressure on the body" [40].

As I have noted elsewhere, negative reactions to Tereshkova's less-than-perfect performance were severely exacerbated by considerations about her gender [41].

In a highly patriarchal society, the standards by which women were judged (especially when they did activities typically associated with men) were far higher than for men. Cosmonaut German Titov, for example, had suffered from some form of space sickness during his Vostok-2 flight

and was unable to be fully alert during his flight, yet he was not made a pariah or penalised for such failings. And, despite many incidents of philandering after his flight, he remained eligible for future space missions until his resignation from the cosmonaut corps in 1970.

Besides gender discrimination, a second equally important factor was Tereshkova's inconsistency about honestly communicating to ground authorities, both during and after her mission. During the mission, she was not candid about her difficulties (for example, her vomiting and general feelings of sickness). After the mission, she was too candid about the shortcomings of the Vostok cabin and of her poorly designed spacesuit - many designers no doubt resented her blunt assessments. Her unusual openness about these problems contrasted sharply with the evaluations of her male colleagues who seemed less reticent to criticise the handiwork of the designers.

On some level, all of this is moot. Valentina Tereshkova was the first woman to venture into space. As such, whether she was indisposed through much of her mission, as some Russian doctors continue to claim, the importance of her singular achievement cannot be denied. She may not have been the best choice for a professional cosmonaut, but she was clearly competent, well-prepared, and a brave young woman when she set off on her historic journey almost 46 years ago.

Acknowledgement

The author wishes to thank Bart Hendrickx and Ralph Gibson, of RIA Novosti, for their kind assistance. Part 1 of this article appeared in *Spaceflight*, January 2009, p18.

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