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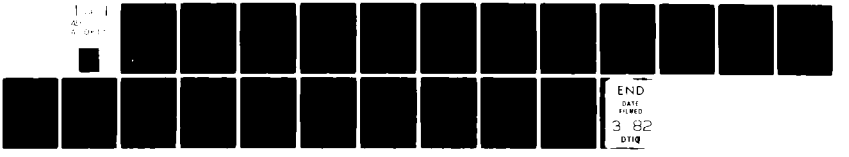

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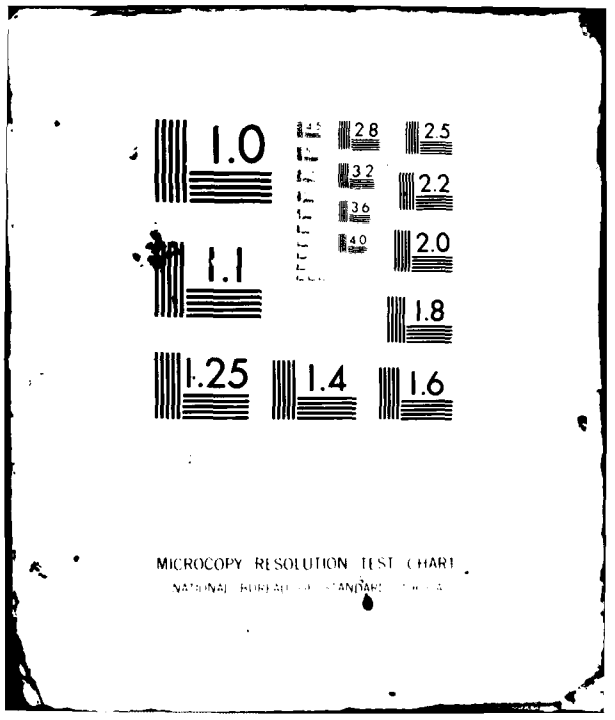
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FOREIGN TECHNOLOGY DIVISION

AERONAUTICAL KNOWLEDGE

(Selected Articles)

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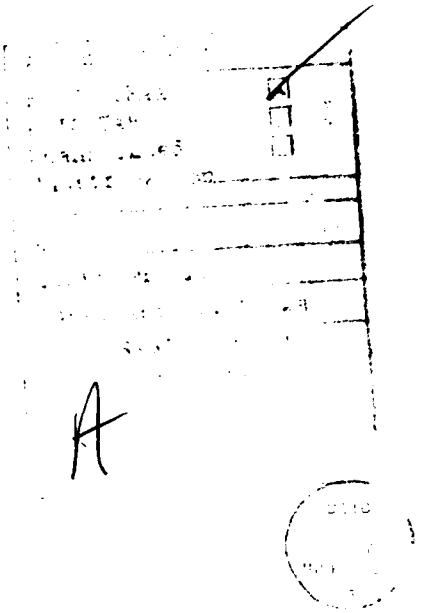

SATELLITE "CHINA 2"

Jiang Bin

March this year was the tenth anniversary of our country's launch of the first scientific, experimental satellite. As this was the second satellite put up by our country, it was known to the world as "China 2". The back cover of this week's issue shows a color photograph.

March 3 1971 our country launched the first scientific, experimental satellite. It weighed 221 kilos, had a perigee of 266 kilometers, an apogee of 1826 kilometers, revolved around the Earth once every 106 minutes and had an orbital plane inclined at 69.9 degrees to the Earth's equatorial plane. The satellite's motion was regular, it achieved the preset objectives and on June 11 1979 it came down over the northern part of America. Being in orbit for more than eight years, this satellite provided our country with scientific and experimental data for the development of long-life man-made satellites, and accumulated valuable experience.

"China 2" was a spherical polyhedron with a diameter of approximately one meter. The entire body of the satellite might be divided into two halves, the upper and lower being basically symmetrical. The waist section of the satellite was a 150 millimeter high cylinder. There were seventy-two trapezoidal planes, consisting of twenty-four of each of three specifications, distributed symmetrically around the two sides of the waist-band area of the satellite.

The top of the satellite was a small regular dodecagonal plane upon which was installed an ultra-short wave antenna. The base of the satellite was a separation cup almost two hundred millimeters in diameter by which it had been attached to the delivery vehicle.

Every ninety degrees around the cylindrical waist-band area were installed short wave antennas, four in all, together forming a cross shape. For ease of deployment, the three meter long antennas were divided into three sections of unequal thicknesses, telescoped together like a radio or television antenna. While on the delivery vehicle, they were in the retracted state with the rods hanging down, being deployed by spin and spring force once the satellite went into orbit.

Reliable Tracking

The satellite rotated at more than one hundred revolutions per minute which maintained a stable attitude as it orbited the Earth. To grasp the laws of satellite motion it was necessary to carry out tracking measurements of the satellite - that is - ground observation. Observation methods could be of two types - radio observation and optical observation. To ensure reliable ground tracking, "China 2" utilized three observation systems, each of which could independently determine the satellite's orbital motion from the ground.

The radio observation was achieved by means of radar transmission and reception of radio waves so that the satellite required corresponding equipment. "China 2" was equipped with a fifty millimeter wave length transponder and a one hundred millimeter wave length beacon, their relatively short antennas being distributed evenly around the waist-band area of the satellite, thus constituting the microwave tracking system. So that the ground radar could easily pull in the target, the beacon radiated a continuous one hundred millimeter radio wave. Once the radar had locked on to the satellite, a fifty millimeter radio wave was transmitted to the satellite which replied with a fifty millimeter radio wave. By means of transmitting and receiving such radio waves, ground radar was able to achieve precise measurement of the satellite's orbit.

The frequency of the radio wave employed for the ultra-short wave tracking system was between thirty and three hundred megahertz (for the operating wave length of ten meters to one meter). The two hundred and two megacycle beacon installed on "China 2" with its antenna mounted on the top of the satellite radiated a continuous radio wave which was received by ground radar which could then compute the satellite's orbital motion.

The optical tracking system required that the satellite have a definite degree of brightness. The external surfaces of "China 2" had undergone a polishing treatment and were therefore very shiny. In sunlight with a relatively dark sky behind, the satellite could be easily observed from the ground, the times of observation being early morning and dusk, and the orbital

motion of the satellite could then be computed from the observation data.

Space Probes

The 'space' referred to here is the region between the Earth and the Sun - known to astronomers as 'sun-earth space'. The subjects of space probes include the Earth's upper atmospheric density, the distribution of the Earth's magnetic field, the properties of solar radiation and cosmic radiation. Thus it may be seen that aspects of space probes range widely over time and physical space. Because of weight limitations, the only probe instrumentation that could be installed in "Caina 2" was a flux meter, a solar X-ray counter and a cosmic ray counter.

The Earth's magnetic field is roughly comparable to an evenly magnetised spherical magnetic field that has a basically fixed orientation possessing two magnetic poles located adjacent to the north and south poles of the Earth known respectively as the north and south magnetic poles. The area affected by the Earth's magnetic field is very great, and cosmic charged particles which either conform to and rotate around the lines of magnetic force by their movement form an inner and an outer radiation belt adjacent to the area in space overhead the Earth's equator. To grasp the laws which govern the distribution and change of the magnetic field permits analysis of many physical phenomena and may be used to measure the attitude of satellites and rockets. The flux meter was therefore utilized to probe the distribution and change of the magnetic field surrounding the Earth.

Large doses of X-rays entering the human body may cause changes to take place in the blood, and organs directly exposed may suffer necrosis. X-rays may also damage the structure of matter and may cause changes to take place in the properties of materials. The solar X-ray counter was utilised to probe the laws of X-rays radiated by the Sun to further astronomical research and to guide the manufacturing of satellites and manned space flight.

The cosmic ray counter was utilised to measure charged particles from all directions including both solar and galactic cosmic rays. Because the mutual interaction of these high energy particles and matter may bring about internal physical and chemical effects in matter, thus damaging the human body and materials, it is of prime importance to space activity to grasp the laws governing cosmic radiation.

Adequate Power Source

The instrumentation in "China 2" required both large and small quantities of electric power as well as electric power supply for both long and short durations. On the basis of this characteristic, two electrical power supply systems were installed on the satellite: one was silver-zinc storage batteries, the other was nickel-cadmium storage batteries charged by silicon solar cells. The former would drain rapidly supplying electrical power to the instruments with a short working period, while the latter would drain more slowly supplying electrical power to the instruments with a long working period.

The power of the silver-zinc storage batteries was limited and could be drained completely; the solar cells, being charged by solar energy, were inexhaustible, but when the satellite entered the zone of the Earth's shadow and they were not receiving sunlight, they could not supply electricity. To make up for this shortcoming, a set of nickel-cadmium batteries were installed in the satellite. When the satellite was in the zone of sunlight, a part of the electrical energy generated by the solar cells would be diverted to the nickel-cadmium batteries to be used once the satellite entered the zone of shadow. The combined energy supply of the silicon solar cells and the nickel-cadmium storage batteries could ensure continuous uninterrupted operation of the instruments on the satellite over a long period of time.

The 10 millimeter by 20 millimeter solar cells employed by "China 2" were serially linked into panels of sixty cells each, installed on the external surface of the satellite being the sheets of dark blue glass that can be seen. In all there were twenty-eight such solar panels evenly distributed on the external surface of the satellite such that, no matter from which direction the sun should be shining, the solar cells would be able to generate electrical power.

Temperature Control

Generally speaking, while the external surface temperature could reach more than one hundred degrees Celsius when the satellite was in the zone of sunlight, in the zone of shadow the external surface temperature could drop below one hundred degrees Celsius below zero. Despite this extreme temperature variation, the instrumentation in "China 2" operated normally. The external surface of "China 2" went through a surface polishing treatment which resulted in a very great reduction in range of temperature variation.

There remained a heat exchange problem within the satellite. If the

considerable amounts of heat generated by the nickel-cadmium storage batteries, the operation of the radio transmitter and other equipment were not immediately dispersed, the rise in overall temperature would disrupt operations. There were other instruments such as the circuitry of the solar angle gauge which generated insufficient heat to maintain their own temperature and needed supplementary heating. In order to satisfy these demands, the instrumentation in "China 2" used the following temperature measures; spray painting of the surfaces, a gold-plating treatment, multilayer thermal insulation cladding and a 'Venetian blind'.

The slats of the 'Venetian blind' were operated by a bimetal strip and could rotate automatically. When the internal temperature was high the slats would rotate open allowing the heat to be dispersed to the outside, and when the temperature was low the slats would close to reduce the dispersing of internal heat to the outside.

Short Wave Telemetry

Of the data that needed to be transmitted from "China 2" to the ground, not only the content of the various space probes but also the attitude of the satellite as measured by the solar angle gauge and the infrared horizon sensor, the temperature in each part of the satellite and the operational state of the many various instruments, some had to be monitored long-term while others had to be monitored every few weeks. For this reason the telemetry systems in "China 2" were of two types: one kind was the primary telemetry system operating short-term; another was the secondary telemetry system operating long-term. The carrier wave frequency of the former was 20.002 megacycles and the carrier wave frequency of the latter was 19.996 megacycles, the radio waves on these two similar frequencies being transmitted simultaneously through one short wave antenna. It was experimentally demonstrated that this transmission system was feasible and that the reliability of the carrier wave was very high.

(Translator's note: the last five characters are illegible.)

HAPPY TO BE HARD AT WORK ON IN-SPACE OVERHAULS

- Marking the maiden flight of the Space Shuttle

Written originally by Dennis Meredith. Translated by Li Hankang. Edited by Zhu Yilin.

> The first manned space flight of the Space Shuttle is scheduled to take place in March this year. By 1985, the reusable Space Shuttle will be making continuous manned space flights placing man-made satellites, space probes and space stations in orbit, as well as carrying out in-orbit repairs and refurbishing of space equipment. Dennis Meredith, a writer specialising in scientific subjects, interviewed Shuttle Astronaut Dick Truly, NASA training experts and engineers responsible for the Space Shuttle's most important payload - the Space Telescope. Dennis Meredith writes a fictional account of a routine Shuttle mission.

One day in 1985, Commander Mitty and his crew carry out a routine Shuttle flight.

Commander Mitty peered out of the Shuttle window at the bright blue sky dotted with puffy white clouds. Launch was only a few minutes away. Mitty was in an almost supine position in his seat. Through the left hand window of the cockpit he could see the massive service gantry from which they had entered the Shuttle by a catwalk withdrawn only one hour previously. To his right sat Captain Ryan running through the preflight checks. Through the cockpit window to the right of Ryan, Mitty could see the grass of the Kennedy Space Center waving in the gentle breeze.

From where he sat, Mitty could not see the solid-fuel boosters about to launch them into space, nor the 46 meter long external fuel tank. Shuttle resembled a large moth sitting on a tree trunk.

In the rear seats sat the other two members of the crew. Mission Specialist Wendy running last-minute checks on all the systems in Shuttle's cargo bay; Payload Specialist Chris adjusting the heartbeat monitor attached to his chest. He was the only one using a heartbeat monitor because he was the only non-astronaut in the four-member crew. The other three were astronauts with space experience having carried out five missions together.

As they sat in their none too roomy seats, the area above, in front, behind, to the right and to the left of Mitty and Ryan was crammed with dials, switches and softly glowing indicator lights. Sitting there, the astronauts were a little like modules plugged into a printed circuit board, appearing tightly efficient.

The Pilots' Stations

Between their knees, Mitty and Ryan each had a stubby black joystick. In space they would be used to control the maneuvering jets to change the orbital motion, and on reentry and landing they would move Shuttle's control surfaces. Above the instrument panel was a square black knob used to control the attitude jets that were used to adjust the flying attitude.

In front of the two men were also a row of adjustable indicators and a white on black floating ball. By observing the rotation of the ball, the pilots could establish the attitude of Shuttle. Between Mitty and Ryan were three greenish cathode ray tubes displaying computer data. The onboard electronic computers could carry out every task from controlling the huge engines to opening and closing the smallest microswitches.

To guard against computer error, five computers were in operation at the same time, providing decision data, but in the end it was Mitty and Ryan who made the final decisions, for they were the true masters of Shuttle.

Now it was still two minutes from liftoff. The Space Center launch control computer would take over the final precise checks of Shuttle prior to pushing the launch button.

"3...2...1...0", sounded the voice of the launch controller in the headsets of the astronauts. With a sky-shaking roar, Shuttle shuddered above 3200 tons of thrust. Liftoff!

Slowly Shuttle rose trailing five columns of fire, two of which were expelled from the solid-fuel boosters with the remaining three expelled from the main engines. Within the first few minutes, the engines would burn off the seven hundred tons of fuel in the external tank.

At first the crew felt no sensation of Shuttle's climb. Seven seconds after liftoff, Shuttle began to roll inverted, and now, from above, the crew could see the clouds and the earth below floating by, but with the ground appearing from the top section of the windshield - truly an amazing sight.

Gradually Mitty and his crew felt the G forces building up until they felt their bodies firmly pressed into their seats by 3 G.

Suddenly Shuttle lurched and the astronauts felt as if they were being thrown forward. This was due to the immediate loss of thrust as the fuel in the solid-fuel boosters tailed off. Then the boosters and Shuttle would part company with the former descending by parachute. Shuttle with the external tank then continued their climb accelerating ever more rapidly towards their scheduled orbit.

The Successful Launch

Now the forces built up to 3 G again until, six minutes after liftoff, Shuttle's main engines shut down. The sudden silence and total weightlessness gave the impression that something had gone wrong. As Mitty heard Chris give a low whistle, he smiled briefly then set about checking out the computers. A successful launch! The computers were preparing to jettison the empty external fuel tank and Mitty sanctioned this procedure. As the fuel tank separated from the top of the inverted Shuttle, Mitty pulled back on the joy-stick, starting the maneuvering jets heading Shuttle off to the side. With the burn complete, Mitty could watch through the window as the fuel tank moved far off Shuttle's course falling rapidly to earth to burn up harmlessly over the open sea.

As on previous flights, they had several objectives on this mission. One was relatively easy - to replace in orbit a communications satellite that had malfunctioned and had been previously retrieved for repair. Their more complex assignment was to overhaul the Space Telescope, a twelve ton piece of hardware that had been in earth orbit since 1983. For two years it had been giving mankind unprecedented clear images of celestial bodies. The astronomers had been ecstatic. But now a bug had developed in one of the communications circuits of the Space Telescope and repairs were needed. Spent batteries and instruments also needed to be changed.

As Mitty and his crew had carried out many missions over the years to do in-orbit satellite capture, overhaul and component changes, to service the Space Telescope on this occasion was, for them, just kids' stuff.

The Workday Begins

Once Shuttle was established in its scheduled orbit, the astronauts set to work on their first assignment - to place in orbit the communications satellite. The work was held up for a while when Chris was hit by space-sickness. People in space for the first time were often affected by space-sickness caused by the sudden disorientation of the inner ear in weightless conditions. Mitty reported the disorder to Houston Space Center and then gave medication to Chris who soon returned to his work station.

After carrying out an inspection of the satellite, Mission Specialist Wendy opened up the clamshell doors of the cargo bay. She carefully manipulated the remote control hand in the cargo bay. The fifteen meter long arm slowly reached out towards the satellite until the claw was fastened firmly onto the satellite. Peering through the rear window of the cockpit, Wendy used the remote control hand to pick up the satellite and place it outside the cargo bay. She ran through the checks to verify that all was normal and then opened the claw, retracted the hand, leaving the satellite in space once again. Then Shuttle's maneuvering jets were fired, leaving the satellite, to head for their next assignment.

But it was lunchtime. The astronauts heated up their canned food in an electric stove - really delicious. "Just like a picnic!" observed Mitty as he took a bite of space stew. After the meal, they got back to work.

The image of the Space Telescope was now appearing on the radarscopes. They piloted Shuttle in towards their objective. Once the Space Telescope was floating close to Shuttle, Mitty took up a position above the rear seats and observed through the open doors of the cargo bay as he eased Shuttle alongside the Space Telescope. Now, with all its antennas and solar panels retracted upon command from ground control, it looked just like a stack of cans.

Now that the remote control arm could easily reach the Space Telescope, Wendy took over the task of monitoring the operation with the TV camera mounted in the cargo bay as she manipulated the mechanical hand bit by bit out towards the Space Telescope until finally it locked onto the special turntable of the Space Telescope. Capturing and moving the twelve ton Space

Telescope was as difficult as picking up a telephone with a bent coathanger, so Wendy was concentrating hard. "Great!" exclaimed Wendy happily as the Space Telescope was gradually moved to its appointed place and lowered onto a special platform in the cargo bay.

Time to sleep. They would begin to overhaul the Space Telescope the next day. While the others prepared for a comfortable night's sleep floating in weightlessness, Chris was still running through preliminary checks on the Space Telescope. Finally everyone was asleep leaving Ryan on watch.

Eight hours later, Mitty who had taken second watch gently nudged awake Wendy and Chris. The two of them stretched and gave a yawn. They let Ryan sleep in for another two hours. Wendy started work preparing for her space walk. Satellite overhaul was usually carried out with remote control devices, with components being changed by automatic extraction and insertion tools. However the servicing of the Space Telescope was much more complicated.

Wendy put on her spacesuit and checked it out. Ryan who had now woken up and eaten breakfast was sitting at his work station. Wendy entered the airlock at the back of the cockpit and from there went out into open space in the cargo bay. Soon her colleagues could see her floating around the cargo bay trailing her safety line behind her.

"OK! Two minutes for play," said Mitty with a laugh. Astronauts outside the cockpit always asked for a couple of minutes to horse around and enjoy the incredible view in space. This time Wendy was no exception. The Earth looked like a softly colored blue and white large ball looming beneath her. As she floated around the cargo bay, Wendy rapidly carried out external checks on the Space Telescope.

Work began. She removed a panel from the Space Telescope and pulled out an instrument tray from which she took a box which she exchanged for another, and then removed another panel to replace batteries and other components. As she operated, she kept in continuous communication with Chris who was an expert on the internal structure of the Space Telescope.

All Systems Go

This job took several days. Wendy and Chris reviewed their work constantly. They could not get rid of a bug in the communications equipment. All they could do was report it to Houston Control Center. A long day went by and it was time to sleep again.

When the crew woke up they found that ground had already sent up a solution to the problem. Then Wendy floated out into the cargo bay and replaced a box that Chris had fixed by following instructions from the ground. The moment she put in the box, Houston sent up the good news that all systems were functioning normally. Back in the cockpit, Wendy manipulated the mechanical hand to pick up the Space Telescope and return it to space where, with its antennas and solar panels deployed it looked like a stack of cans with wings.

"Let's go home!" announced the Commander. Then they closed the cargo bay doors, left the Space Telescope and began the reentry of the atmosphere.

Mitty rolled Shuttle inverted and pointed the tail forward to slow down by firing the engines. Once the engines had done their work with a long hiss, Shuttle's speed fell off rapidly and they began their descent towards the atmosphere. Mitty then rolled Shuttle once again and, nose high, reentered the atmosphere.

One hundred and twenty kilometers high, as Shuttle slammed into the atmosphere at 29,000 kilometers an hour, the temperature climbed fast as it was subjected to the extreme heat. With the temperature in excess of 1,100 degrees Celsius and the exterior of Shuttle a sheet of fire, the crew lowered the protective visors on their helmets.

At an altitude of thirty kilometers, the coast of California leapt into view. This time Shuttle would be landing at Vandenberg Air Force Base. This was because the next flight would be a Defense Department mission flown by a military crew taking of from Vandenberg Air Force Base.

Ten kilometers high, the desolate wasteland of Vandenberg rose to meet them. Ryan took control of Shuttle. He was about to be promoted to Commander and needed the landing experience. He carefully piloted Shuttle into the landing pattern. As Shuttle had no air-breathing engines it had to rely on a glide approach to land. To date so far no one had missed a landing. So the conversation with ground concerned routine matters only.

Five kilometers from touchdown Shuttle picked up the microwave landing beacon. Ryan maintained the appropriate glideslope for landing. Although Shuttle was as big as a DC-9 it was as responsive as a jet fighter. In fact its landing speed was that of a fighter - more than three hundred and twenty kilometers an hour. Shuttle gave a jolt and the wheels raced along the baking hot desert runway throwing up a great billowing cloud of dust behind.

Ryan stood on the brake pedals and taxied towards the distant ground support vehicles. A mere half hour had elapsed between commencing reentry into the atmosphere and rolling to a stop, but for the astronauts it seemed like a long time.

The crew took one hour to check out all the instrumentation. After verifying that the cooling systems were circulating normally in Shuttle still emitting heat, they left Shuttle by a side door, climbed down a small portable ladder and took their seats in the waiting bus. The bus carried the successful returning crew members towards a distant hangar.

Illustrated by Wei Guobo

(Translated and edited from 'Science Digest' January 1980)

A GLIMPSE BEHIND THE SCENES OF THE SOVIET SPACE PROGRAM

Song Jiaqi, Du Jifu and Zhu Xianzhang

For a long time Soviet activity in the fields of carrier rockets and space technology has been interwoven closely with military planning and for that reason has been kept top secret. Soviet officials seldom reveal the historical circumstances of this category of technological development. This is particularly true on the subject of serious mishaps involving Soviet rockets, satellites and spacecraft when they say not one word. This article which is based on reports on the subject published in the West such as a series in the West German weekly magazine "Der Spiegel" entitled 'The Secret History of the Soviet Space Program' draws aside one corner of the curtain of secrecy to allow our readers to catch a glimpse. As the complete article is comparatively long, the first half was published in last week's issue, with the conclusion in this issue.

In a Bid to be First they Tied up a Bundle. In Their Race for Space a Puppy Died.

The strong repercussions in the West caused by the launching of the first man-made satellite exceeded the most optimistic expectations of the Soviet leaders. For the Soviets to be first in space on this occasion was an event that went against American forecasts. It gave the American government and people a violent shock and pessimism shrouded America. Since they were economically and technically second to none, America was not resigned to remaining second to the Soviet Union and spared no human, material or financial resources in their determination to enter into a space race with the Soviet Union on a long term basis. In October 1958 the National Aeronautics and Space

Administration was set up to coordinate all American space activity. The race was on and America very quickly surpassed the Soviet Union in terms of numbers of satellites. At the end of 1957 the Soviet Union successfully launched two satellites, launching only one satellite weighing three thousand pounds during the whole of 1958; America meanwhile launched five satellites in 1958. Krylov had long since realised that when America started launching satellites the scope of their potential would far exceed that of the Soviet Union as America already had rockets with sufficient thrust and was making plans for manned space flight at a time when the Soviet Union had no such plans.

In 1959 Krylov decided to set up a 'crash program' to put a man in earth orbit. He linked together five four-unit rocket engines to form one huge delivery vehicle, that is to say, the first stage of the rocket would be the equivalent of twenty engine units. Of these five units, only one was installed within the rocket casing with the other four installed around the periphery of the rocket each having its own engine cone. Thus the outside diameter of the central rocket would be unchanged. This new type of rocket generating five hundred tons of thrust would be able to place in earth orbit a payload of more than five tons.

The next subject for discussion was that of the manned spacecraft itself. The crucial question was how to bring the spacecraft safely back to Earth. Krylov learned from published American reports that the American 'Mercury' capsule would use parachutes for splashdown and recovery at sea. At first, Krylov planned to adopt this method too. Khrushchev however vetoed this proposal. He demanded that a Soviet spacecraft should come down on the national soil of the Soviet Union and would not permit the capsule to be recovered at sea for reasons that needed no explanation. If the landing zone were to be the open sea, Western experts and the press would be swarming all over, looking at everything, and Soviet secrets would be revealed to the world. If the Soviet spacecraft were to come down on Soviet soil, Krylov had no alternative but to adopt the method of having the cosmonauts eject from the spacecraft prior to landing, using parachutes for landing and recovery.

In May 1960 a rocket placed a space capsule in circular earth orbit. Due to a failure of the deceleration devices, the capsule could not leave orbit and became a satellite rotating in space.

Then, America released a press report: manned space flights would begin in Spring 1961. Consequently the Moscow authorities gave instructions for every phase of the manned space flight program to be speeded up, with work on all unrelated experimentation to be halted without exception. Then Krylov sent

down to his subordinates a directive that only two more experimental flights carrying dogs were to be allowed before carrying out a manned space flight.

Things did not go right. November 1 1960 the Soviet Union launched a spacecraft carrying two puppies which was a write-off after the deceleration devices developed a malfunction and the ejection descent was a failure.

The Triumphal Return of Gagarin. The Farcical Press Conference.

In 1960 the Soviet Union selected a group of cosmonauts from the Air Force and gave them specialised training. Krylov handpicked the most outstanding of them - Major Yuri Gagarin - to be the first Soviet cosmonaut.

At nine in the morning April 12 1961, Moscow Radio broadcast the news: the Soviet Union had launched the spacecraft 'Vostok' piloted by Major Yuri Gagarin. A little later they broadcast a further immensely satisfied report: the cosmonaut had returned to earth safely. Although Gagarin's flight lasted only one hour and forty-eight minutes completing only one orbit of the Earth, he became Mankind's first honored envoy to Space, to the amazement of everyone.

At a press conference held April 15 in the Academy of Sciences Building on Kropotkin Street in Moscow Major Gagarin met the Press receiving enthusiastic applause. While the press conference was chaired by the President of the Soviet Academy of Sciences, Nesemyonov, notable by their absence were the so-called theoretician of spaceflight, Kayodeshev, and Designer-in-chief, Krylov. Behind Gagarin and Nesemyonov sat a most imposing character - Mikhail Korushenkin, Chief Inspector of Space Affairs, whose responsibility was to offer advise to Gagarin and the Chairman of the press conference. He proceeded to instruct them precisely how to respond to each of the questions asked by the correspondents.

Korushenkin was under orders not to allow specific details of how Gagarin had left the spacecraft and landed independently to be revealed at the conference. There was one correspondent there who came straight to the point and asked Gagarin: "So, how did you land after all?" Prompted by Korushenkin, Gagarin vaguely replied: "When it's a matter of the structure of spacecraft, there can be many ways of landing...." When the correspondents heard this, they looked at each other in blank dismay and did not know what to say next. This farcical press conference became a standing joke amongst the correspondents.

In any case Krylov was now exceedingly content having won yet another battle with the Americans. The American 'Mercury' manned spaceflight program

started in October 1958, and May 5 1961 'Mercury 3' achieved a manned sub-orbital flight - Krylov was twenty-three days ahead of the Americans. Every country in the world recognised that America had lost the race this time.

A Designer has a Brilliant Idea and Offers Himself. The 'Voskhod' Three Brave Danger.

In late 1963, when news reached Moscow that America was planning to use one spacecraft to place two men in Space, Khrushchev immediately had Krylov prepare a report on the existing state of the Soviet space program. At that time, Krylov had complete information about the NASA program. In his research office he set up a special unit to review American news reports, preparing a comprehensive daily report on the American space program.

In line with the Russian proverb to prepare your sleigh in summer, Krylov had previously foreseen building a three-man spacecraft, but had shelved the idea because the Soviet Union was unable at that time to construct rockets with sufficient thrust. And then Khrushchev sent down a directive, "By next year, in this revolutionary epoch, it will be necessary to send three men into Space together."

Krylov returned to his research office and immediately called a meeting of all the designers and engineers of rockets and spacecraft at which he announced: "We have a job to do. By November 7 1964 at the latest we will put a three-man spacecraft in orbit."

Krylov concluded by saying that if anyone should have a idea of how to do this, no matter how wildly ambitious, he would be prepared to listen, day or night.

The next day he gave instructions for a crash program to be carried out modifying the original one-man 'Vostok' space capsule to squeeze in three seats and to reduce the weight of the spacecraft wherever possible. There was uproar. Someone protested loudly: "That's crazy, totally impossible." Finally everyone agreed to give it a try. Even though they racked their brains as to how to stuff three men into a one-man spacecraft, removing a lot of scientific instrumentation and even reducing to the absolute barest minimum the life support systems that maintained vital activity in the capsule, at the end of the day they were unable to fit three men into the capsule. Just when they were at their wits' end, the head of the landing equipment design section, Feoktistov, came up with a solution; if they let the three cosmonauts squeeze into the 'Vostok' capsule without wearing their spacesuits, this would save some space. It was a

risk, but it was the only solution. Krylov asked: "Anyway, who would be prepared to go on a space flight without a spacesuit?" "I, for one!" said Feoktistov, and that's how an unfit designer suddenly became a cosmonaut. The designers found a way to modify the seating plan, arranging the seating in the form of triangle with the front one so close to the rear seats that in effect one cosmonaut was sitting on the laps of the other two. After feverish preparation, the difficulties were finally all resolved.

An unprecedented event took place at the formal departure ceremony on October 12 1964 when Krylov stepped forward to embrace Cosmonaut Komarov, Flight Engineer Feoktistov and Dr. Yegorov who were wearing light clothing only. Then they climbed up to spacecraft 'Voskhod 1' way up on top of the thirty-eight meter high rocket.

The three cosmonauts squeezed into the capsule and closed the top window from inside. After liftoff the rocket placed the spacecraft in orbit and twenty -four hours later they landed in the southern Urals. Although this flight was not such a great achievement, the Soviet press boasted of the cosmonauts' not wearing spacesuits as if Soviet spacecraft were so reliable that it was not even necessary to use spacesuits.

On the very day that 'Voskhod 1' landed, Khrushchev was summoned back to Moscow from his dacha and that buffoon who capered on the political stage was thrown out.

A Tragic End to the Space Walk. Komarov Dies in a Parachute Accident.

When the Kremlin authorities had finished their farce of changing horses, Krylov raised the suggestion that a cosmonaut should leave the spacecraft and conduct a walk in space. In fact this 'Pioneering Work' was intended to get ahead of the Americans once again and to present a gift to the new leadership. The plan was quickly approved and Krylov's machine set to work. There were fewer problems with 'Voskhod 2' than there had been with 'Voskhod 1' and although this time only two cosmonauts were to enter the capsule, there was no way they could dispense with their bulky spacesuits. Leonov who was to make the first space walk outside the capsule was in peak condition, superbly athletic and a champion sky-diver as well. After training, he could get into the capsule with his eyes closed in one minute. March 18 1965 when 'Voskhod 2' set out on its journey, Moscow broadcast the news to the entire world that the spacecraft was in orbit. At first they kept silent about the objective of the flight, and it was only after Leonov had left the capsule that a special news item was broadcast.

Leonov made his exit from the spacecraft without a hitch and promptly received the ground communication. But, when he began to obey orders to return, eight dramatic minutes went by and he was still struggling outside the capsule. The people in the ground control center could hear his anxious voice: "I can't make it; I'll try again, it's no good, I still can't get in...." Finally he gasped out "Ula", and then a string of curses. What had happened was that out in space Leonov's spacesuit had inflated like a balloon, an effect long-since foreseen by Western researchers that had been overlooked by the Soviets.

'Voskhod 2' was the last manned space flight to take place during Krylov's lifetime. Fifteen months after his death, in April 1967, 'Soyuz' appeared on the scene and a new manned space flight began. Because Soviet electronics technology was backward, there were doubts about the reliability of the space-craft, so that when 'Soyuz' was launched it carried only one cosmonaut even though it had been designed for three, in order to lessen the danger as much as possible, and the cosmonaut selected was Komarov who was well-trained and had already made one space flight before. Unfortunately this flight ended in disaster, the spacecraft crashlanded and when the parachutes malfunctioned, Komarov hit the ground to become the 'sacrificial offering' of this flight.

An Unknown Name is Revealed Posthumously. A Nonentity Becomes Famous After his Death

To the end of his days, Krylov deeply regretted that his real name was not known to the outside world. To enforce secrecy, the Soviet authorities gave strict orders that no newspaper or magazine was to publish the names of any space research scientist. Every report that appeared in public had to go through strict KGB censorship. To add to the confusion of world public opinion, Academician Shedov who actually had nothing to do with rockets was made the leading personality of space research.

At the first international conference held following the first man-made satellite, Shedov who was recognised as the chief rocket designer was surrounded by people asking him all sorts of questions about space, and so he followed orders, neither denying nor directly confirming anything. Western reports called Shedov the father of the first satellite. When Krylov heard the news, he was indignant and flew into a rage. Although he wanted to publicly resign, in the end he could not go against government decisions and accepted his position as an 'unsung hero' after all. January 1966 Krylov finally achieved his long-awaited worldwide fame when his name and photograph appeared in the press. It was not to offer him birthday congratulations however, but to announce his

death at the age of fifty-nine. The Soviet government brought out his biography and his memoirs, a film was made and all the media published his outstanding achievements.

Krylov's funeral was an exceptionally solemn affair, the names of the highest-ranking leaders appeared at the head of the obituary notice, and his ashes were scattered in Red Square outside the Kremlin. After Krylov's death, the curtain of secrecy hiding Soviet space activity was drawn back again a little. In his memory, a space tracking vessel was named 'Krylov'.

The End