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Spaceflight

The International Magazine of Space and Astr

SOVIETS in SPACE

Mir's Double Anniversary

- Space Walks
- Latest Missions
- Readers Letters

Vol. 31 No. 2

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SOVIETS in SPACE

Mir's Double Anniversary

February 1989

- **The launch of the Mir Space Station into orbit on February 20, 1986.**
- **The start of continuous manned operations on February 5, 1987.**

To commemorate Mir's Double Anniversary, the February 1989 issue of *Spaceflight* includes special features on the Soviet Space Programme under the theme title of 'Soviets in Space'.

***Spaceflight* has long been recognised as a leading Space Publication within the Soviet Union, where a Soviet edition of the magazine has been distributed for many years.**

Front Cover: (Main Picture) The Soviet Union's Mir space station, seen from an approaching Soyuz capsule.
(Top Insert) Cosmonaut Yuri Romanenko prepares his space suit before making an EVA in 1977. A major feature on space walks from the Salyut space stations begins on p.45.
(Lower Insert) Cosmonauts Yuri Romanenko and Alexander Laveikin wave to the cameras before boarding Soyuz TM-2 to begin the continuous manning of the Mir space station.

SOVIETS in SPACE

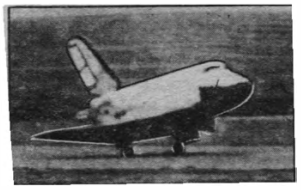
The Coming of Glasnost

The political change which has swept through the Soviet Union is beginning to show its presence in that nation's space programme. *Spaceflight* has long been recognised as a source of information on Soviet space activities. It welcomes the arrival of Glasnost and the opportunity of providing readers with even greater detailed coverage.

Recent events have illustrated the new openness:

- The crew and launch time of Soyuz T-15 in March 1986 was announced in advance. This practice has been continued for all Soviet manned missions.
- The Soviet Union has offered its space facilities for commercial use.
- Other nations were invited to participate in the Soviet Union's planetary exploration programme. For example the Phobos probe and the Mars 94 project. There have been numerous invitations from Soviet space officials for a joint US/Soviet manned mission to Mars.
- Failures in the Soviet space programme are no longer concealed and are openly discussed in the Soviet press. The failure of a Proton rocket in early 1988 was reported, whereas previously news of Soviet launch failures only came from Western space analysts. The world watched in September 1988 as two cosmonauts seemed marooned in orbit, the traditional news blackouts were replaced by full reports.
- In mid-1988 the Soviet press agency, Tass, began to announce the launch vehicle of Soviet satellites, including military launches.
- Western journalists have been allowed access to the Baikonur Cosmodrome. Tim Furniss, Fellow of the British Interplanetary Society, was at Baikonur for the launch of the joint Soviet/French mission in November 1988 (see 'Correspondence').
- The Soviets' plans for the Mir space station were revealed at a press conference prior to the joint Soviet/French mission. During the first quarter of 1989 a module as large as the original station will be docked to Mir. The module will carry the Soviet Union's Manned Manoeuvering Units (MMU). Cosmonauts Aleksandr Viktorenko and Aleksandr Serebov will test the MMUs when they take over from the present Mir crew in April. Journalists at the Baikonur Cosmodrome were shown one of the new style space suits with its MMU attached, they were permitted to take photographs.

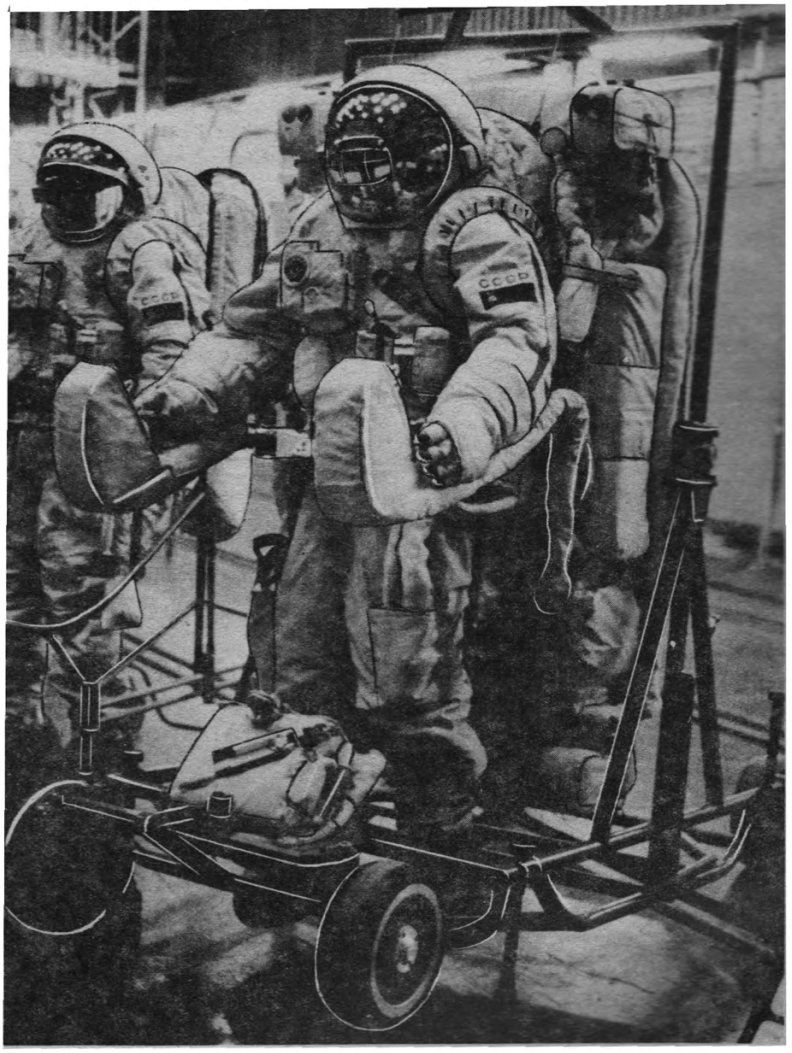
'Soviets in Space' continues on p.45. *Peter R. Bond* writes about 'Shuttle Glasnost' on p. 50.



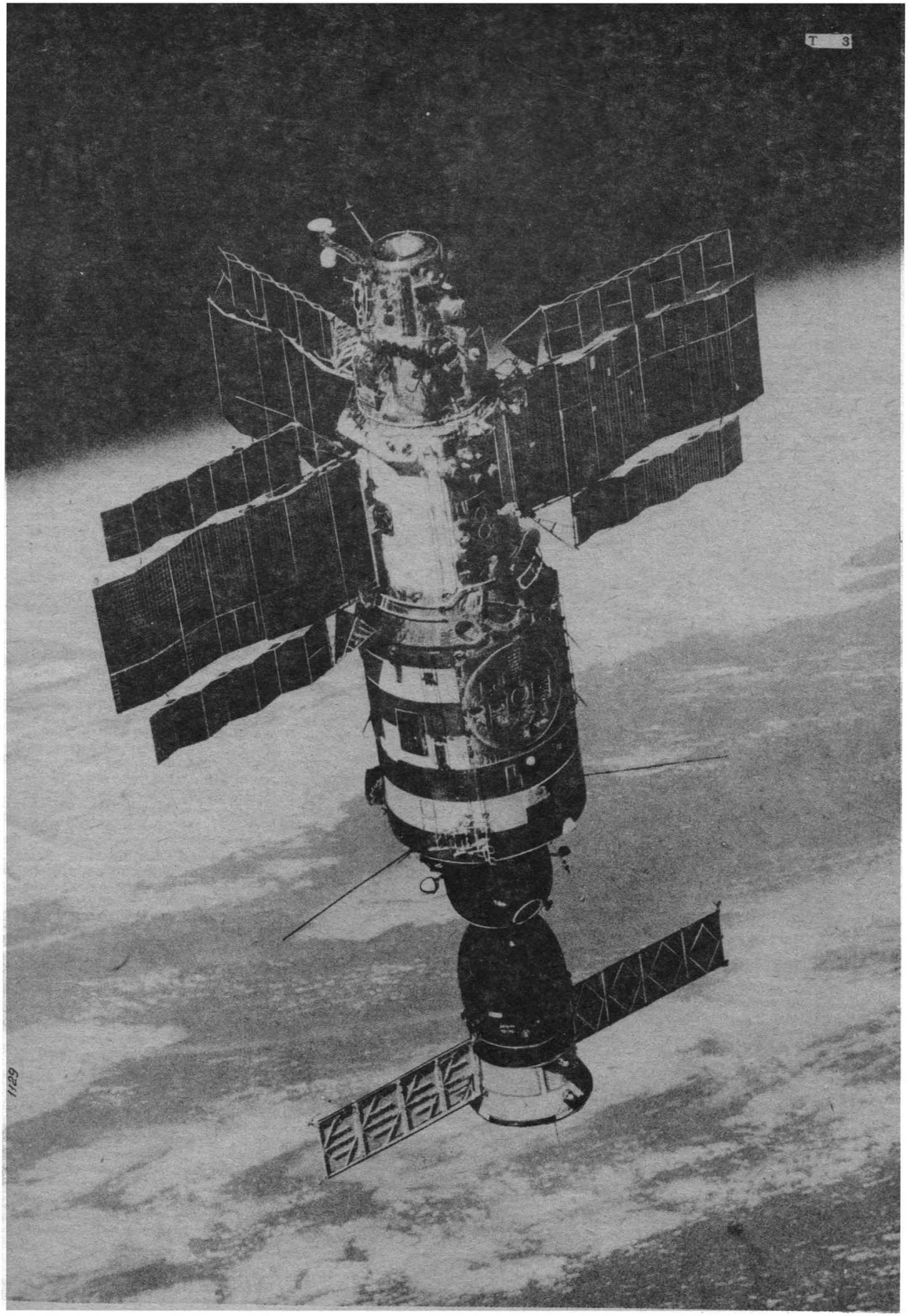
- Most recently we have seen the unveiling of the Soviet space shuttle, Buran. This was the first time a Soviet manned spacecraft was revealed in advance of its first test flight.

Soviet MMU Revealed

The Soviet Union has displayed its Manned Manoeuvring Unit to the press at the Baikonur Cosmodrome. The back-pack is to be tested later this year outside the Mir space station. *Tim Furniss*



The Salyut 7 space station, with a Soyuz craft docked to its rear port. The station was launched in April 1982, and remains in orbit to this day. Salyut 7 received ten Soyuz spacecraft during its operational period. In 1986 it was boosted into a higher orbit to delay its reentry. Soviet space officials have recently announced that the 19 tonne space station will be returned to Earth by the Buran Space Shuttle.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STS-27 MISSION REPORT

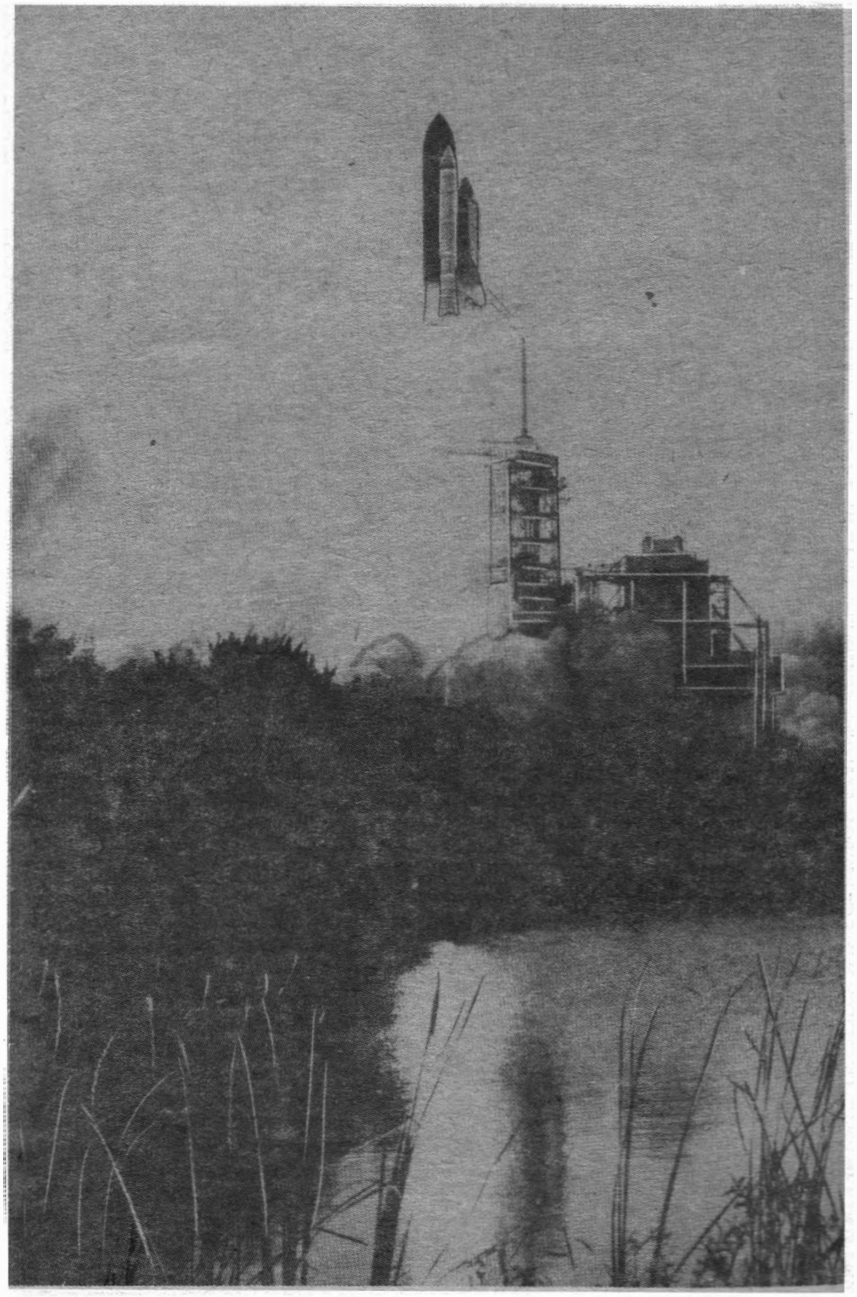
Atlantis in Action

Space Shuttle mission STS-27 was a classified military flight. During the four-day flight, the massive Lacrosse reconnaissance satellite was deployed. *Spaceflight* provides an insight into this secret Department of Defense mission.

By Roelof Schuiling
At the Kennedy Space Center
and
Steven Young

The Space Shuttle Atlantis, carrying a crew of five and a classified military payload, lifted off from the Kennedy Space Center's launch pad 39B on December 2, 1988. The lift-off came at 14:30:34 GMT within minutes of the 11:32 to 14:32 launch window closing.

STS-27 with the space shuttle Atlantis shortly after lift-off from Pad 39B at the Kennedy Space Center. *NASA*



In keeping with the classified nature of the flight, the countdown status was not revealed until the "T minus nine minutes and counting" point.

The landing was at Edwards Air Force Base, California at 23:36:10 GMT on December 6. The crew; Commander Robert 'Hoot' Gibson, Pilot Guy Gardner, together with Mission Specialists Richard 'Mike' Mullane, William Shepherd and Jerry Ross were met by NASA Administrator James Fletcher, who called the mission "a great flight, a super flight."

The mission, designated STS-27, was Atlantis' first flight in three years. The previous launches for Atlantis were STS 51-J on October 3, 1985 and STS 61-B on November 11, 1985.

Launch Preparations

The Atlantis had a smooth launch preparation period. The stacking of the Solid Rocket Boosters (SRBs) for STS-27 took just under three months, beginning on July 30 and finishing on September 20. Atlantis was towed from its bay in the Orbiter Processing Facility to the Vehicle Assembly Building (VAB) during the night of October 22 and was mated with the external tank on October 24. The shuttle stack was rolled out to pad 39B on November 2.

During the course of on-the-pad testing of the orbiter's Auxiliary Power System Units it was noted that an isolation valve in unit 2 was sticking and the valve was replaced. When Atlantis was powered up instrumentation indicated the left inboard main landing gear tyre had a slow leak. The landing gear is inaccessible when the orbiter is mated to the External Tank. If the leak had proved serious a roll back to the VAB would have been necessary. The leak rate was monitored and was determined to be approximately 1.7 psi per day. The tyre held 333 psi on November 30 and it was felt that this was sufficient to allow the mission to proceed as the minimum acceptable tyre pressure was approximately 275 psi.

Launch Day

The December 2 launch of STS-27 was delayed until the last minute by upper level winds that exceeded launch limits. Similar weather had prevented the launch of Atlantis the previous day.

The countdown went ahead when the high level winds died down. At T-31 seconds a hold was ordered, cloud cover at the Trans-Atlantic abort

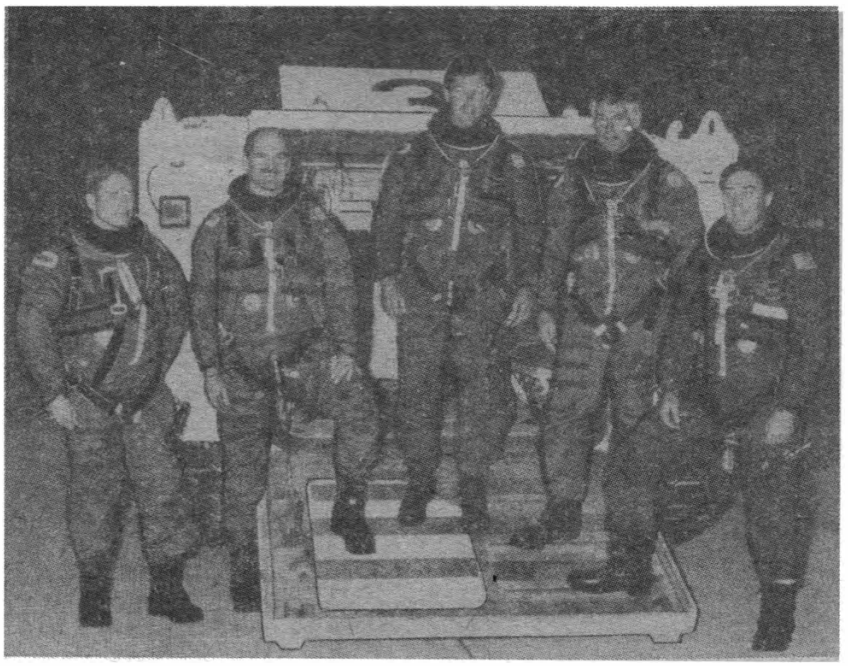
site in Zaragosa Spain had reached over 50%. The countdown was resumed when the Mission Management Team decided the cloud cover was not a problem, if an abort had occurred the skies would have cleared before landing.

As Atlantis began its roll manoeuver observers on the ground could see this was not a usual 28.5 degree inclination launch. The shuttle was heading towards the maximum permitted inclination of 57 degrees. This high inclination orbit would cover most of the Soviet Union. The launch trajectory closely followed the Eastern coast line of the US.

During the ascent the voice transmissions between the shuttle and mission control were not broadcast by NASA. However unscrambled ground to air transmissions could be monitored with a UHF radio.

The SRB separation took place normally and the boosters were returned to Cape Canaveral Air Force Station on December 3. When the booster segments were disassembled engineers found no signs of hot gases reaching the O-rings.

The Atlantis launch was a direct ascent to orbit, requiring just one Orbital Manoeuvering System (OMS) burn to circularise the spacecraft's orbit.



The five crew members of STS-27, dressed in their partially pressurised flight suits, stand in front of an M1-13 armoured personnel carrier at the Kennedy Space Center's Shuttle Landing Facility. The M1-13, for which the crew is being trained, is used during emergency egress situations. From left to right: William Shepherd; Guy Gardner; Robert 'Hoot' Gibson; Richard (Mike) Mullane; and Jerry Ross. *NASA*

Satellite Deployment

After completing post-ascent checks the crew were given a go-ahead to begin on-orbit operations. The $500 million Lacrosse satellite was deployed approximately five hours into the flight during Atlantis' sixth orbit of the Earth.

A final checkout of Lacrosse's onboard systems was made before the crew were given permission to deploy the satellite. Mission Specialist Mike Mullane, using the Remote Manipulator System (RMS), lifted the satellite from its cradle in the payload bay and positioned it in space above the orbiter. Once he was sure the satellite was stable he released the grapple fixture in the 'wrist' of the RMS.

Atlantis' crew then stood by to observe the deployment of Lacrosse's large solar array. It was reported that the first attempt to deploy the panels failed. Astronauts Ross and Shepherd were prepared to make a spacewalk to manually open them. Ross has over 11 hours EVA experience; he made two space walks to erect the EASE and ACCESS structures in the payload bay during a previous shuttle mission (STS 61-B). The emergency EVA was not necessary, ground control sent a second command to deploy the solar panels and the array opened.

The Lacrosse satellite is able to operate night and day regardless of weather conditions. The Pentagon hopes the satellite will be able to locate Soviet mobile missile systems, even when they are concealed amongst trees.

Serious Tile Damage

The crew observed substantial tile damage to the orbiter's right hand side using the camera at the end of the RMS. Television pictures of the launch showed a shower of debris during the SRB separation. The debris is believed to have caused the tile damage.

One possible source of origin for the debris was the External Tank, which, constructed five years ago, was the oldest External Tank to fly. The tank was also used for tests at Vandenberg Air Force Base, during which it was filled with cryogenic propellants. It is possible the External Tank's thermal insulation was affected during these tests by the super-cold fuel, weakening it enough to break away from the tank when the SRB separation motors fired.

About 700 tiles were damaged and about 150 will have to be replaced before Atlantis' next flight.

There was one other significant malfunction during the flight: water from a evaporation collector pooled in the crew compartment. The water was removed by the crew and a back-up system was brought into use.

Atlantis was returned to the Kennedy Space Center by the 747 Shuttle Carrier Aircraft on December 13.

STS-27 at a Glance

LAUNCHED: 14:30:34 GMT, December 2
LAUNCH SITE: Pad 39B, Kennedy Space Center, USA

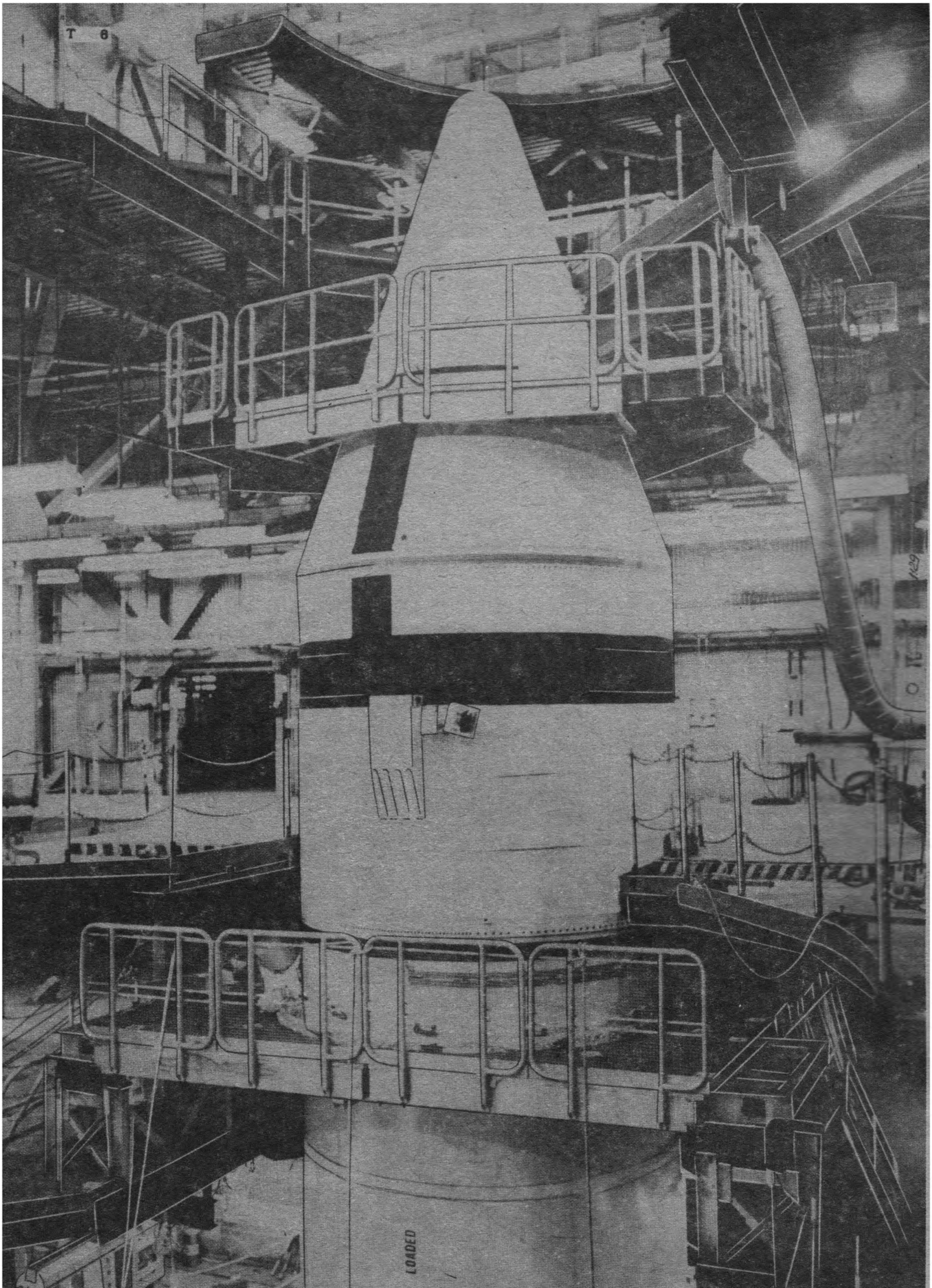
LANDED: 23:36:10 GMT, December 6
LANDING SITE: Runway 17, Edwards Air Force Base, USA

ORBIT: approx. 390-460km
INCLINATION: 57 degrees
DURATION: 105hrs 5min 24sec

COMMANDER: Robert 'Hoot' Gibson
PILOT: Guy Gardner
MISSION SPECIALISTS:
Richard 'Mike' Mullane
William Shepherd
Jerry Ross

PAYLOAD: Lacrosse

The launch trajectory for STS-27. The 57 degree inclination of the orbit resulted in a flight path that followed the East coast of the US.



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INTERNATIONAL SPACE REPORT

A monthly review of space news and events

Deal on ESA Funding

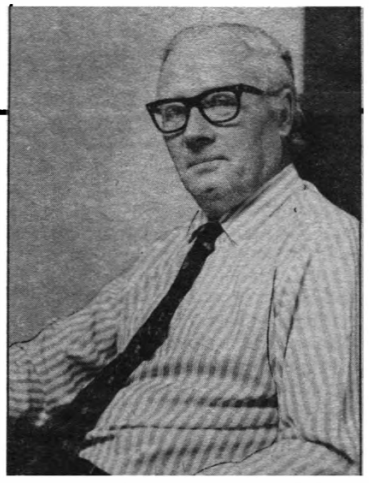
In return for the UK's approval for a 5% increase in funding for the European Space Programme, the ESA Council has agreed to conduct an independent review of the costs and management of the ESA Science Programme. The move is seen as a 'U' turn in UK space policy. The Government had previously said it was unconvinced that the increase was justified.

The agreement was reached at a meeting of the ESA Council on December 15, 1988. The ESA Science Programme, known as Horizon 2000, includes the Soho/Cluster mission (***Spaceflight***, October 1988, p.382) and the Cassini probe to Saturn and its moon Titan (***Spaceflight***, January 1989, p.9). The decision to increase the funding had to be unanimous. The UK's initial disapproval threatened to prevent the other ESA nations from going ahead. It was suggested that Britain could lose its ESA membership if it blocked the extra funding.

The UK's agreement to support the budget increase does not indicate a change in the Government's general space policy. If the UK had refused to agree it would have found itself isolated, all the other ESA nations were in full support of the increase. The Government had little choice, agree or face possible expulsion from ESA. Britain has been seen as the 'financial conscience' of ESA and demanded an independent review into the organisation and management of the ESA science programme, with the objective of making the programme more cost effective.

The British delegation was led by Mr Arthur Pryor, the Director General of the British National Space Centre. He said. "The United Kingdom fullysupports this agreement which demonstrates our continued commitment to Horizon 2000 as the centrepiece of our space science research. We also welcome the ESA Council's collective resolve to maintain cost discipline on Horizon 2000 and to seek the most cost effective use of the extensive resources committed to this programme."

Director of ESA's scientific programme, Professor Roger Bonnet commented on the agreement."The Council's unanimous decision was one of extreme importance to the scientific programme. It shows a great will to go forward together."



Arthur Pryor *BNSC*

The next shuttle launch, STS-29, was scheduled for launch on February 23, 1989, at the time of going to press. Its left-hand Solid Rocket Booster (SRB) is shown here in the Vehicle Assembly Building shortly after the nose cap had been placed on top of the SRB stack. *NASA*

SATELLITE DIGEST – 218

Robert D. Christy

Continued from the December 1988 issue

A monthly listing of satellite and spacecraft launches, complied from open sources. The heading to each launch gives the name of the satellite, its international designation and its number in the NORAD catalogue. Launch times are given in Universal Time and are accurate to about five minutes except where marked with an asterisk, where the time is to the nearest minute as announced by the launching agency.

GORIZONT 16, 1988–71A, 19397
Launched: 1952, 18 August 1988 from Tyuratam by D–1–e.
Spacecraft data: Stepped cylinder with a dish aerial array at one end. Electrical power is provided by a pair of rotatable solar panels at right angles to the body. Station keeping is by the use of gas jets, and three-axis stabilisation is achieved by momentum wheels. The length is about 5 m, the maximum diameter about 2 m, and the mass around 2000 kg.
Mission: Communications satellite providing continuous telephone, telegraphic and television links both within the USSR and abroad.
Orbit: Geosynchronous above 80 degrees east.

COSMOS 1964, 1988–72A, 19412
Launched: 1050, 23 August 1988 from Tyuratam by A–2.
Spacecraft data: Based on the Vostok manned spacecraft and consisting of a spherical, camera carrying re-entry module supported by a conical instrument unit containing batteries, control equipment and a rocket motor system. A 2 m diameter, 0.5 m deep, cylindrical, supplementary instrument package may be carried at the forward end. The overall length is about 6 m, maximum diameter 2.4 m and the mass is between 6 and 7 tonnes.
Mission: Military photo-reconnaissance, recovered after 15 days.
Orbit: 231 × 285 km, 89.70 min, 70.00 deg.

COSMOS 1965, 1988–73A, 19414
Launched: 1115, 23 August 1988 from Plesestk by A–2.
Spacecraft data: Possibly based on the Vostok manned spacecraft and consisting of a spherical re-entry module with a conical instrument unit containing batteries, control equipment and a rocket motor system, and a 2 m diameter, 0.5 m deep, cylindrical, supplementary instrument package may be carried at the forward end. The overall length is about 6 m, maximum diameter 2.4 m and the mass is between 6 and 7 tonnes.
Mission: Photo-reconnaissance, recovered after 30 days. All or part of the payload was an Earth resources package operating under the 'Priroda' programme.
Orbit: 257 × 277 km, 89.92 min, 82.36 deg, later manoeuvred to 339 × 355 km, 91.54 min, 82.33 deg.

OSCAR 25 & OSCAR 31, 1988–74A&B, 19419 & 19420
Launched: 0712, 25 August 1988 from Vandenberg AFB by Scout.
Spacecraft data: Transit-type navigation satellites.
Mission: Pair of navigation satellites.
Orbit: 1036 × 1182 km, 107.53 min, 89.99 deg.

INTERNATIONAL SPACE REPORT

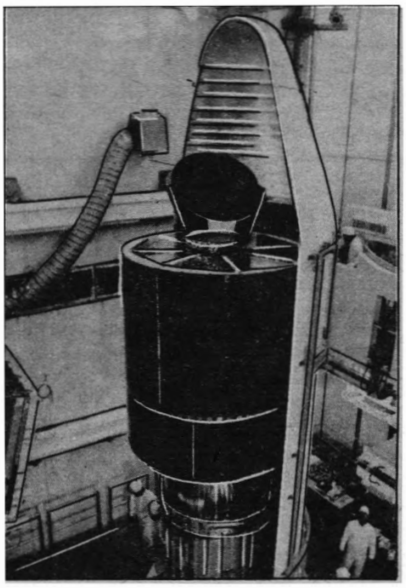
SOYUZ-TM 6, 1988–75A, 19443
Launched: 0423*, 29 August 1988 from Tyuratam by A–2.
Spacecraft data: Near-spherical orbital compartment carrying a rendezvous radar tower, conical re-entry module and cylindrical instrument unit with a pair of solar panels, and containing batteries and a combined rocket motor/attitude control system. Length 7.5 m (including the docking unit), maximum diameter 2.2 m and mass around 7000 kg.
Mission: Carried Soviet/Afghan crew of Vladimir Lyakhov, Valery Poliakov and Abdul Ahad Mohmand to Mir. Docking with Mir's rear port occurred at 0541 on August 31. Lyakhov and Mohmand returned to Earth in Soyuz-TM 5, landing at 0050 on September 7, following abortive landing attempts on September 6. At 0105 on September 8, with Titov, Manarov and Poliakov aboard, it undocked and then re-docked at Mir's forward port, 20 minutes later.
Orbit: Initially 195 × 228 km, 88.66 min, 51.57 deg, then by way of a 234 × 259 km transfer orbit to a rendezvous with Mir in an orbit of 339 × 366 km, 91.53 min, 51.62 deg.

USA 31, 1988–77A, 19458
Launched: 1205*, 2 September 1988 from Cape Canaveral by Titan 34D/IUS.
Spacecraft data: not available.
Mission: Electronic-intelligence gathering from geosynchronous orbit. The IUS reportedly failed to operate correctly.
Orbit: near-geosynchronous.

USA 32, 1988–78
Launched: 5 September 1988 from Vandenberg AFB by Titan 2.
Spacecraft data: Parent satellite and a cluster of (probably) three sub-satellites, joined together by several-kilometre long wires to maintain formation.
Mission: Electronic-surveillance over Ocean areas.
Orbit: 1050 × 1170 km, 107.5min, 63.4 deg (approximate orbit).

COSMOS 1967, 1988–79A, 19462
Lauched: 1030, 6 September 1988 from Plesetsk, USSR by A–2.
Spacecraft data: Based on the Vostok manned spacecraft and consisting of a spherical, camera carrying re-entry module supported by a conical instrument unit containing batteries, control equipment and a rocket motor system. A 2 m diameter, 0.5 m deep, cylindrical, supplementary instrument package may be carried at the forward end. The overall length is about 6 m, maximum diameter 2.4 m and the mass is between 6 and 7 tonnes.
Mission: Military photo-reconnaissance, recovered after 9 days.
Orbit: 228 × 278 km, 89.61 min, 72.88 deg.

FENGYUN 1, 1988–80A, 19467
Launched: 2030, 7 September 1988 from Taiyuan by Long March 4.
Spacecraft data: Rectangular, box-shaped body, about 1.5 m long on each side, and equipped with a pair of solar panels parallel with one face. The mass is 750 kg.
Mission: Meteorological satellite in sun-synchronous orbit, returning cloud-cover pictures and other weather data.
Orbit: 881 × 904 km, 102.90 min, 99.12 deg.



Payload installation prior to the launch of Japan's Sakura 3B communications satellite on September 16, 1988 (see below).
NASDA

GSTAR 3, 1988–81A, 19483
Launched: 2300*, 8 September 1988 from Kourou by Ariane 3.
Spacecraft data: Three-axis stabilised, box-shaped body, 1.63 × 1.32 × 0.99 m, with an aerial array at one end. Power is provided by a 14.3 m span solar array. The mass is 759 kg (in geosynchronous orbit).
Mission: US domestic comsat, including the Geostar radio-location package. Improperly-loaded fuel meant the satellite was unbalanced and it tumbled during the apogee-motor firing, producing an incorrect, unusable orbit.
Orbit: 16587 × 36160 km, 982.98 min, 1.52 deg.

SBS 5, 1988–81B, 19484
Launched: 2300*, 8 September 1988 from Kourou, Guyana by Ariane 3.
Spacecraft data: Cylindrical, spin-stabilised body with a de-spun aerial array. The length is 6.6 m (excluding aerials), and the diameter 2.2 m. The mass is 725 kg (in geosynchronous orbit).
Mission: US domestic comsat, providing point-to-point services for business users in the continental United States.
Orbit: geosynchronous above 122 deg west.

COSMOS 1968, 1988–82A, 19488
Launched: 1040, 9 September 1988 from Plesetsk, USSR by A–2.
Spacecraft data: Possibly based on the Vostok manned spacecraft and consisting of a spherical re-entry module with a conical instrument unit containing batteries, control equipment and a rocket motor system, and a 2 m diameter, 0.5 m deep, cylindrical, supplementary instrument package may be carried at the forward end. The overall length is about 6 m, maximum diameter 2.4 m and the mass is between 6 and 7 tonnes.
Mission: Photo-reconnaissance, recovered after 14 days. All or part of the payload was an Earth resources package operating under the 'Priroda' programme
Orbit: 260 × 275 km, 89.93 min, 82.34 deg.

PROGRESS 38, 1988–83A, 19486
Lauched: 2334*, 9 September 1988 from Tyuratam by A–2
Spacecraft data: Soyuz derived design, having a near-spherical supplies compartment carrying a rendezvous radar tower, a covered liquids tank section and cylindrical instrument unit containing batteries and a combined rocket motor/attitude control system. Length 7.5 m (including the docking unit), maximum diameter 2.2 m and mass around 7000 kg.
Mission: Carried equipment and consumable supplies to the resident crew of Mir. It docked with Kvant's aft-facing hatch at 0122 on July 20. It undocked on October 23 and was de-orbited the same day.
Orbit: Initially 186 × 246 km, 88.77 min, 51.63 deg, then by way of a 234 × 332 km transfer orbit to a docking with Mir in an orbit of 337 × 363 km 91.47 min, 90.62 deg.

COSMOS 1969, 1988–84A, 19495
Launched: 1500, 15 September 1988 from Plesetsk by A–2.
Spacecraft data: Possibly based on the Vostok manned spacecraft and consisting of a spherical camera module supported by a conical instrument unit containing batteries, control equipment and a rocket motor system. A supplementary equipment package may be fitted at the forward end. Several small, heat shielded containers may be carried for periodic return to Earth of film. The overall length is about 6 m, maximum diameter 2.4 m and the mass around 7000 kg.
Mission: Military photo-reconnaissance over an extended period.
Orbit: 168 × 348 km, 89.68 min, 67.14 deg, manoeuvrable.

COSMOS 1970–1972, 1988–85A–C, 19501–19503
Launched: 0201, 16 September 1988 from Tyuratam by D–1–e.
Spacecraft data: not available
Mission: Single launch of a triplet of GLONASS (Global Navigation Satellite System) vehicles.
Orbit: 19115 × 19146 km, 675.75 min, 64.87 deg.

SAKURA 3B (CS–3B). 1988–86A, 19508
Launched: 1000, 16 September 1988 from Tanegashima by H–1
Spacecraft data: Cylindrical body, 2.8 m long and 2.2 m diameter. The mass is 1099 kg (in geosynchronous orbit).
Mission: Japanese built and launched communications satellite.
Orbit: geosynchronous above 136 deg east longitude.

OFFEQ 1, 1988–87A, 19519
Launched: 0932*, 19 September 1988 from Palmachim by Shavik.
Spacecraft data: Octagonal frustrum, 2.3 m long and varying from 0.7 m to 1.2 m diameter. The mass is 156 kg.
Mission: Israeli built and launched space-technology experiments satellite.
Orbit: 247 × 1155 km, 98.65 min, 142.87 deg.

Above the Planet

—Salyut EVA Operations—

With the advent of the Mir Complex, and its permanent manning, the Soviet Union has demonstrated a confidence and willingness to undertake work outside the orbital complex on a regular basis for both planned and unplanned tasks.

The EVAs from the Mir complex have been described in the relevant parts of the Mission Report series.

However, one factor in the Soviet confidence in the use of men outside the complex for tricky, and sometimes dangerous, repair and retrieval tasks, was the experience gained during the EVAs conducted during the Salyut 6 and Salyut 7 missions.

Before Salyut

The Soviet Union's cosmonauts undertook two EVAs in the 1960s. The first was that of Aleksei Leonov. On March 18, 1965 the cosmonaut made the first excursion by man outside his spacecraft whilst in orbit. He spent 12 minutes and 9 seconds outside the craft Voskhod-2. The cosmonaut had spent 24 minutes exposed to the vacuum of space inside and outside of the flexible airlock attatched to the side of the Vostok-derived spacecraft. Despite Soviet claims of a perfect EVA, it emerged later that Leonov had expended a great deal of energy during the short excursion and had to reduce the pressure in his suit to clamber back into the airlock. His companion on the flight was the late Pavel Belyayev.

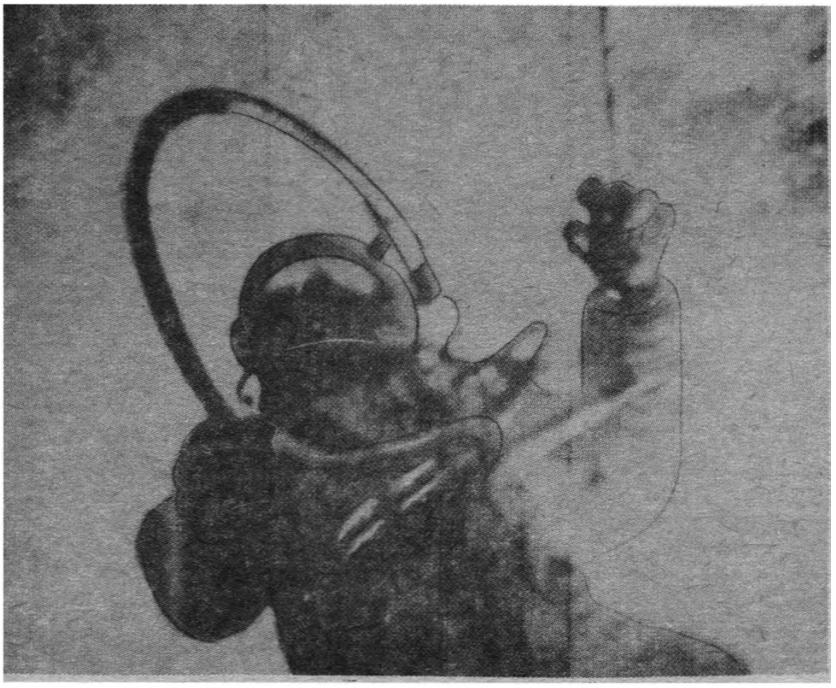
The Soviets have recently revealed that a further Voskhod EVA mission was planned. In this one, which would presumably have repeated Leonov's task, a woman cosmonaut would have been the spacewalker. Valentina Tereshkova was pictured in an EVA suit. Had she conducted the mission she would have become the first woman to fly into space twice and the first to undertake a spacewalk. Those records, however, would have to wait for another 21 years.

The Soviets concelled further Voskhod missions after Leonov's.

In the period 1965–1969 there was much discussion about a Soviet Lunar mission, aimed at beating the Americans to the Moon.

One of the preparatory features of the programme probably involved the docking together in near-Earth orbit of two Soyuz spacecraft, the successor to Vostok / Voskhod. This would accomplish the manoeuvres achieved by the American moonship precursors – the Gemini spacecraft. Two cosmonauts would then transfer outside the spacecraft from one to the other demonstrating the Soviet prototype EVA suit.

The mission was to be flown in April 1967 and was reportedly ordered by the Soviet government even though



Soviet cosmonaut Aleksei Leonov becomes the first man to step outside his spacecraft during the Voskhod-2 mission in 1965. *All Photographs Novosti*

By Neville Kidger

Soviet engineers and designers thought the plan to be risky and premature for the first piloted flight of the new spacecraft, even though it had flown unmanned.

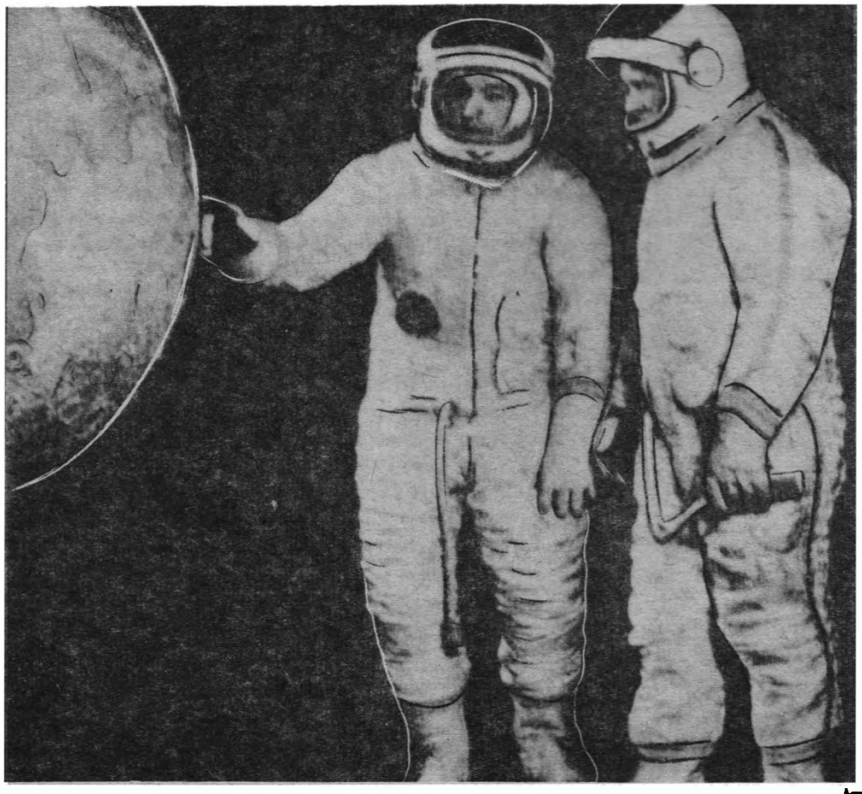
Nonetheless, on April 24, 1967, Soyuz 1 was launched with cosmonaut Vladimir Komarov. The plan to launch Soyuz 2 the next day for a docking with Soyuz 1 and the transfer of two men *via* open space was scrapped when as-yet-unknown problems caused the recall of Soyuz 1 after just one day in space. Tragically, Komarov was killed with his descent cabin impacted the Earth. The Soviets say that his parachute lines tangled.

The Soyuz 2 crew of Valeri Bykovski, Aleksei Yeliseyev and Yevgheni Khrunov, was stood down pending the investigation.

Twelve years afterwards the Soviet released a photograph which showed the two spacewalker cosmonauts – Yeliseyev and Khrunov – looking at a globe of the Moon. This picture was probably taken to illustrate the ancestry of the Lunar space suit, when it was eventually used. There appears to be no other illustration of cosmonauts in similar situations.

In January 1969 Yeliseyev and Khrunov did perform their EVA. They took an hour to cross from Soyuz 5 to Soyuz 4 in which they returned to Earth. However, the flight had no purpose beyond propaganda for the Lunar programme – the Americans were about to win that race – and little value for the space station programme the Soviets were about to embark upon – automatic Soyuz dockings had been performed before.

SOVIETS in SPACE



Cosmonauts Yeliseyeve and Khrunov looking at a globe of the moon. The picture shows the Soyuz-T EVA suit which might have been taken as a basis for a lunar space suit.

Salyut 1

Due to the limited use of the first Salyut station (one mission terminated with the crew unable to enter the station and the second curtailed early with the resulting deaths of the three men aboard Soyuz 11) it is not known if EVAs from the station were contemplated. However, photographs of the station on Earth do not appear to show an EVA hatch.

A picture has been published in the west showing a cosmonaut on a tethered EVA exiting from the docking port at the front of the station. However, no Soyuz is shown. Because the origins of the picture are unknown to this writer it is difficult to evaluate its potential as a serious EVA scenario. Question: where would the manned Soyuz have been?

In 1972 the Soviets reportedly tried to buy a number of American pressure suits. The purchase was stopped by the American government.

1973 Revelations

In April 1973 the Soviets launched Salyut 2. Within two weeks of its launch it had broken up in Earth orbit. Transmissions identified it as a military version of the Salyut station.

On May 11, 1973 a new Salyut was launched, this time a civil version. The station experienced a problem on its very first orbit which caused it to waste all of its attitude control fuel. The Soviets abandoned it in orbit and called it Kosmos 557, passing it off as a routine science satellite.

Both Kosmos 557 and Salyut 2 decayed from orbit within six days of each other in late-May 1973.

It was later revealed that Aleksei Leonov had been training for the civil Salyut. With his background it is possible that EVAs were contemplated from Salyut / Kosmos 557. However, with the loss of the station, Leonov and his other crewmates were transferred to the joint USSR/USA ASTP mission.

In June 1973 a delegation from the western press was allowed into Star Town, near Moscow to view the Soviet's expanding facilities for cosmonaut training. Whilst there, Vladimir Shatalov showed the delegation a mock-up of a Salyut station with three solar panels located further aft than the first pair of solar wings of Salyut 1.

Also in evidence, on the transfer compartment, was a circular hatch. Contemporary accounts wondered if this was an EVA hatch. Later revelations showed these speculations to be correct.

Military Salyuts

Salyut 2 transmitted on a separate frequency to the civil Salyuts and that station's successor, Salyut 3, exhibited the same characteristics.

Because the actual configuration of the military Salyuts 2, 3 and 5 has yet to be disclosed by Soviet authorities, we cannot know what, it any, EVA capabilities these stations possessed.

The stations were designed by the Chelomi Bureau, as are the heavy Kosmos modules which have been docked with Salyuts 6 and 7. These modules do not appear to possess an EVA hatch. It seems unlikely, therefore, that there was a possibility, or requirement, for an EVA from the military stations.

In October 1976 the Soyuz 23 mission to the Salyut 5 station was aborted when problems surfaced during rendezvous between the ship and station. The flight engineer of that mission, Valeri Rozhdestvenski, was described as a member of a special training programme involving zero-g simulations and parachute drops. He had also completed a four-year stint as the commander of a deep-sea diving group in the Baltic. Some western interpretations of this led to the belief that EVA was a part of the mission. However, there is no further evidence of any EVA involvement for the cosmonaut.

Salyut 4

The Salyut model shown in 1973 was eventually revealed as Salyut 4, which was placed into orbit on December 26, 1974.

The first expedition to the station lasted 30 days and was the first successful mission to a civil Salyut station. The Gubarev / Grechko crew apparently had no EVA plans.

The second crew, Lazarev and Makarov, may have been different. They were launched on April 5 1975 with the intention of spending two months in space. However, their Soyuz rocket ran into problems during the separation of its second and third stages with the result that the men conducted a sub-orbital flight which saw them escape narrowly from death.

The back-ups for the flight, Klimuk and Sevastyanov, were launched on May 24, 1975 and spent 63 days in space with no EVAs.

In May 1976, Klimuk revealed that EVA work was a part of the two men's mission but had been dropped because of scheduling and training problems. He did reveal that EVAs were to be part of future missions.

The next station to be launched, however, was the military Salyut 5.

Salyut 6

Salyut 6 was lofted into orbit on September 29, 1977 and the first crew to be launched to it, cosmonauts Vladimir Kovalenok and Valeri Ryumin,

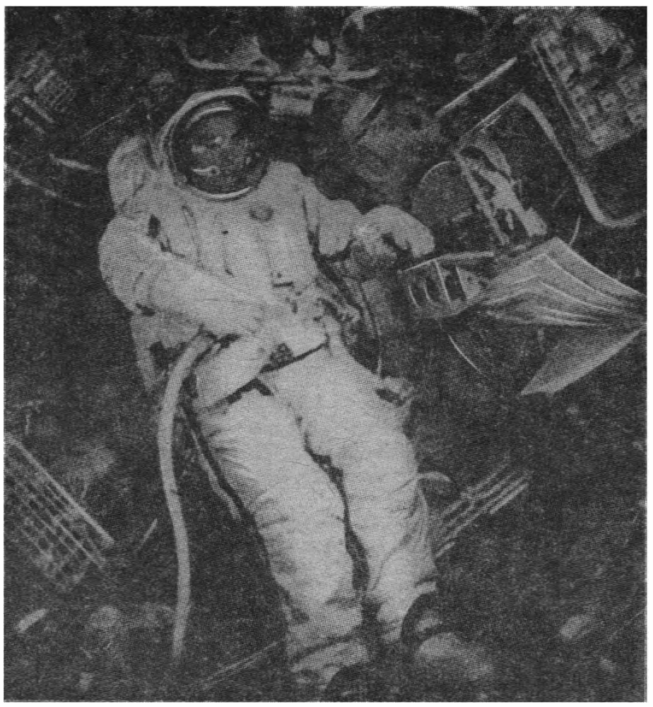
(Top left) Georgi Grechko in the Salyut 6 airlock.

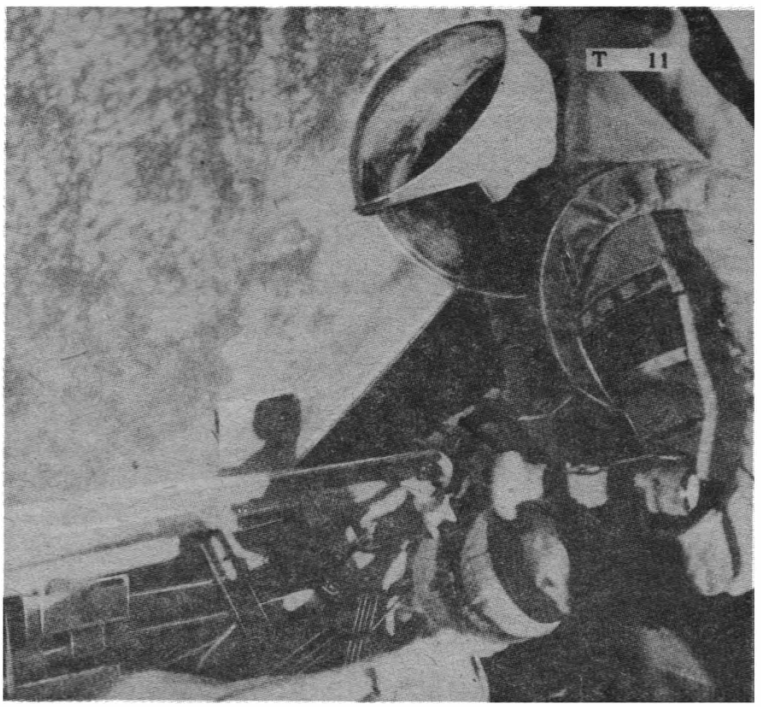
(Top right) Leonid Kizim repairing the Salyut 7 propulsion system.

(Centre) EVA specialists: (left to right) Vladimir Solovyov, Vladimir Dzhanibekov, Svetlana Savitskaya and Leonid Kizim.

(Bottom left) Training for EVAs in the water tank at Star City.

(Bottom right) Romanenko wearing his EVA suit onboard Salyut 6.

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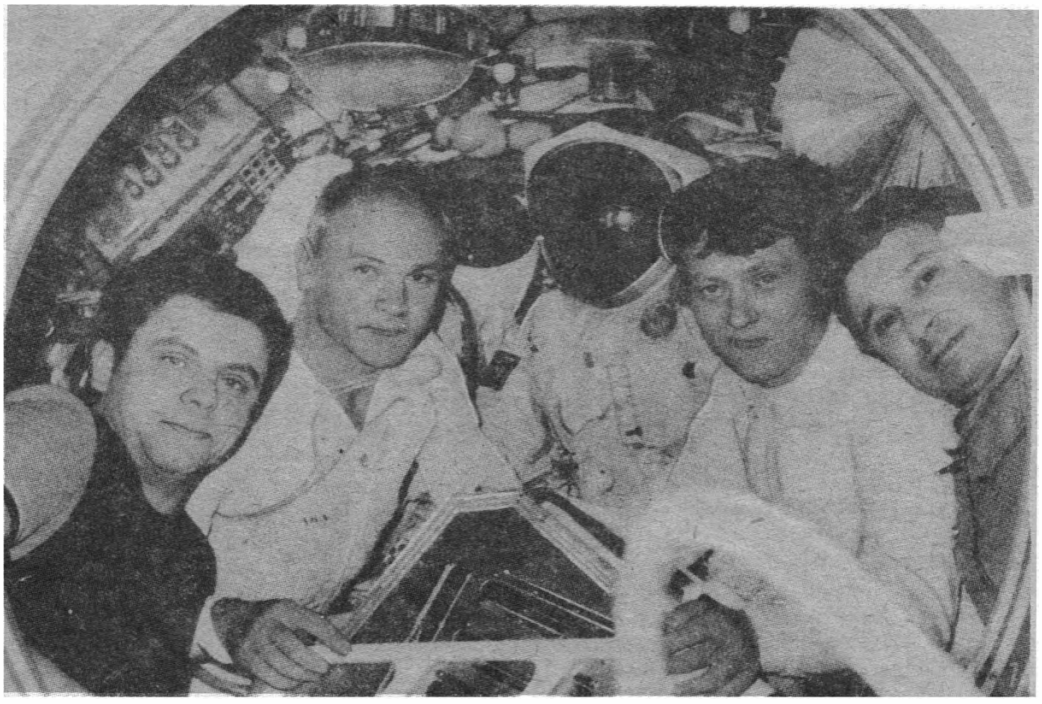
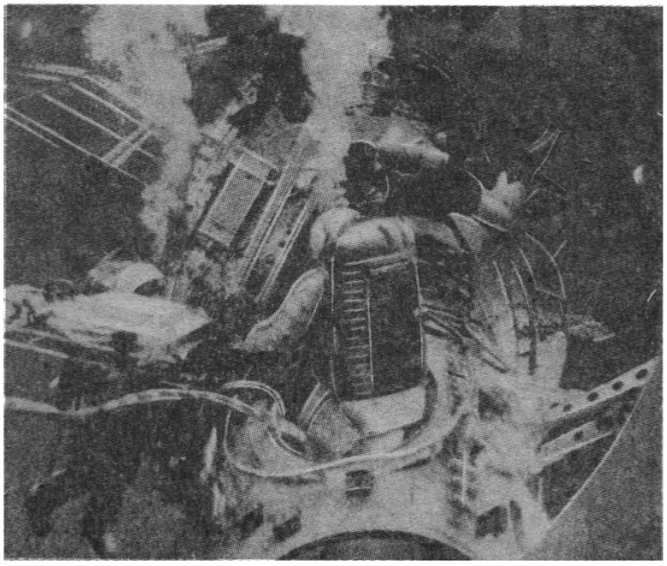
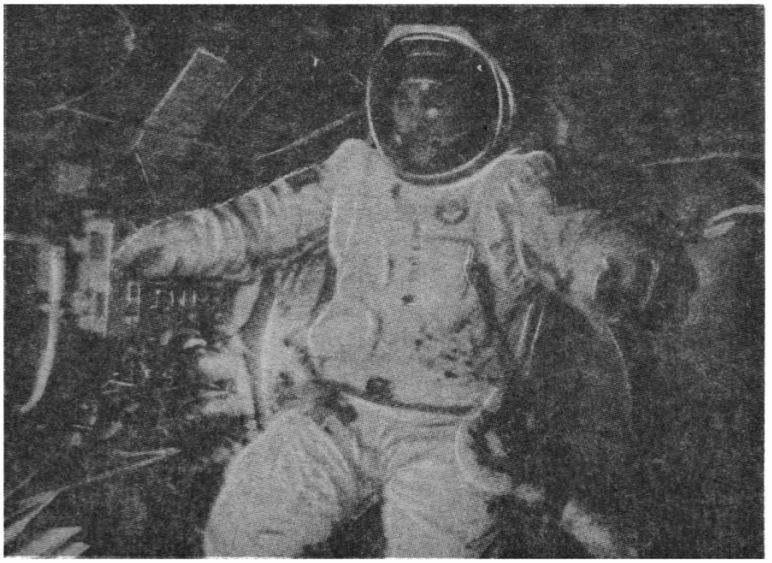
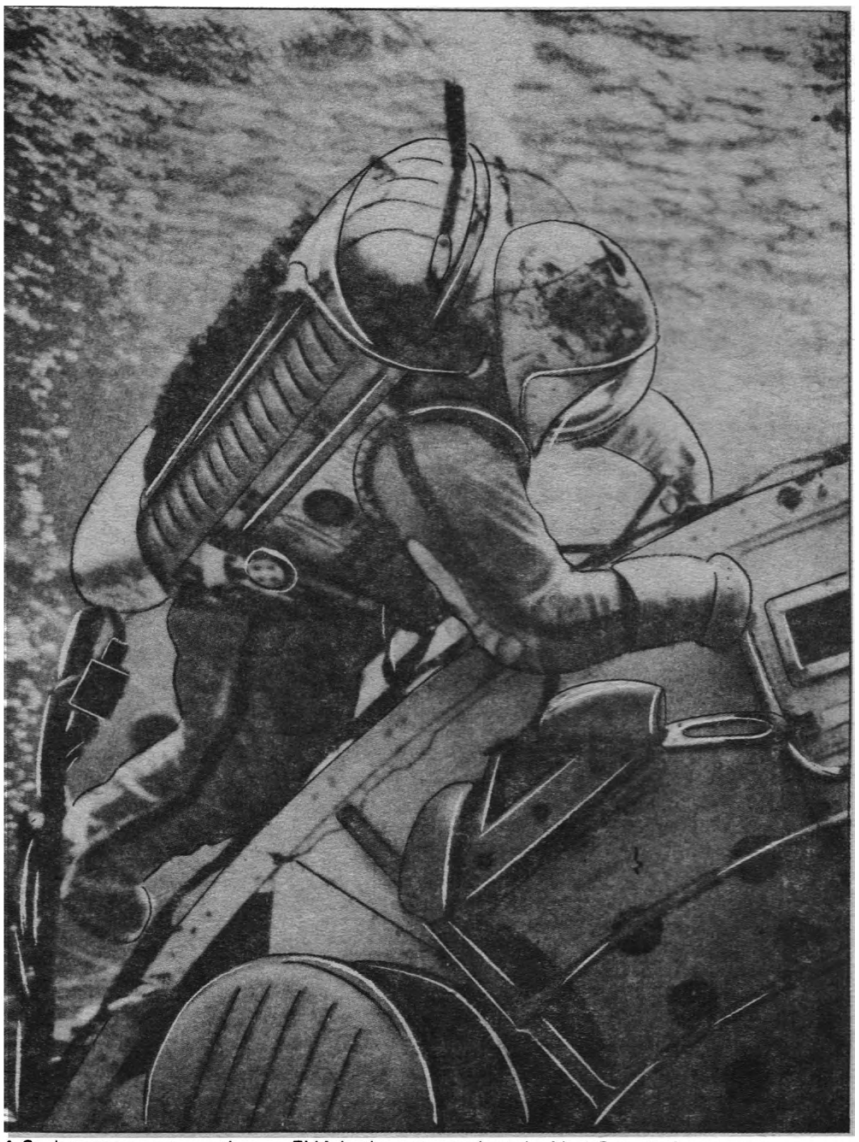








A Soviet cosmonaut practices an EVA in the water tank at the Yuri Gagarin Cosmonauts Training Centre.

followed on October 9, on Soyuz 25.

Because the spacecraft was launched with a blaze of publicity there was speculation in the west that the upcoming 60th anniversary of the October Revolution in the USSR would see a spacewalk as a spectacular celebration of the event.

But the Soyuz 25 crew returned home after just two days, the victims of a random piece of technical failure. When they had tried to dock with the station's front port the probe of the Soyuz did not capture the drogue of the station.

As many as four attempts were made to achieve a hard dock, and the Soyuz and Salyut were at one time tracked as a single object by western sensors.

The failure led to a reappraisal by Soviet managers. Crews were broken up and reformed to ensure a mixture of experienced and new cosmonauts instead of rookie crews. Then there was the problem of the Salyut docking port.

At the time, it was not known if the problem lay with the Salyut recepticle or the Soyuz docking probe. The probe had been lost when the Soyuz's living quarters were cast off, as planned, after retrofire. It had been destroyed in the atmosphere. The only part of the docking devices left to examine was, therefore, the Salyut front docking cone.

A plan was devised which would see the next cosmonauts to the station go outside the Salyut to examine the cone and the surrounding connections on the docking ring.

Cosmonauts Yuri Romanenko and Georgi Grechko were assigned to the mission. Grechko trained in the water tank at Star Town leaning out of the docking hatch and examining the ring and cone.

On December 10, 1977, Soyuz 26 was placed into orbit manned by Romanenko and Grechko. The next day it docked with Salyut's rear port and the men entered the station. When the Soviets announced the docking it was the first the world knew of Salyut's two docking units.

Grechko later wrote that the docking unit hatch was not intended for EVA work. "The difficulty was to decide which would be better: to proceed with our exit into open space or to return to the station. The station was developing a mounting number of minor faults that were posing a threat to the space walk and, thus, to the station itself," he wrote.

Nine days after launch the preparations for the EVA were complete. After donning their new semi-rigid EVA spacesuits, the cosmonauts depressurised the transfer compartment of Salyut. At 2136 GMT, whilst flying over the southern Pacific Ocean, in bright sunlight, the hatch of the docking unit was opened. Grechko stuck his upper half out of the hatch opening and, using tools passed to him by Romanenko, began the mechanical check of the docking ring. The EVA was timed so that the sunlight illumiated the work. Lights were available for shaded areas.

The experienced flight engineer examined the condition of the individual components of the docking system including the joints, sensors, guide pins, fasteners, sealing surfaces, etc. Grechko was outside for 20 minutes.

He later reported that he had "attentively studied the butt end and the adjoining cowling. The butt end is brand new as though just taken off a machine tool. There are no scratches, traces or dents on it. All of the docking equipment – lamps, electrical sockets, latches – all is in fine order. The receiving cone is also clean, without a single scratch."

With those words Grechko assured the continued full scale operation of the Salyut 6 station.

Salyut passed into darkness about 12 minutes after Grechko had finished his inspection, according to Robert Christy. Contact with the Flight Control Centre (FCC) would soon be resumed. However, presumably around this time, Romaneko decided to have a look outside himself. But he had forgotten that he was not connected to the interior with a safety line and began drifting out. Grechko reached out and pulled him back in.

The story of this incident first emerged at the post-flight press conference and was first widely publicised by James Oberg. However, Oberg has recently noted that the details of the incident have been described by Grechko "in many, many variations, in no small part due to Grechko's own creativity and imagination." The cosmonaut has related how he had to stretch "a long way" to grab Romanenko and "almost didn't get him" to experienced space journalist Henry Cooper. He left that writer with the impression that without interven-

tion Romenko would have floated out of Salyut into an independent orbit and presumably death. Grechko said that he told Romanenko "it's a good thing I caught you."

When contact was resumed with FCC there was no mention of the incident. Grechko told the controllers of his findings about the docking unit.

The cosmonauts closed the hatch after it had been opened for 1 hour 28 minutes. However, at this point a problem arose. Telemetry returned to FCC revealed that a valve which bled air out of the transfer compartment to depressurise it had stuck open. If the indication was correct the repressurisation of the compartment would not be possible. The air would simply flow out of the station through the stuck valve.

Deputy flight controller Viktor Blagov later admitted that the FCC staff were "quite worried" at this point.

Instructions were issued to Romanenko and Grechko to begin slowly filling the compartment with air, to determine if it was flowing out into space or repressurising the compartment. As indications of increased pressure in the compartment were received at FCC there was relief.

The fault was eventually traced to a cable fault, possibly caused by condensation. (This also worried the FCC and a search was later made for water. To the relief of all, none was found in the electrics).

Georgi Grechko

Yuri Romanenko

A Stroll Outside : July 29 1978

Vladimir Kovalenok and Aleksandr Ivanchenkov were on the 45th day of their 140-day mission when they conducted the first EVA through the Salyut 6 side hatch. The men's tasks were the removal of samples from Salyut's exterior and attaching replacement samples.

Earlier, officials had said that EVAs would be performed only during malfunctions. Various "hypothetical emergencies" had been formulated on the ground including failure to close the cover for the BST-1M submillimetre telescope, repairs to the solar batteries or other problems which could not be foreseen.

Kovalenok and Ivanchenkov had trained in Star Town's hydro tank for the EVA and had studied videotapes of their training on the station. Two days before they were scheduled to emerge they conducted a full dress rehearsal for the EVA right up to the operations before hatch opening.

On July 29 the men donned their suits and began depressurising the forward transfer compartment of Salyut 6 having sealed themselves into it. Most of the final checks before exiting the station came during a 30 minute pass over the ground stations in the USSR.

At 0357 GMT, a minute earlier than planned, the men were given permission to open the hatch. As the men opened it the complex – consisting of Soyuz 29/Salyut 6/Progress 2 – was over the Sea of Japan.

The "reaping of the scientific harvest" began immediately, whilst the complex was still in daylight. Fixed to the outer skin of the station were three panels containing samples of rubber, plastics, duraluminium, steel, glass and ceramic materials. Ivanchenkov reported that the rubber was in good condition.

These panels had been fixed to the exterior of Salyut before its launch some ten months earlier. A micrometeorite panel was also removed. Later examination showed hundreds of small craters in a 1/16th m^2 area. Konstantin Feoktistov later said that it was practically "raining" meteorites.

A cassette with bio-polymers, the Medusa experiment, was removed.

The experiment consisted of three parts – two exterior parts of the cassette with an open and a closed part and a control cassette inside Salyut. The cassettes contained components of nucleic acids. Later examination of these gave researchers a hint that life may have originated in space by revealing that the exposed samples contained substances similar to nucleosides, the sub-unit of nucleic acids, which had apparently been stimulated by their exposure to direct sunlight. Medusa experiments continued through the Salyut programme.

Ivanchenkov then floated outside and attached the Yakor (Anchor) device at the left hand side of the hatch. He reported that it held firm as the station drifted out of radio contact with FCC.

The complex entered the shadow of Earth at about 0425 GMT. According to one analyst, the men erected portable lamps to work in the nighttime portion of the orbit but switched them off so that they could view the stars and lights on the Earth's surface. They reportedly could see lights from ships and, at one point near to sunrise, saw the five-second-long bright trail of a nearby meteor as it flashed by the station. Kovalenok missed the opportunity to photograph the spectacular event.

A TV camera was fixed to Salyut's hatch. Contact with FCC was resumed at 0502, just at sunrise. The first TV pictures were returned shortly afterwards showing Ivanchenkov floating against the backdrop of the blue and white of Earth. The men returned TV pictures of the areas of the station where they had removed the sample packages and showed new cassettes they had attached.

At one point Kovalenok described the work as "very agitated... difficult, but interesting."

Kovalenok's heart rate was measured as 105 beats per minute whilst his partner's registered 95.

In the 54 minutes of daylight during their second "day" the men checked features of the complex relating to movement outside. They also installed a special device to record the background cosmic radiation.

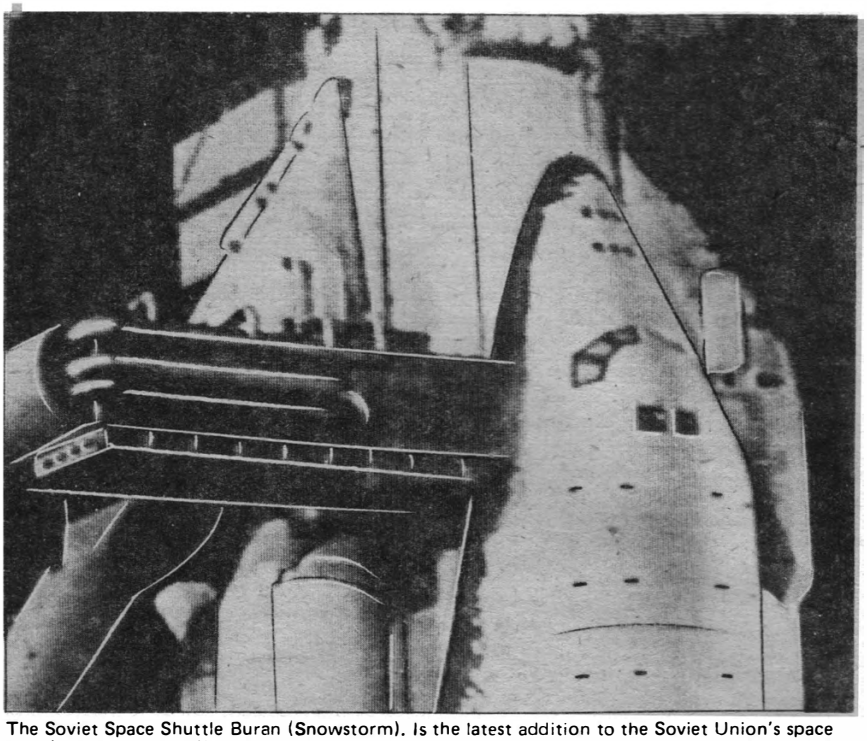
The men completed their work earlier than planned and were told to return to Salyut by FCC. However, Kovalenok declined saying that "we would just like to take our time, because it is the first time in 45 days that we have been out of doors for a walk."

The complex entered Earth's shadow again at about 0556 GMT and about 4 minutes later the men closed the hatch to return to Salyut and the rest of their mission.

The second EVA from Salyut 6 had lasted 2 hours and 5 minutes.

This major feature on Soviet EVA operations continues in the next edition of *Spaceflight*.

The Soviet Snowstorm; Winged Wonder or White Elephant?



The Soviet Space Shuttle Buran (Snowstorm). Is the latest addition to the Soviet Union's space fleet 'a costly mistake'?

On 15 November, the Soviet Space Shuttle Buran (Snowstorm) completed a triumphant maiden flight after two orbits of the Earth. President Gorbachev described this event as opening up "a qualitatively new stage in the Soviet space research programme". Only a week later, this "outstanding achievement of Soviet cosmonautics" was thoroughly debunked by one of the Soviet Union's leading space scientists. Glasnost strikes again!

By Peter R. Bond

Academician Roald Sagdeyev is the retiring director of the Space Research Institute in Moscow. He has been the leading light in the Soviet drive towards international co-operation in the peaceful exploration of space, an initiative which clearly has the backing of the Soviet government. However, he has become increasingly outspoken in recent months, openly condemning the "poor discipline among mission controllers" which led to the disablement of the Phobos 1 spacecraft, and actively promoting the election of former dissident Andrei Sakharov to the Presidium of the USSR Academy of Sciences.

In an article written to coincide with the visit of these two scientists to the USA, Mr. Sagdeyev condemned the American and Soviet Shuttles as having "absolutely no scientific value". He went on to write that the Shuttle was "an outstanding technological achievement" but a costly mistake "We have put too much emphasis on manned flight at the expense of unmanned efforts that produce more scientific information at lower cost." Is this just another case of sour grapes from an individual who sees his particular area of specialisation starved of funds while another, supposedly less worthwhile, area of scientific endeavour receives an abundance of cash and political support?

Sagdeyev condemned the American and Soviet Shuttles as having "absolutely no scientific value". He went on to write that the Shuttle was "an outstanding technological achievement" but a costly mistake.

The question of the relative efficiency and cost-effectiveness of manned exploration of the Solar System versus exploration by unmanned probes has existed for decades Is it really necessary to spend a fortune on sending people into space when 'intelligent' robots could be used at a fraction of the cost and at no risk to human life?

This debate was particularly strident in the 60's and early 70's when the Soviets were singing the praises of their robot lunar explorers at a time when huge sums of American taxpayers' money were being spent on sending men to the Moon and returning them safely to Earth An explosion on Apollo 13 nearly stranded three astronauts in space, and only marvellous improvisation, combined with the good fortune that the lunar module was still attached, saved the crew from a lingering death

Yet many supporters of manned flights were quick to counter that no robot could make decisions and value judgements like the human brain. On numerous occasions, human ingenuity has saved an experiment which would otherwise have been doomed. Apollo astronauts were able to select unusual or striking rock samples in a way not open to robot craft Furthermore, the astronauts brought home a vast haul of lunar rocks weighing 385 kg compared with the tiny handfuls returned by automatic Luna craft.

Despite using technology which has often been described as primitive or outdated, Soviet scientists have regularly and successfully put automatic systems into operation in space The first automatic docking of two unmanned spacecraft, Cosmos 186 and 188, took place as long ago as 1967. Since then, heavy Cosmos modules, including the Kvant astrophysical module, and 39 Progress supply craft have docked automatically with Soviet space stations. The Soviets have made much of the fact that Buran's first flight was also conducted automatically, a feat never accomplished by the American Shuttle.

The Soviet Shuttle incorporates several other safety factors compared with its American counterpart. The US version was originally intended to fly with liquid fuel boosters rather than the Solid Rocket Boosters (SRB's) which resulted in the calamitous explosion of Challenger in 1986. SRB's are cheaper and easier to manufacture since they do not need the complex internal plumbing of liquid motors. However, they have the big disadvantage that, like fireworks, they cannot be extinguished or throttled back once ignition has begun. The Soviets have designed Buran to fly piggyback on the liquid-fuelled Energia, the world's most powerful launcher. In the event of a problem with one of the engines on Energia, it can automatically be shut down, enabling Buran to abort to orbit or return for an emergency landing.

The cost-effectiveness of the Soviet system is improved by Energia's flexibility. As

SOVIETS in SPACE

well as providing the propulsion for Shuttle launches, the giant booster can be used to place payloads of more than 100 tonnes in low Earth orbit or 18 tonnes in geostationary orbit, and used to send craft weighing 32 tonnes to the Moon or 28 tonnes to Mars and Venus. This capability and flexibility are the envy of every other spacefaring nation. Furthermore, the Soviets have designed Energia to be at least partially reusable. The four first stage boosters fall away in pairs and parachute back to Earth ready for refuelling and further use, while the core stage splashes down in the Pacific.

So why is Academician Sagdeyev complaining? Soviet officials have admitted that the Energia-Buran system has taken ten years to develop and has cost some $10 billion – approximately the same as the American Shuttle. Although they have obviously been helped by American pioneering research – some Western authorities, including the Pentagon, claim that Buran is almost a straight copy of the American Shuttle – nine design bureaus are thought to have been involved in this major programme, swallowing up capital and resources which could have been used in other areas.

Meanwhile, even before the replacement for Challenger is wheeled out onto the runway, the American space agency NASA is looking forward to safer, more efficient launch vehicles, such as the unmanned Shuttle-C (***Spaceflight***, November 1988 p. 412). The American military have already shown their disenchantment with the Shuttle by ordering a fleet of expendable launch vehicles. It is now clear that the Shuttle will never be a financial success as a satellite launcher, and that it will continue to be a drain on the NASA budget for years to come, filtering off funds which could be directed towards the Freedom space station and the once-proud Solar System exploration programme. Clearly Mr. Sagdeyev believes the same thing is happening in the Soviet Union.

The US vehicle was originally intended to act as a shuttle craft carrying crews and cargo to and from an orbiting space station. Budgetary constraints, political opposition and public apathy led to the cancellation of the successor to Skylab. The Soviets already have their permanently manned space station, Mir, and intend to orbit a much larger version in the 1990's which will be constructed using the Energia-Buran system. Meanwhile, specialised research modules will be added to the existing station until it grows to a formidable 135 tonne structure. However, the Soviet Shuttle is apparently not intended as a regular supply craft for the space stations.

Glavkosmos chairman Alexander Dunayev has disclosed that several reusable Shuttles are under construction, and that they should be operational for "decades". However, he went on to emphasise that Shuttles would only carry spacecraft or orbit in exceptional cases since an Energia-Buran launch costs tens of times more than a launch by existing conventional carrier rockets. Dunayev also disclosed that no more than two to four Shuttle flights a year are envisaged. These comments have been reinforced by Vladimir Shatalov, chief of cosmonaut training: "Considering that the USSR plans to continue using all types of rockets, Buran-type craft aren't expected to fly very often." So why build a Shuttle craft?

Roald Sagdeyev

The desire to update hardware must be one motive. The existing fleet of expendable boosters annually launches more than 100 payloads into orbit, far more than all other nations put together. These dependable workhorses and variations of the three-man Soyuz ferry have served the Soviets well for the past 20 years, but any self-respecting space power which is eager to project the image of a thriving, modern post-industrial country cannot be expected to rely for ever on outdated technology.

"Considering that the USSR plans to continue using all types of rockets, Buran-type craft aren't expected to fly very often." So why build a shuttle craft ?

Once the argument for safer, more modern manned spacecraft is won, the discussion then turns to what you can do with the new creation. Early official statements vaguely mentioned "orbiting some large-scale but fragile loads, repairs out in space or bringing back to Earth satellites that have developed faults". As in the US version, a "manipulator" in the cargo bay is available for releasing or placing satellites in the bay. Such opportunities for satellite repair work at an altitude of 250 km are fairly limited since many satellites orbit Earth at much greater altitudes.

On the other hand, Buran's capability to carry a 30 tonne payload into low Earth orbit (considerably more than the US version) or to return a 20 tonne load (equivalent to a heavy Cosmos research module or the entire Mir base unit) back to Earth has obvious advantages. The orbiter can also be used for the Soviet equivalent of a Shuttle-Spacelab mission, lasting up to a month in low orbit.

Recent Soviet pronouncements have been more specific about the future operations of their Shuttle. Chief Designer Reusable Spaceships, Yuri Semenov, has announced that Buran will one day retrieve the mothballed Salyut 7 and return it to Earth for inspection. However, its main mission is to "launch costly facilities fitted out with unique scientific instruments, for example, large optical telescopes with sophisticated electronic equipment". Other uses could include "the creation in orbit of big radio telescopes, aerial systems, solar power stations and interplanetary complexes. These are extremely expensive constructions, each of which is the only one of its kind and needs to be serviced by manipulators, robots and qualified personnel". Such large constructions could one day include a 450 tonne craft for a manned Mars expedition. But do such specialised functions really justify massive expenditure on a Shuttle craft?

What about transfer of crews to and from the space station? Shatalov admits that it makes more sense to use the usual Soyuz system to carry two or three men into orbit. However, Buran is designed to dock with Mir, and is capable of carrying up to 10 crew, including "experimenters and researchers". This description implies that science specialists will play an increasing part in future crews visiting Mir, replacing the military test pilots who have so far dominated the cosmonaut corps.

Mir is capable of receiving four more scientific laboratories similar to Kvant, and, from Soviet statements, these modules clearly have an important role to play in the coming years, despite delays in their development. They will include facilities for micro-gravity processing of materials, for Earth-resources investigation, and astrophysical observations. Certainly, a flight on board the Shuttle should be less stressful for older, relatively unfit scientists, particularly during re-entry, than on the cramped Soyuz capsule. Researchers will also be able to bring back more samples and equipment than is currently possible in the cramped Soyuz TM.

Mikhail Gorbachev expressed his hopes and ambitions for the new craft shortly after Buran's safe return: the Shuttle "makes it possible to concentrate the principal efforts and means in those areas of space exploration that will ensure the maximum economic return to the national economy and will advance science towards higher frontiers". Is this brave rhetoric simply an echo of the words so proudly spoken by President Reagan after the American Shuttle's maiden flight in 1981?

Academician Sagdeyev clearly disagrees with his political master. Comparing the space programmes of the two superpowers in an unflattering light, he wrote: "The US aerospace industry, like the Soviet industry bureaucracies, used its influence to subvert the logic of science." He is not alone. Academician Vladimir Struminsky is of the opinion that Buran is less cost-efficient for ferrying cargoes to orbit and retrieving them than traditional spacecraft. Energia designer Boris Gubanov has admitted that the booster's payload-takeoff weight ratio can be quite low, mainly due to the problem of ensuring extra safety measures for Shuttle crews.

Professor Sagdeyev speaks for many space scientists all over the world, not least in the United States where years of expertise in planetary exploration have been squandered during a decade of inactivity. Is his pessimism justified? Is the Soviet Snowstorm a winged wonder or a white elephant? No doubt readers of ***Spaceflight*** have their options on this matter. Only time will tell.

BOOK NOTICES

RACE INTO SPACE: The Soviet Space Programme

B. Harvey, J. Wiley & Sons Ltd., Baffins Lane, Chichester, W. Sussex, England, PO19 1UD, 1988, 381pp, £16.95.

In this account the author describes the awe and astonishment widely felt when the first Sputnik circled the Earth and which, he believes will continue to inspire further generations of scientists and technologists.

The dramatic events of the Soviet Space Programme are recounted from its earliest beginnings, starting with the theoreticians of the 19th century whose ideas culminated in the Sputnik launches in 1955–57. Gagarin's epic single-orbit flight is dealt with in detail as well as the many ensuing pioneer manned spaceflights, including the flight of Valentina Tereschkova, the first woman to venture into space.

USSR-US rivalry in the race to the Moon is described, followed by an account of Soviet Space Centres which contains much which will be new to many readers.

Soviet deep space missions, so successful in flights to Venus, achieved patchwork results when applied to Mars, though such mishaps were more than outweighed by the extensive manned space flights over a number of years involving the Salyut and Mir Space Stations and record-duration stays by cosmonauts.

It remains a mystery to many in Europe and elsewhere why a country such as the USSR should invest so much material resources in the conquest of space when it faces major difficulties in agricultural production and in meeting consumer needs generally . The factors that led the USSR into space in the 1950s undoubtedly had little to do with space clairvoyants The drive for military supremacy and the desire to demonstrate technological prowess were undoubtedly the real factors that provided the initial will to put men into space and send the first rockets to other worlds.

By the late 1970s, Russian cosmonauts were flying in space for half a year at a time and a decade later the Soviets were operating a permanent space station in orbit where modules were docked together, reformed and refuelled though, ironically, these years of solid achievement have been virtually unnoticed outside the USSR itself.

Even so, much previous Soviet space history remains unclear e.g. the story of how the Soviet lunar plans evolved, changed, and ultimately collapsed. There is also little about possible earlier space stations and even the history of the Soviet Space Shuttle remains obscure.

This book endeavours to record and assess all these events and to place them into perspective.

As the author remarks, *"The race into space may now be over: the conquest of the solar system could be about to begin"*.

The Soviet Manned Space Programme

P. Clark, Salamander Books, 52 Bedford Row, London, WC1R 4LR, 1988, 192pp, £14.95.

This book evolved from papers originally prepared by the author and Ralph Gibbons for publication in the Journal of the British Interplanetary Society and is dedicated to the memory of Anthony Kendon (1947–1987) a former Fellow of the Society.

The USSR Space Programme continually evokes surprise at the realization of size and vitality of both their manned and unmanned programmes, including launch vehicle lift capacity and the rapidly extending number of man-hours logged.

This superbly illustrated book describes the origin of this ambitious programme, the rivalries with America that spurred Soviet designers in the 1960's and the evolving strategy behind the manned missions that have led to the dominant position of the USSR in such missions today.

The book also looks ahead to the forthcoming Soviet Shuttle and to the, even larger, permanently manned space station complexes as well and, ultimately, to a manned Mars Mission.

The Soviet Space Programme

R D. Humble, Routledge, Chapman & Hall Ltd., 11 New Fetter Lane, London, EC4P 4EE, 1988, 158pp, £30.00.

Although the USSR Space Programme has been impressive and embraced a number of projects and activities ahead of the Amercians, until very recently the Soviets have been unduly secretive about many aspects, even those of a non-military character.

This book endeavours to redress the balance by providing an overview of Soviet Space programmes from the beginning to the present time, an important theme emphasised being the substantial degree to which it has been orientated towards military purposes.

Guide to Manned Space Missions

C. Van Den Berg, Jr, Gemini Productions Holland, Fuustraat 10, 3362 NC Sliedrecht, The Netherlands. 1988, 131pp, £7.95.

This book, based on the use of a computer database, provides an account of all manned space flights between 1961-88, including the thirteen X-15 rocket-aircraft missions which exceeded an altitude of 80 km, the height often regarded as the demarkation line between air and space. Also listed are all who were trained or selected for future or cancelled missions but who never actually ventured into space.

The volume is divided into three major parts – Manned Space Programmes, Manned Space Missions and details of astronauts and cosmonauts in various formats. All material is presented in tabular form, each table beginning with a section which explains the column numbering.

Webb Society Deep-Sky Observer's Handbook Vol.6 (Anonoymous Galaxies)

Ed. K.G. Jones, Enslow Publishers Inc., P O Box 38 Aldershot, Hants, GU12 6BP. 1987, 160pp £10.95.

Webb Society Deep-Sky Observer's Handbook Vol. 7 (The Southern Sky)

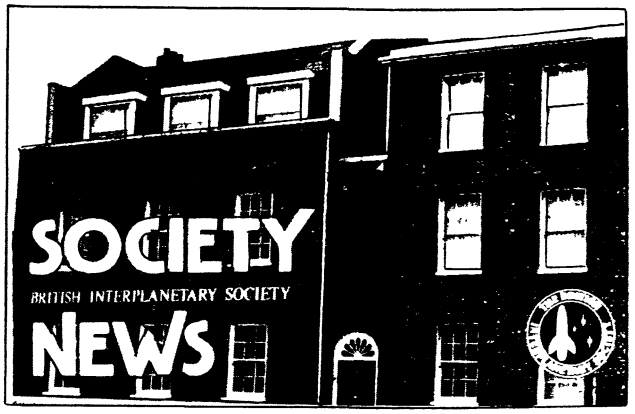
Ed K.G. Jones, Enslow Publishers Inc., P O Box 38, Aldershot, Hants, GU12 6BP. 1987, 228pp, £14.95.

Both of these belong to a series of independent volumes addressed to the more serious amateur astronomer, the series title commemorating the Reverend T. W. Webb (1807-1885), an eminent amateur astronomer who authored the classic work *"Celestial Objects for Common Telescopes"*, first published in 1859. Each volume is complete and self-contained with respect to the subject covered.

Anonymous galaxies, i.e. objects not listed even in the comprehensive New General Catalogue and its two index supplements, are dealt with in Vol.6. After a brief historical review, the book describes the older visual catalogues and the many modern photographic catalogues and atlases upon which any search for anonymous galaxies must be based. Following chapters indicate the methods required to observe such faint and remote objects, for advances in telescope making in recent years now make it possible for an amateur to be the first to observe and describe one of them. The second part of the book contains a catalogue which details, with diagrams, observations of 165 galaxies. Actually, many are listed in specialised catalogues but some really are "unlisted" and thus, hitherto truly anonymous, for which their particular observers may now claim right of discovery.

Whereas earlier volumes were confined to areas of the sky north of about 20 degrees S.decl., Vol.7 describes some of the glittering prizes to be seen only from the southern hemisphere. It starts with a short history of observations of the southern sky, followed by extended descriptions of a dozen or so major celestial objects. The major part then catalogues and illutrates some 300 other important objects, though rather briefly.

An idea of the riches accumulated south of, say, 30 degrees S.decl i.e. comprising only one quarter of the total celestial sphere, can be gauged from the fact that it includes the centre of our galaxy, the "Coal-sack" - that most prominent of the great clouds of interstellar dust, the Magellanic Clouds, planetary and diffuse nebulae in abundance and both open and closed star clusters. All this without the attraction of the Southern Cross and Alpha Centauri.



Society in Good Shape for 1989

The Society enters 1989 with the green light showing for an effective programme of activities. Much of this is made possible by the continuing support of members and others who support the Society in its role of promoting the advancement of space and astronautics.

1988 saw important new developments in space with a continuing close involvement by the Society and many of its members, either through the Society or on an individual basis.

Robert H. Oakes of Gosport, Hants writes:

> I should like to take this opportunity to congratulate all those involved with the running of our Society and on the excellence of its publications, which must be the finest available in this country Well done! In addition I would like to express my appreciation of the continuing efforts to publicize and advance both manned and unmanned astronautics by our Society's executive members – especially in the light of the political climate that exists in our country at the present time

1988 was also a time of considerable upheaval at the Society's HQ due to the renovation of the premises, both externally and internally (***Spaceflight,*** January 1988, p.31). Work is continuing on the building's interior and, although much still remains to be done, it is clear that the attendant benefits to our programme will be showing through in 1989.

News . . . Society News . . . Society

The Society fulfils an international role through its world-wide membership and by virtue of its position as the UK National Representative Body of the International Astronautical Federation (IAF). As part of this work the Society will be co-sponsoring the IAF International Conference on Space Power to be held in June 1989 and the 8th International Space Development Conference to held in Chicago in May 1989.

In addition the Society is co-sponsoring an Institute of Electrical Engineers (IEE) meeting on Electric Propulsion.

Details of these events will appear in the Meetings Diary.

The Society will continue to keep readers up-to-date with news and views of developments in space by its ***Spaceflight*** magazine, which has world-wide distribution. Overseas copies will continue to be dispatched by air-speed delivery.

Detailed technical material will continue to be published in JBIS for which several special issues are planned during 1989. The technical work of the Society will also be carried forward through its meetings programme and, for those members who are at a distance and not able to attend, reports of meetings and of the papers presented will be published wherever practicable.

'Join Now for 1989'

Joining the BIS means becoming part of a world-wide membership for promoting space and astronautics. Founded in 1933, the BIS has been to the fore from the early pioneering days of interplanetary concepts to the dramatic space accomplishments of the present day.

The BIS continues to look towards the future, as it has done in previous years, realising that progress depends on energetic and broad-based support for the development of new and peaceful space initiatives and the advancement of relevant knowledge. Membership of the Society is an effective way of providing such support and of advancing space and astronautics internationally.

At this time of the year members are asked to make a special effort to bring the work of the Society to the attention of colleagues and others and to invite them to "Join Now for 1989". A copy of ***Spaceflight*** will be sent by the Society, free-of-charge, to any friend or colleague nominated. Please write to the Society with appropriate names and addresses.

MEETINGS DIARY

Society meetings, unless otherwise stated, are held in the Society's Conference Room, 27/29 South Lambeth Road, London SW8 1SZ. Meetings are restricted to Society members unless otherwise stated. Tickets should be applied for in good time by writing to the Executive Secretary at the above address enclosing an SAE. Subject to space being available members may also apply for a ticket for one guest.

LIBRARY OPENING

The Society Library is open to members on the first Wednesday of each month (except August) between 5.30 pm and 7 pm. Membership cards must be produced.

1 February 1989, 7.00-8.30 p.m. Lecture

THE DAWN OF THE SPACE AGE

A lecture by Dr. John Becklake. The space age began on October 4 with the launch of Sputnik 1. This was the culmination of a sequence of events dating from the start of the 20th Century.

Admission is by ticket only. Members should apply in good time by enclosing a stamped addressed envelope.

March 1 1989, 7.00-8.30 p.m. Lecture

SOME INTERESTING SPACE PIONEERS

This lecture by Professor Ian Smith reviews the contribution made by a number of noted space pioneers known to the speaker, including Wernher von Braun and Val Cleaver.

Admission is by ticket only. Members should apply in good time enclosing a stamped addressed envelope.

8 March 1988, 2.00-5.00pm Colloquium

ELECTRIC PROPULSION COLLOQUIUM

A meeting co-sponsored by the British Interplanetary Society and the Institute of Electrical Engineers. The primary aim of the meeting is to discuss the applications of Electric Propulsion, not the technology itself.

For more information please write to the Executive Secretary, 27/29 South Lambeth Road, London, SW8 1SZ.

3 June 1989 10am-4.30pm Symposium

SOVIET ASTRONAUTICS

Venue: Conference Room, British Interplanetary Society, 27/29 South Lambeth Road, London SW8 1SZ.

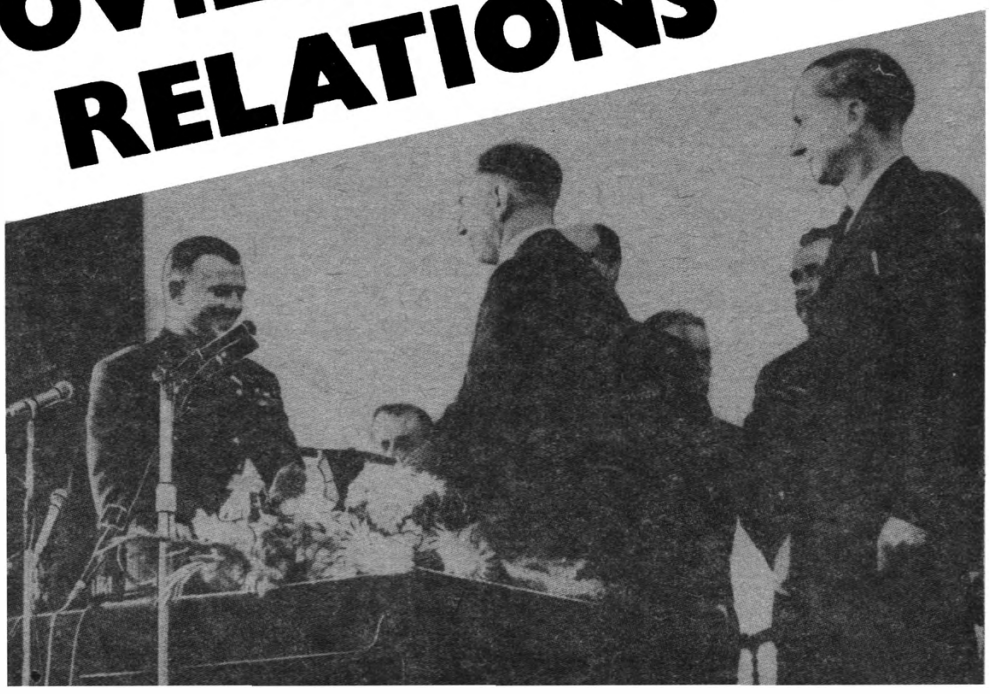
Offers of Papers
Authors wishing to present papers should contact the Executive Secretary.

Registration
Forms are available from the Executive Secretary, The British Interplanetary Society, 27/29 South Lambeth Road, London SW8 1SZ. Tel: 01-735 3160.

BIS-SOVIET RELATIONS

First Man in Space Honoured by Presentation of BIS Gold Medal

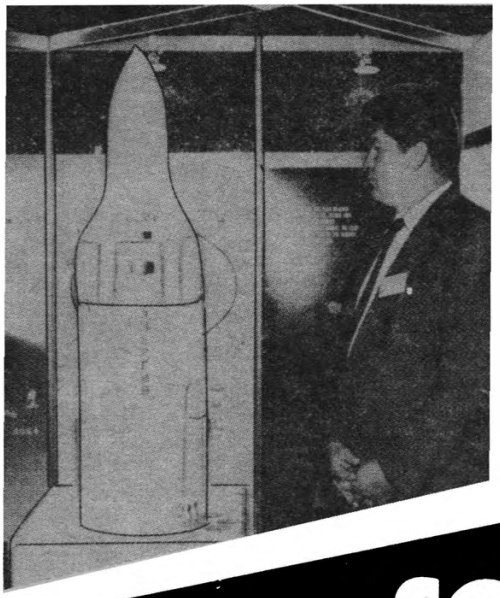
The medal is three inches in diameter and bears the presentation inscription on one side, in this case to Yuri Gagarin



Dr W R Maxwell, with other representatives of the Society, presents its Gold Medal to Yuri Gagarin during his visit to London in 1961

ENERGIA Model First Shown at BIS' SPACE '87

Cosmonaut Valeri Ryumin and the Energia model at SPACE '87, Brighton. *P. J. Fulford*

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Spaceflight

February 1989

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The British Interplanetary Society
27/29 South Lambeth Road
London, SW8 1SZ, England

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BIS-SOVIET RELATIONS

Valentina Tereshkova receives the Society's Gold Medal in recognition of her historic flight in Vostok 6 during a visit to London at the invitation of the BIS The presentation was made by Dr L R. Shepherd at a special meeting of the Society at the Piccadilly Hotel, London.

First Woman in Space Honoured by Presentation of BIS Gold Medal

The other side of the medal bears a motif comprising of the world, a space rocket and a human figure

BIS 50th Anniversary Honoured by 'Intercosmos' Council of the USSR Academy of Sciences

АКАДЕМИЯ НАУК СССР
СОВЕТ ПО МЕЖДУНАРОДНОМУ СОТРУДНИЧЕСТВУ
В ОБЛАСТИ ИССЛЕДОВАНИЯ И ИСПОЛЬЗОВАНИЯ КОСМИЧЕСКОГО ПРОСТРАНСТВА
«ИНТЕРКОСМОС»

ACADEMY OF SCIENCES OF THE USSR
COUNCIL ON INTERNATIONAL
COOPERATION IN RESEARCH AND USES OF OUTER SPACE
«INTERCOSMOS»

[illegible]

1 ноября 1983г. №10240/1137

L J Carter
Executive Secretary
27/29 South Lambeth Road
London SW8 1SZ
England

Уважаемый господин Картер,

Совет "Интеркосмос" при АН СССР шлет Британскому обществу межпланетных сообщений поздравления в связи с 50-летием его деятельности и наилучшие пожелания. Мы ценим большой вклад Общества в развитие космонавтики в мирных целях на благо человечества и в информирование общественности о космических достижениях.

С уважением,

Председатель Совета
"Интеркосмос" при Академии наук
СССР
академик В.А.Котельников

The translation reads:

Dear Mr. Carter,

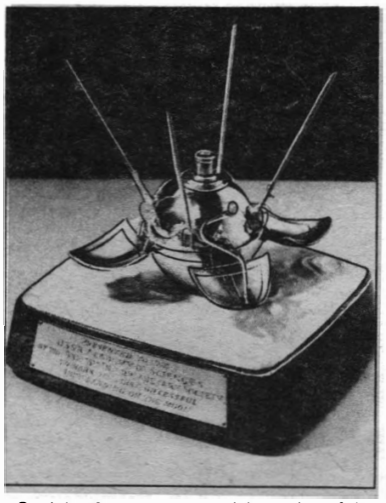
The "Intercosmos" Council of the USSR Academy of Sciences sends its congratulations and best wishes to the British Interplanetary Society on the occasion of the 50th Anniversary of its activity. We appreciate the great contribution of the Society to the development of cosmonautics of peaceful aims for the welfare of humanity and to the (task of) informing the public about space achievements.

Yours respectfully,

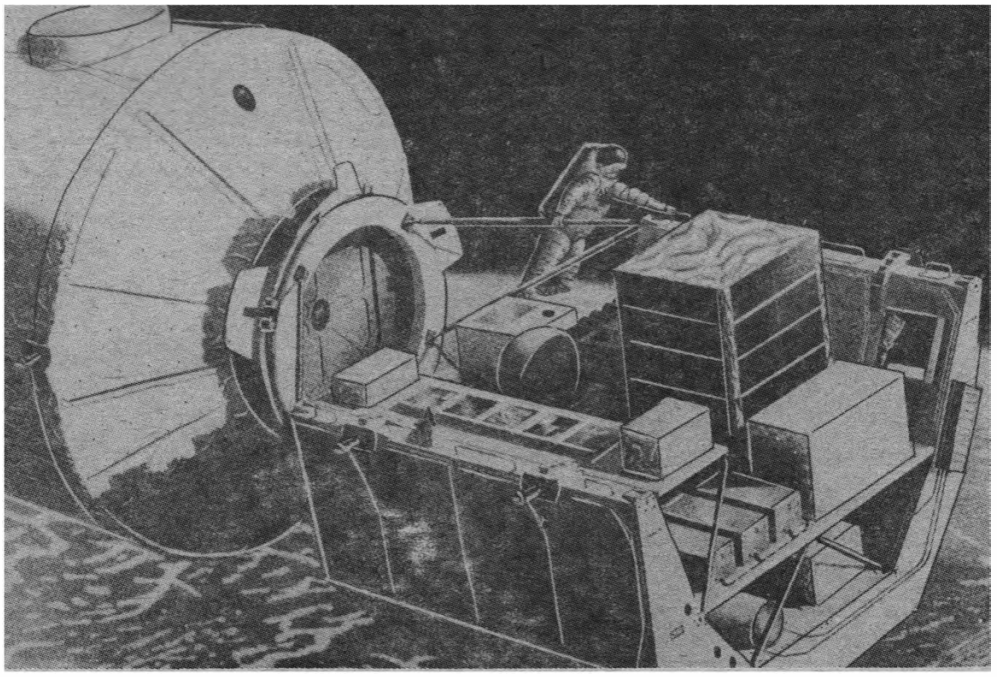
Academician V.A. KOTELNIKOU
Chairman of the "Intercosmos" Council
of the USSR Academy of Sciences

Poster:
Cosmonauts, Valentin Lebedev, Anatoli Berezovoi and Svetlana Savitskaya relax onboard the Salyut 7 space station in 1982.

First Successful Lunar Soft Landing by Luna 9



On July 13, 1966, at a special meeting of the Society at University College London, Dr L R Shepherd presented this silver model of Luna 9 to Academician A. A Blagonravov representing the USSR Academy of Sciences to mark the first soft landing on the Moon on February 3, 1966



A pallet attached to the Columbus Attached Pressurised Laboratory acting as an exposed experiment platform, a concept outlined in a British Aerospace paper at the symposium.

Expanding the Space Infrastructure

The following Report on the one-day symposium held by the Society on November 15, 1988 is provided by *Mark Hempsell*:

By 'Space Infrastructure' is meant the collection of those working elements which provide the supporting functions to space activity. Included are such systems as launch vehicles, space stations, lunar bases and planetary transportation systems, all analogous to roads, railways, power utilities and the like of our terrestrial infrastructure.

It was, therefore, very timely that the Society should have held a symposium on this subject on November 15, 1988, the same day that the Soviet Union successfully tested a major new element in their own space infrastructures.

Eight papers were presented ranging from the long-term future of space infrastructures to detailed proposals for systems able to support the next step.

The day started with Bob Parkinson outlining work on models for the space economy appropriate to the middle of the next century. This gave, in impressive detail, the likely economic interaction of bases and colonies throughout the Solar System, from the Moon to Jupiter. The major exports of this economy to Earth would come from solar power satellites, microgravity processing products and tourism in low-Earth orbit, all for a postulated population of around 25,000 people with a gross space product of 16 billion 1986 dollars.

The next paper from Mark Hempsell built on this work by describing a programme for expanding the current space infrastructure to the size indicated by the Parkinson model. It estimated a time-scale of at least 45 years after establishing the space station to build up colonies and bases of the size indicated by the model. It suggested also that the infrastructure described might provide the minimum needed to meet the requirements of an expanding industrial-based civilisation in the 21st century.

John Sved also explored the broad thrust of expansion into space, in particular the drive to establish a lunar colony, drawing a series of striking comparisons with the British colonization of Australia.

Two following papers, by Uwe Riedel and Klaus-Peter Ludwig from MBB/ERNO, gave an overview of infrastructure studies funded by ESA, the German Government and internally by the company. Most significant in the short term was a study for ESA called "Long-Term Evolution Toward European Manned Spaceflight", which outlined development of an independent European Space Station and which had been followed up by a series of more detailed studies that will, hopefully, lead to such a station in the first decade of the next century.

Other studies took a more long-term view, including an interesting re-examination of solar power satellites in the light of technology improvements since the last major examination in the mid 1970s. As might be expected the increasing number of studies now being conducted in support of decision-makers at all levels in Germany starkly contrasts with the situation in the United Kingdom.

Gerry Webb and P. Hansson of Commercial Space Technologies Ltd, presented a joint paper on the subject of exploiting the resources of the Martian moons, Phobos and Deimos. The theme was finding the easiest source of materials to supply the major space industries needed to maintain a technology-based civilization. The audience was reminded of the oft-forgotten fact that it takes less energy to reach the Martian moons than it does to reach the lunar surface. The paper suggested some of the materials that could be returned, with particular emphasis on platinum and related metals.

The day finished with two papers on several detailed matters. Mark Hempsell and Charles Martin of British Aeorspace presented a joint paper showing the potential use of the Spacelab Pallets as exposed platforms on the Freedom space station while Dave Salt discussed details of transportation between the space station and lunar facilities, showing the impact of various locations on launch window, flight times and velocity.

Almost half the papers made reference to the work of Tony Martin who delivered a paper at SPACE '84 on the need of space resources to prevent the collapse of a technology-based civilization over the next two centuries. It was therefore appropriate that he was in the audience and started off a lively and wide-ranging discussion on our need for space infrastructures.

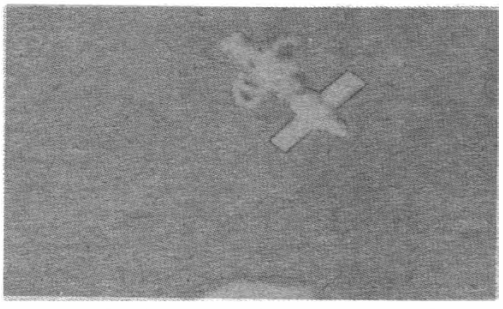
SOVIETS In SPACE CORRESPONDENCE

Soviet Spacecraft Revealed

Sir, Whilst at the recent Soviet space exhibition in Birmingham I saw two videos and managed to snap some shots of two vehicles which have not, to my knowledge, been seen in the west.

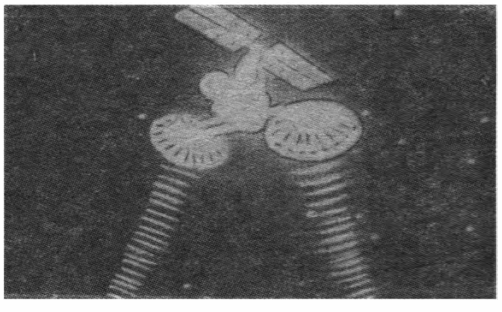
The two vehicles are:

Kosmos 1686. This appears in a long-range shot taken by the departing Soyuz T-15 crewmen. Not much is evident of the actual structure but we can see that it has solar panels, it is attached to the front of Salyut 7, and has a "stunted" appearance. The Soviets said that this Heavy Kosmos module did not carry a return vehicle as did the Kosmos 1443 vehicle. Therefore, until better shots are available, we must conclude that the front contains a battery of telescopes.



Salyut 7 and Kosmos 1686 taken from Soyuz T-15.

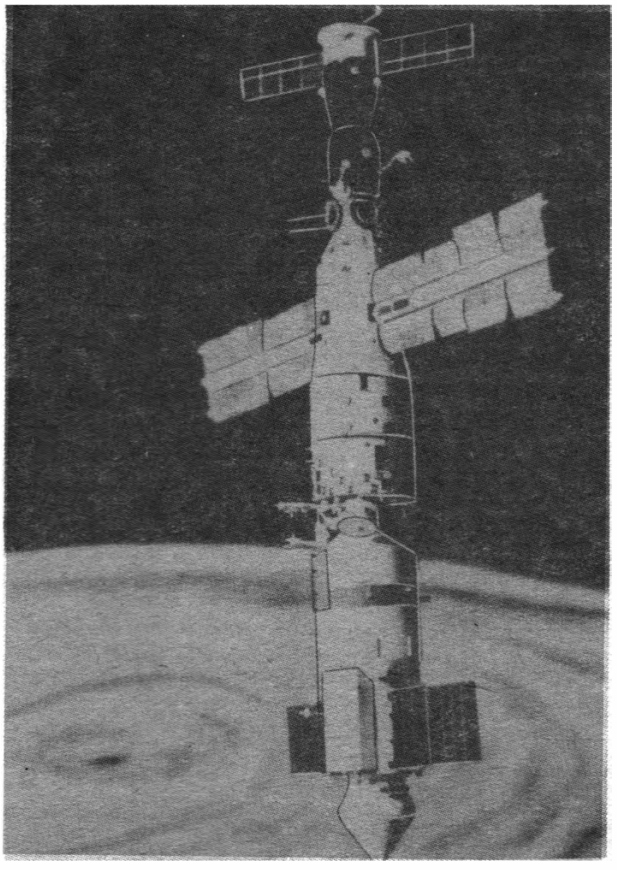
Luch. This is the film's rendition of the Kosmos 1700 Luch SDRN relay satellite in geostationary orbit. It carries two large antennas for receiving transmissions from Mir and for relaying these to the ground. Two solar panels atop the box-and-cylindrical structure provide power to the electronics.



Luch (Kosmos 1700) illustration.

Finally, I have enclosed a photo of a model made by Phil Mills of the Kvant Functional Assembly Block constructed on the basis of Soviet drawings. The FAB, which served as the engine block for the delivery of the Kvant astrophysics module was left in orbit after detaching from the Mir complex. The extra firings of its engines to achieve the rendezvous and docking with Mir in April 1987 meant that it was left with insufficient fuel for a controlled reentry and it burned up on 25 August.

NEVILLE KIDGER
Morley, Leeds, UK



Model by Phil Mills of the Kvant/Mir complex before the Kvant FAB was detached on April 12, 1987.

Soyuz Orbital Module

Sir, With reference to the letters in ***Spaceflight*** (June and August 1988) concerning the Soyuz TM Orbital Module.

In view of the problems encountered by Vladimir Lyakhov and Abdul Ahad Mohmand aboard Soyuz TM-5 returning to Earth in September I would have thought the module's use was obvious. It is simply provided above all else to give the crew more room. It will be recalled that the cosmonauts spent an uncomfortable 24 hours in the cramped Soyuz Descent Module prior to their delayed return to Earth.

Moreover, since that flight several cosmonauts and Soviet space officials have commented that the orbital module might be retained longer after undocking from Mir prior to reentry. It will be interesting if this procedure is changed for future flights.

Keep up the good work at ***Spaceflight***.

GEORGE A. SPITERI
Birmingham, UK

Energia

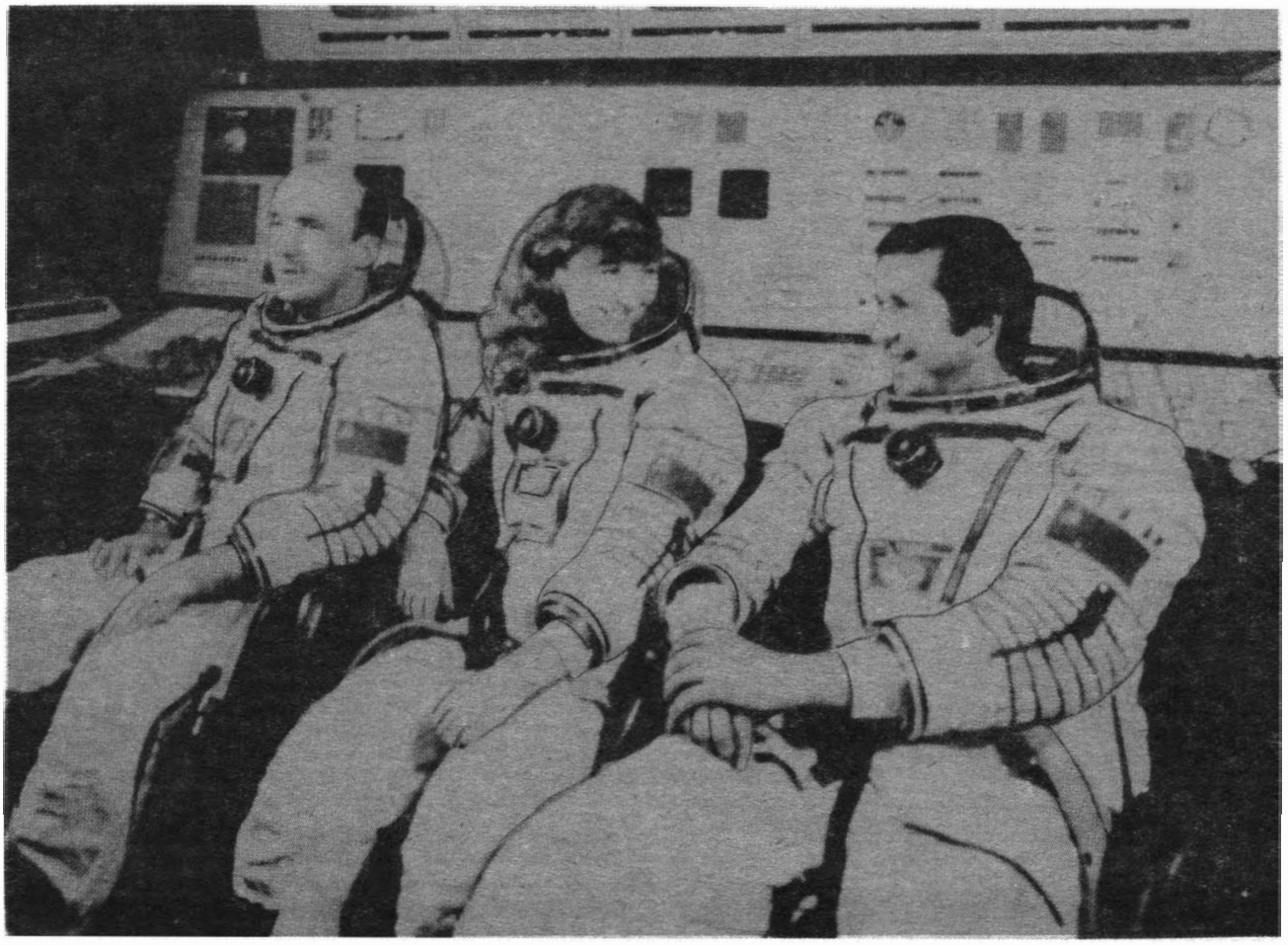
Sir, Further to Mr. Lawton's letter in November ***Spaceflight***, p.438, we have now seen numerous pictures of Energia in combination with the Soviet shuttle Buran.

The length of Buran, given as 36 metres, is consistent with the height of Energia given as 60 metres. But in this case the diameter of Energia's core is hardly much less than 8.5 metres, not 8 as stated.

The height/width ratio of the "Brighton model" of Energia is not correct.

The core diameter makes a greater difference to the estimated size of Energia than the height, since the volume varies as the square of the diameter. Taking the core diameter as 8.5 metres makes Energia one-eigth bigger than if it was 8 metres – no small consideration.

TONY DEVEREUX
Essex, UK



The back-up crew of Soyuz T-7. Left to right: V.V. Vasyutin, Irina Pronina and V.P. Savinykh. It is understood that Irina Pronina may be assigned to a Mir mission in 1991.

Soviet Backup List

Sir, Enclosed is a list of back up crews to Soviet missions which I received recently from the information group in Zvezdny Gorodok. It solves some longstanding mysteries like the names of the Soyuz–13 back ups and the name of the back up flight engineer of Soyuz–24. All in all, it contained six new names. I'm sure the list will be of interest.

Valery Aleksandrovich Yazdovsky was born on July 8, 1930. He joined the cosmonaut team in November 1969 and left in December 1973 (the month Soyuz 13, for which he was the back up flight engineer, was launched).

Lev Vasilyevich Vorobyov was born on February 24, 1931. He became a cosmonaut in October 1963 and left in June 1974. Michail Ivanovich Lisun was born on September 5, 1935, and became a cosmonaut in October 1965. He is said to be still active.

Vladimir Sergeyevich Kozelsky was born on January 12, 1942 and selected in May 1967. He too is still active.

Vladimir Yevenyevich Preobrazhensky was born on February 3, 1939 and was selected in October 1965. He left the team in October 1980.

Yekaterina Aleksandrovna Ivanova was born in 1949. She became a cosmonaut in 1980. Another member of this selection was Irina Rudolfovna Pronina who was born on April 14, 1953. Both are still active.

Vostok–1	Titov G S.	Soyuz–1	Gagarin Y.A.
Vostok–2	Nikolayev A.G.	Soyuz–3	Shatalov V.A. Volynov B.V.
Vostok–3	Bykovsky V.F Volynov B.V	Soyuz–4	Shonin G.S.
Vostok–4	Komarov V M Volynov B.V.	Soyuz–5	Filipchenko A.V Kubasov V.N. Gorbatko V V.
Vostok–5	Volynov B V		
Vostok–6	Solovyova I.B. Ponomareva V.L.	Soyuz–6	Shatalov V.A. Yeliseyev A.S.
Voskhod–1	Volynov B V. Katys G P. Lazarev V G.	Soyuz–7	Shatalov V.A. Kolodin P.I Yeliseyev A.S
Voskhod–2	Gorbatko V.V. Zaikin D A. Khrunov Y.V.	Soyuz–8	Nikolayev A.G. Sevastyanov V.I.
Soyuz–9	Filipchenko A.V. Grechko G.M. Lazarev V G. Yazdovsky V.A.	Soyuz–14	Sarafanov G.M. Demin L.S. Volynov B.V Zholobov V.M. Zudov V.D. Rozhdestvensky V.I
Soyuz–10	Leonov A.A. Kubasov G.M. Kolodin G.I. Dobrovolsky G.T. Volkov V.N. Patsayev V.I	Soyuz–15	Volynov B V Zholobov V.M. Zudov V.D. Rozhdestvensky V I.
Soyuz–11	Leonov A.A. Kubasov V.N. Kolodin G.I.	Soyuz–16	Dzhanibekov V.A. Andreyev B.D. Romanenko Y.B. Ivanchenkov A.S.
Soyuz–12	Gubarev A.A. Grechko G.M.	Soyuz–17	Lazarev V.G. Makarov O.G. Klimuk P.I. Sevastyanov V.I.
Soyuz–13	Vorobyov L.B. Yazdovsky V.A.		

CORRESPONDENCE

Soyuz–18	Kovalyonok V.V. Ponomaryov Y.A.
Soyuz–19	Filipchenko A.V. Rukavishnikov N.N. Romanenko Y.V. Ivanchenkov A.S. Dzhanibekov V.A. Andreyev B.D.
Soyuz–21	Zudov V.D. Rozhdestvensky V.I. Gorbatko V.V. Glazkov Y.N. Berezovoi A.N. Lisun M.I.
Soyuz–22	Malyshev Y.V. Strekalov G.M. Popov L.I. Andreyev B D.
Soyuz–23	Gorbatko V.V. Glazkov Y.N. Berezovoi A.N Lisun M.I.
Soyuz–24	Berezovoi A.N. Lisun M.I. Kozelsky V.S. Preobrazhensky V.E.
Soyuz–25	Romanenko Y.V. Ivanchenkov A.S.
Soyuz–26	Kovalyonok V.V Ivanchenkov A.S.
Soyuz–27	Kovalyonok V V. Ivanchenkov A.S.
Soyuz–28	Rukavishnikov N N. Pelcak O.
Soyuz–29	Lyakhov V.A. Ryumin V.V.
Soyuz–30	Kubasov V N. Jankowski Z.
Soyuz–31	Gorbatko V V. Kollner E.
Soyuz–32	Popov L.I. Lebedev V V.
Soyuz–33	Romanenko Y.V. Aleksandrov A.P.
Soyuz–35	Zudov V.D. Andreyev B.D.
Soyuz–36	Dzhanibekov V.A. Magyari B.
Soyuz T–2	Kizim L.D. Makarov O.G.
Soyuz–37	Bykovsky V F. Liem B.T.
Soyuz–38	Khrunov Y.V. Lopez-Falcon J A.
Soyuz T–3	Lazarev V.G. Savinykh V.P. Polyakov V V.
Soyuz T–4	Zudov V.D. Andreyev B.D.
Soyuz–39	Lyakhov V.A. Ganzorig M.
Soyuz–40	Romanenko Y.V. Dediu D.
Soyuz T–5	Titov V.G. Strekalov G.M.
Soyuz T–6	Kizim L.D. Solovyov V.A. Baudry P.
Soyuz T–7	Vasyutin V.V. Savinykh V.P. Pronina I.R.*
Soyuz T–8	Lyakhov V.A. Savinykh V.P. Aleksandrov A.P.
Soyuz T–9	Titov V.G. Strekalov G.M.
Soyuz T–10	Vasyutin V.V. Savinykh V.P. Polyakov V.V.
Soyuz T–11	Berezovoi A.N. Grechko G.M. Malhotra R.
Soyuz T–12	Vasyutin V.V. Savinykh V.P. Ivanova E.A.
Soyuz T–13	Popov L.I. Aleksandrov A.P.
Soyuz T–14	Viktorenko A.S. Strekalov G.M. Saley Y.V.**
Soyuz T–15	Viktorenko A.S. Aleksandrov A.P.
Soyuz TM–2	Titov V.G. Serebrov A.A.
Soyuz TM–3	Solovyov A.Y. Savinykh V.P. Habib M.
Soyuz TM–4	Volkov A.A. Kaleri A.Y. Shchukin A.V.
Soyuz TM–5	Lyakhov V.A. Serebrov A.A. Stoyanov K.

* Irina Rudolfovna Pronina was born on April 14, 1953
** Yevgeny Vladimirovich Saley was born on January 1, 1950.

BERT VIS
Den Haag, The Netherlands

Soviet Back-up Crews

Sir, My reaction to ***Spaceflight*** is belated because of the slow distribution of the magazine in the Soviet Union.

In ***Spaceflight***, March 1988, p.115, Neville Kidger assumed that Aleksandr Shchukin was in the same group as Levchenko. He is incorrect. Comrade Maltsev from the Cosmonaut Training Centre informed me about the biographical data of Shchukin. Aleksandr Shchukin joined the cosmonaut team in 1982 (Volk and Levchenko were in 1978). Readers might be interested to learn that Shchukin was born on January 19, 1946 in Vienna, Austria.

In correspondence, ***Spaceflight***, February 1988, p.72, Anne van den Berg linked Dr Ilyuin with the Voskhod 1 mission. This is wrong. In April 1988 our military newspaper *Krasnaya Zvezda* revealed that seven men were trained for this space flight: Two pilots (V. Komarov and B. Volynov), two engineers (K. Feoktistov, G. Katys) and three physicians (V. Lararev, A. Sorokin, B. Yegorov).

Georgi Katys and Alexi Sorokin have been unknown for a very long time. I recently received photographs of these two men from the Cosmonaut Training Centre.

Georgi Katys

Alexei Sorokin

Anne van de Berg suggested that Viktorenko must have been the Soyuz 13 back-up commander, with Sevastyanov being the back-up flight engineer. This is also wrong. In *Aviatsiya i Kosmonavtika* no.6, 1988 (p.44–45) Viktorenko revealed that in May 1977 A. Nikolayev visited Viktorenko's aircraft unit of the Baltic Fleet for cosmonaut selection. He wrote; "After medical tests I and N. Grekov were selected to join the cosmonaut team." So he was not at the Cosmonaut Training Centre until after the Soyuz 13 mission.

I can say that the Soyuz 13 back-ups were both space rookies and were to have been the prime crew but were replaced by Kilmuk and Lebedev.

Women Cosmonaut Crew Revealed

There has been much speculation and assumptions made in the space press about a Soviet all-woman crew.

I recently asked comrade S.M. Yegupov, an employee of the Cosmonaut Training Centre, about the crew. He informed me that the all-woman crew that trained for a Salyut–7 mission was:

- Svetlana Yevgenyevna Savitskaya
- Yekaterina Aleksandrovna Ivanova
- Yelena Ivanovna Dobrokvashina

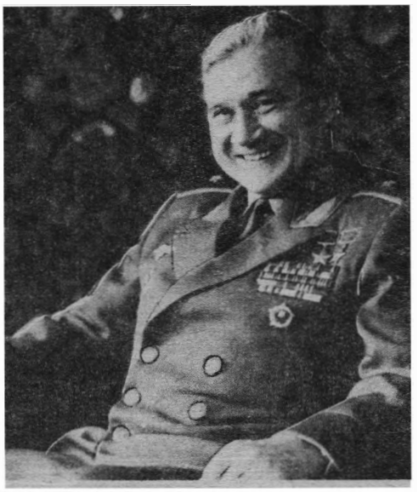
I hope this information is of interest to your readers.

VADIM Y. MOLCHANOV
Tula, USSR

Ed. *Since receiving this letter we have learnt of the sad death of Aleksandr Shuchukin in an aircraft accident on August 18, 1988.*

Y.P. Artyukhin

G.T. Dobrovolski



A.V. Filipchenko

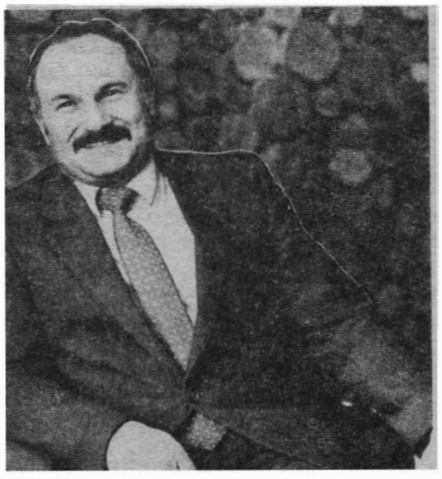
Cosmonauts of 1963

Sir, Recently the Cosmonaut Training Centre sent to me the list of cosmonauts selected in 1963. Readers may be interested to learn their names.

1. Yuri Petrovich ARTYUKHIN
2. Eduard Ivanovich BUINOVSKI
3. Georg Timoteyevich DOBROVOLSKI
4. Lev Stepanovich DYOMIN
5. Anatoli Vasilyevich FILIPCHENKO
6. Aleksey Aleksandrovich GUBAREV
7. Vladislav Ivanovich GULYAYEV
8. Pyotr Ivanovich KOLODIN
9. Eduard Pavlovich KUGNO
10. Anatoli Petrovich KUKLIN
11. Aleksandr Nikolayevich MATNICHENKO
12. Vladimir Aleksandrovich SHATALOV
13. Lev Vasilyevich VOROBYOV
14. Anatoli Fyodorovich VORONOV
15. Vitali Mikhailovich ZHOLOBOV

Seven of them became real cosmonauts. Two others were in back-up crews – Kolodin was the RE on the Soyuz 7, 10, 11 and Vorobyov was the CDR on the Soyuz 13, so six men were left out.

VADIM Y. MOLCHANOV
Tula, USSR



V.M. Zholobov

V.A. Shatalov

A.A. Gubarev

A Visit to Baikonur

Sir, You may be interested in the following facts that emerged from a visit to the Baikonur Cosmodrome.

The next module to be launched to the Mir space station will be a 20-ton Mir class spacecraft, providing additional life support systems and a large EVA airlock with a one metre diameter airlock.

The module will carry the first Soviet MMU. This will be tested by cosmonaut Alexander Volkov but only inside the module.

The MMU will be flown first by Alexander Serebrov, the flight engineer of Soyuz TM8 which will be launched in late April to replace the Volkov-Krikalev-Polyakov crew. Serebrov's commander will be Alexander Viktorenko and, if France agrees to pay for a commercial mission, the third crewmember could be Chretien's back up Michel Tognini. All three make up the back up crew of Soyuz TM7.

The Soviet space shuttle ejector seat is based on the Mig 25 and can be used from the launch pad to up to a speed of Mach 3. It can also be used for speeds below Mach 3 during landing and even on the runway if necessary.

Energia's core stage is not recovered and there are no plans to recover it. Its strap-on stages are not recovered either but there are plans to do so in future, with parachutes, soft landing rockets or a combination of both. The "packs" seen on the side of the strap-ons on the first two Energias are merely simulated parachute/engine containers.

The next flight of the Soviet shuttle will be unmanned and

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an extended mission. The third flight will be manned by two test pilots but probably not until 1990.

Tyuratam, the name of the railway junction near to which the "Baikonur Cosmodrome" was developed, is derived from Tyura Tam – the burial place of Tyura, a son of Jenghis Khan.

The name of Baikonur was chosen for the cosmodrome in 1961 because, needing to give Gagarin's launch site in order for his flight to be properly ratified, a flustered engineer chose Baikonur because in Russian it means "rich region", which to him sounded better than "burial place."

It has been formerly confirmed by General Kerim Kerimov, Soviet president of the state commission for manned spaceflight, that the original Soyuz 11 crew was indeed, Alexei Leonov, Valeri Kubasov and Pyotr Kolodin and they were replaced en masse by the back up crew when a medical inspection showed up a spot on Kubasov's lung. This was the final medical inspection before Kerimov was to formally announce the crew a few days before lift off so Leonov and company became the so far, only total crew to be replaced so close to lift off. Kerimov had toyed with the idea of just replacing Kubasov but felt it was too late.

TIM FURNISS
Bideford, Devon, UK

A Second Soviet Spaceplane?

Sir, Many indications [1] have appeared that the Soviets are developing one or more small but highly manoeuvrable spaceplanes with an aerodynamic shape quite different from the much larger Buran, the Soviet counterpart to the US Space Shuttle. It is, therfore, safe to assume that their planned role in the Soviet space programme is also quite different.

Although the general name "Kosmolyot" (Russian term for 'spaceplane') had often been used to describe these craft, I prefer the name 'Albatros' to distinguish a specific machine whose main characteristics resemble those of its natural counterpart, defined as "a large bird with a powerful gliding flight capable of spending long periods away from land".

Reports suggest that a small manned spaceplane is to begin full-scale testing as part of a programme to run separately from but in parallel with, the continuing (Buran) shuttle programme, and is intended for defence purposes, reconaissance work and the emergency repair of large Soviet satellites. The machine is expected to be operational in 1990. Its launch vehicle is the new SL-16 booster which has flown successfully seven times up to June 1987.

The SL-16M 'Albatros' launcher and the SL-16 Kosmos 1786 launcher are possibly recoverable. Testing the first stage recovery system [3] would seem to have been the object of the initial sub-orbital trials of Kosmos 1697 and 1714. Less than two months separated these trials so it may be concluded that certain aspects of the recovery system had to be fully proved in this first phase. It is, therefore, likely that these two firings were of the same equipment, providing information on typical turn-around times (51 days), the behaviour of their first recoverable booster and how the actual recovery and refurbishment programme met the design requirements.

Kosmos 1767 was the first true orbital vehicle, achieving a nominal orbit of 250 km apogee and 190 km perigee. It was presumed successful. Kosmos 1786 had exceptional orbital elements and is interesting for its apogee, given as 2,560 km. This figure, confirmed by Goddard Space Center, probably represents an extra impulse added by a motored dummy payload, after the style of the first 'Energia' launch.

This could be a Soviet test of an SL-16 launcher carrying a "dumb" but motored upper stage, i.e. and 'Albatros'-type payload. The Kosmos 1786 orbit could be indicative of the wide range of orbital choices available to the spaceplane needed to fill its projected role. The payload itself would have been a complete dummy, correct in mass, thrust, and mass ratio, but lacking aerodynamic characteristics.

The SL-16 launch programme has been very rapid (2 years) and apparently highly successful.

Ref. 4 mentioned the probability of a spaceplane design (Kosmolyot I) intended for use with the Proton SL-13 launch vehicle. Early sketches of Kosmolyot I show it to bear a strong resemblence to the abandoned Boeing X-20 'Dynasoar' project. A full size 'Dynasoar' would have been launched by Titan, a close counterpart of Proton. This scheme foundered when the launch vehicle did not receive man-rating. A new but similar launch vehicle, inherently safer and with a sturdier structure, has been realised in the newly emerged SL-16.

The extra programme taken by the launch vehicle development was also used to refine the Kosmolyot design as a result of flight testing an experimental scale model, which I have provisionally called 'Mischka', to arrive at Kosmolyot II. 'Mischka' showed that the earier ideas similar to Dynasoar have been considerably modified. The wings have a very sharp dihedral of approximately 45 degrees, a vertical fin has been added, the fuselage has been fattened, and a carefully contoured nose included in what appears to be a sophisticated craft intended to explore manoevrability and control over a very wide velocity range.

The outlines of "Mischka" bear a strong resemblance to the very successful Martin X-24B flown during the early and mid 1970's.

"Mischka" clearly shows a configuration expected for 'Albatros', but a significant question is – "what scale does Mischka represent?". Scaling factors on hypersonic aircraft are not simple: a minor instability in a model may be more of major importance on a full-sized man-carrying craft.

Western analysts are not agreed on the scale factor involved between 'Mischka' and the full-sized 'Albatros'. The US Department of Defence considers it to be a ⅓ scale model [5], others a ¼ scale [1]. The latter seems to produce too large a vehicle for 15 tonnes total weight and also may be stretching modelling scale dynamic factors too far. A scaling factor of 2.75 between 'Mischka' and 'Albatros' would give rise to a conservative design.

DOD consider that for 15 tonnes all-up weight 'Albatros' will have a wing span of 9.4 metres, a length of 16.25 metres and a fuselage depth of approximately 3.0 metres. This would comfortably fit on top of an SL-16 lift vehicle but the weight seems optimistically light for the quoted dimensions.

Using its single large manueovring engine, 'Albatros' would skim the upper atmosphere at a height of 80 km (50 miles). After high-resolution surveillance has been completed, the motor would be turned on to give the velocity increment needed to allow the spacecraft to do an orbital rendezvous with a spacestation complex.

A spaceplane like this would be capable of being lifted into LEO, docking with a space complex and performing various upper atmosphere tasks before returning to be refuelled and serviced. After a space duration of say 6 months or so, it would return to Earth base for checks. When these are completed 'Albatros' is placed atop an SL-16 and sent into orbit for a further 6 months mission.

When it does finally achieve operational status it will *complement*, not replace the existing Soyuz craft.

A.T. LAWTON
Goring, Sussex, UK

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Space Shuttles

Sir, In comparing the American and Soviet shuttles it is perhaps worth pointing out that the Soviet decision to locate the main engines on the external fuel tank, rather than on the shuttle body (and thus condemning them to destruction when the tank is discarded) has perhaps proved a wiser decision.

NASA originally planned that their main engines would be reuseable almost infinitely – with a minimum life of (at the very least) fifty flights. Technology has proved once again difficult to master, and in fact the space shuttle main engines are lucky to survive ten flights, with only one exceptionally well built motor – serial number 2012 – having made fifteen.

With mass production being cheaper than individual refurbishment, the Soviets have taken advantage of NASA's problems and made a decision which in the long term can only be more cost effective and which certainly provides greater reliability.

R. A. FLOOD
Darmstadt
West Germany

Space Elevator

Sir, Congratulations on the excellent article on "Space Tethers," by Rodica Ionasescu and Paul Penzo. The article gives me an opportunity to correct one misconception that most tether researchers have about the origin of the space elevator concept.

Tsiolkovsky did not invent the space elevator. His 1896 thought experiment envisioned a "cosmic railway" above the atmosphere and helped him understand the reversal of gravity on a tall tower, but it was not a workable device, any more than Einstein's famous "gedankenexperiment" on the equivalence of gravity and inertia in an elevator in space envisioned a real structure.

The first person to propose a real elevator was the Leningrad engineer Yuri Artsutanov [1]. In 1960, he proposed a large, passenger-carrying tower between the equator and a geostationary satellite and recognized some unusual energy aspects of the space elevator not seen by Tsiolkovsky. He did not publish a technical paper, however, and his work was not known in the West in 1966, when Isaacs *et al.* re-invented the space elevator on a small scale [2]. They proposed "walking" small payloads into orbit by alternately raising and lowering two fine wires balanced about the geostationary point. This paper also received very little notice.

The third, and last, invention of the space elevator was my "orbital tower," conceived in 1970 and published in 1975 [3]. This concept is, like Artsutanov's, a large-scale, passenger-carrying device. I also proposed the re-capture of the energy of returning payloads to power other payloads into orbit, thus requiring almost zero net energy input. A recent paper [4] summarises these and more recent concepts for building elevators into space.

After the wide dissemination of my Acta Astronautica article, the concept became well known; there will likely be no more lonely discoverers of the space elevator. The important point is that Tsiolkovsky's work was simply a thought experiment, the credit for the first invention of the space elevator rightly belongs to Yuri Artsutanov.

JEROME PEARSON
Ohio, USA

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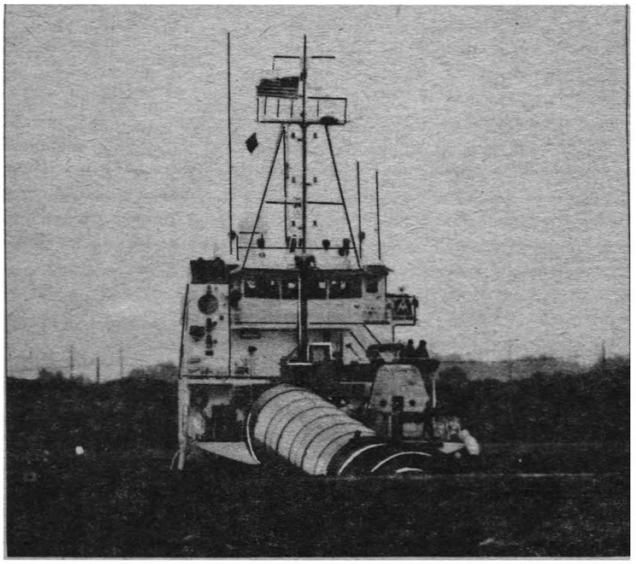
Gherman Titov, the second man to orbit the Earth and the youngest man in space at the age of 25 in August 1961, photographed recently by Tim Furniss at Baikonur. *Tim Furniss*

SRB Recovery

Sir, I took the enclosed picture from the Jetty Park at Port Canaveral, Florida on September 30, 1988 using a 500mm lens. It shows the right hand Solid Rocket Booster being towed into Port Canaveral after the STS-26 launch of Discovery. The booster frustrum is seen on the fantail of the recovery vessel, the Liberty Star.

JOEL W. POWELL
Calgary, Alberta, Canada

On the day after the launch of Discovery the skies are overcast as a recovered SRB is towed into port *Joel W Powell*



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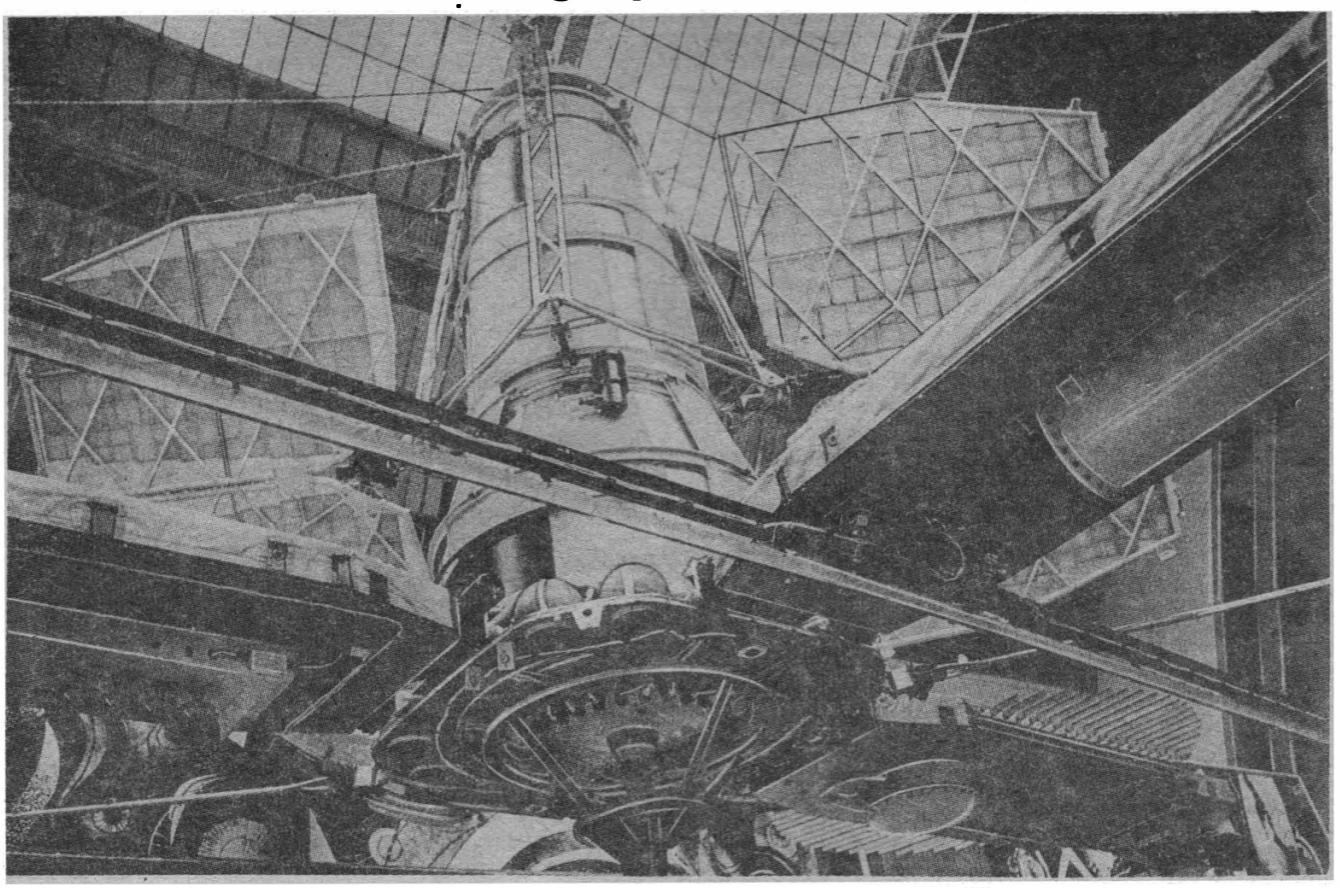
A New Eye on the Seas

Soviet Oceanographic Satellite System



The central cone of Okean. Four panels are attached to the lower structure, with downward-pointing instruments. Upper surfaces have mustard colour surround to reflect the Sun's rays. *Brian Harvey*

On July 5, 1988 the Soviet Union announced that it had established an operational space system for the observation of our planet's seas and water surfaces. A new designation, Okean (ocean) was issued to mark the series. In fact, the Soviet Union has flown operational oceanographic missions for five years under the Cosmos series. These missions are part of an impressive level of Soviet commitment to Earth resources and space applications work.

By Brian Harvey

Cosmos 1500, orbited in September 1983, was a new and distinct operational design of a Cosmos satellite. It was a truncated cone with four long and large vanes where downward-looking observation instruments were mounted. Sun-seeking solar panels were attached to the upper cone. Spacecraft weight has been estimated at 1,600 kg, but the working model recently displayed in Moscow suggests it may be much more. This new design was first mooted by NORAD in 1986 [1] but the Cosmos 1500 design was not made public until later. At around this time, the USSR revealed that the Cosmos 1500 model had been tested twice before 1983 [2].

These preoperational missions were Cosmos 1076 and Cosmos 1151, of February 1979 and January 1980 respectively. Both satellites – and the subsequent operational missions – went into orbits typical of electronic intelligence (ELINT) satellites – 82.5 deg flying out of Plesetsk. In fact, were it not for an oceanographic role being ascribed to them, it would have been hard to identify them from standard ELINT missions. All have come out of Plesetsk northern cosmodrome, probably on the Cyclone rocket, though some accounts have suggested the A2 and even the C1 booster [3].

These two preoperational flights took place at the same time as the United States was developing advanced oceanographic techniques. SEASAT went into a 805 km orbit in June 1978 and until that October it provided spectacular vistas of sea conditions around the globe.

Description of the Series

No full account of the series was published until Cosmos 1500 was returning good data. It was announced that the series was intended to cover the world's oceans in a three-day phase, with special attention being paid to the Arctic and Antarctic. The former is of considerable economic importance to the Soviet Union, where cargoes must be shipped along Siberia's northern shores. Ice and weather conditions are crucial in determining when ships can go through [4].

Data from the Cosmos 1500/Okean series can be transmitted either in real time or transferred to memory and then relayed to ground centres in either:

Moscow
Novosibirsk or
Kharbarovsk.

Images can be transmitted to 570 points, of which 70 are on Soviet ground territory itself. Remote autonomous reception apparatuses are linked into the system.

Side-looking Radar System (SLRS)

Cosmos 1500 was the first of the series to carry a side-looking radar system. It takes a single frame at a time

and can identify land masses and ice-formations by day or by night. Visual images are returned by way of an optical low-resolution multichannel scanner of 1.5km resoluton, and a multichannel microwave radiometer operating at 0.8, 1.35 and 8.5cm.

The SLRS is able to measure wave heights. The intensity of radar reflections is proportionate to the spectral density and energy of wave ripples. The spectral characteristics vary according to winds, currents, and weather systems.

The SLRS has a swath measuring 450km by 500km, and a spatial resolution of 1.5 ±0.5km. Operating frequency is 3cm. The system was designed by the Ukrainian Institute for Radiophysics and Electrics.

Data from the Okean series is transmitted on standard radio links in order to facilitate users. SLRS and optical data are read out side by side for purposes of calibration and convenience.

The SLRS system was not ready for the preoperational missions, Cosmos 1076 and 1151. Instead, they carried a Meteor-series type scanner, an infrared radiometer to measure sea temperature, and a radio system to pick up signals from remote buoys for retransmission.

Ice-fields

The Okean series has an important role in locating cyclones, currents, and vortexes. Photographs and radar images from Cosmos 1500 taken of the Gulf of Finland identified rippling west-driven winds that threatened flooding in Leningrad. In August and September 1984 Cosmos 1500 tracked Hurricane Diana off the east coast of the United States. The SLRS was able to make very precise estimates of surface wind velocities of the hurricane while it was still at sea [5].

The most spectacular results associated with Cosmos 1500 relate to its ice work. The SLRS has proved particularly adept at identifying ice-fields and the depths of icebergs and glaciers.

In October 1984, Cosmos 1500 radar images located a way through the ice for ten vessels trapped in the Long Strait between the east Siberian and Chukchi seas. The images were obtained at night through thick cloud cover.

The Rescue of the Mikhail Somov

In 1985 the arctic explorer vessel *Mikhail Somov* became trapped in Antarctica near the *Russkaya* polar station. Temperatures plunged to −30°C and the crew were in danger of their lives. Cosmos 1500 radar images found a way for the icebreaker *Vladivostok* to reach the *Mikhail Somov* and bring it to clear waters.

The SLRS is so sensitive it can identify oil or petrol spills at sea, distinguish old ice from newly-formed ice, determine cracks and crevices, and locate channels under the ice.

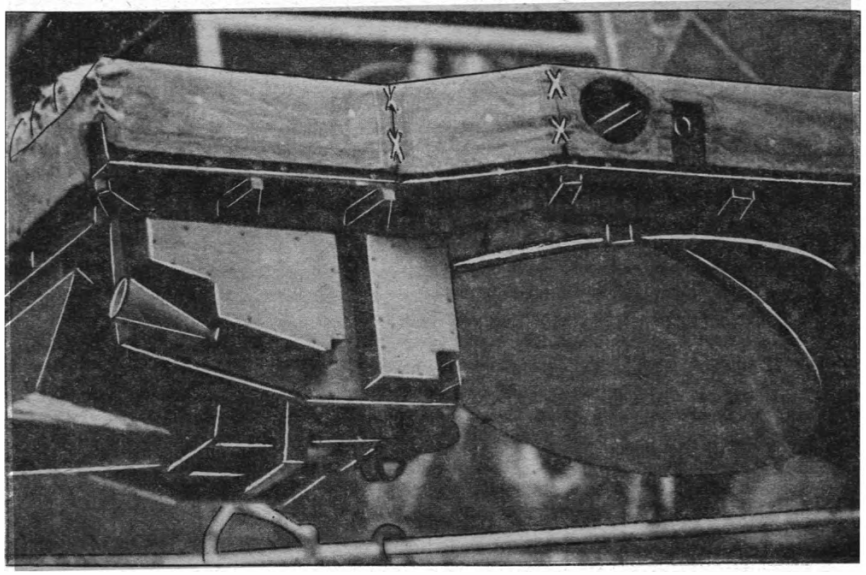
In the course of 1985, Cosmos 1500 compiled an ice-map of Antarctica. New ice cupolas were found on Queen Maud Land, as was an extinct volcano. At the other end of the world, climatically speaking, SLRS images of the Sahara desert found circular structures at 21 N, 11W, that may be the remnants of an ancient fortress now sanded over.

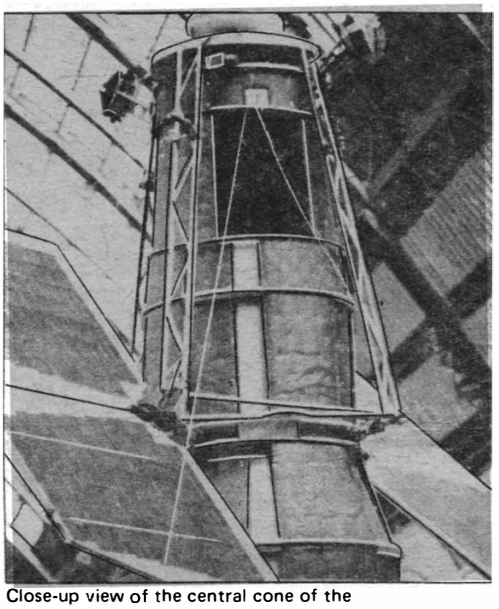
The first operational mission, Cosmos 1500, has been followed by Cosmos 1602 (a year to the day later), Cosmos 1766 (July 1986), Cosmos 1869 (July 1987) and Okean 1 (July 1988). A yearly pattern of launches seems to be established. Cosmos 1869 was only partially successful, the SLRS not deploying correctly.

Recent Developments

The Okean series is part of a growing Soviet earth resources component of its space programme. Several other recent missions have had an oceanographic component.

The main instrument on the Okean oceanographic satellite - the Sideways-Looking Radar System (SLRS). *Brian Harvey*





Close-up view of the central cone of the Cosmos 1500/Okean satellite. Two solar panels are attached to a truss where they can be rotated to face the Sun. *Brian Harvey*

The enigmatic Cosmos 1870 rode a Proton booster out of Baikonour on 25 July 1987. A Mir-class payload, it was thought to weigh up to 21 tonnes. No physical description has been issued, although the announcement spoke of how the platform would be devoted to hydrology, cartography, and meteorology. Its principal component was, like the Okean series, a radar imaging system. The fact that Cosmos 1870 transmitted on Kvant and Star module frequencies suggested that it was a prototype man-tended free-flying earth resources and ocean studies platform [6].

Cosmos 1940 (April 1988) was the first of a new series of long-promised geosynchronous meteorological satellites. Its purpose was announced as being to study the processes taking place in the Earth's atmosphere and oceans [7]. The Soviet geosynchronous meteorological system is to involve seven satellites in a network called *Prognoz* (forecast). Cosmos 1940 is at 24 W.

The Soviet Union now has a three-element Earth resources satellite system at work : geosynchronous meteorological satellites, the Okean ocean observers, and the mysterious Cosmos 1870 large platform.

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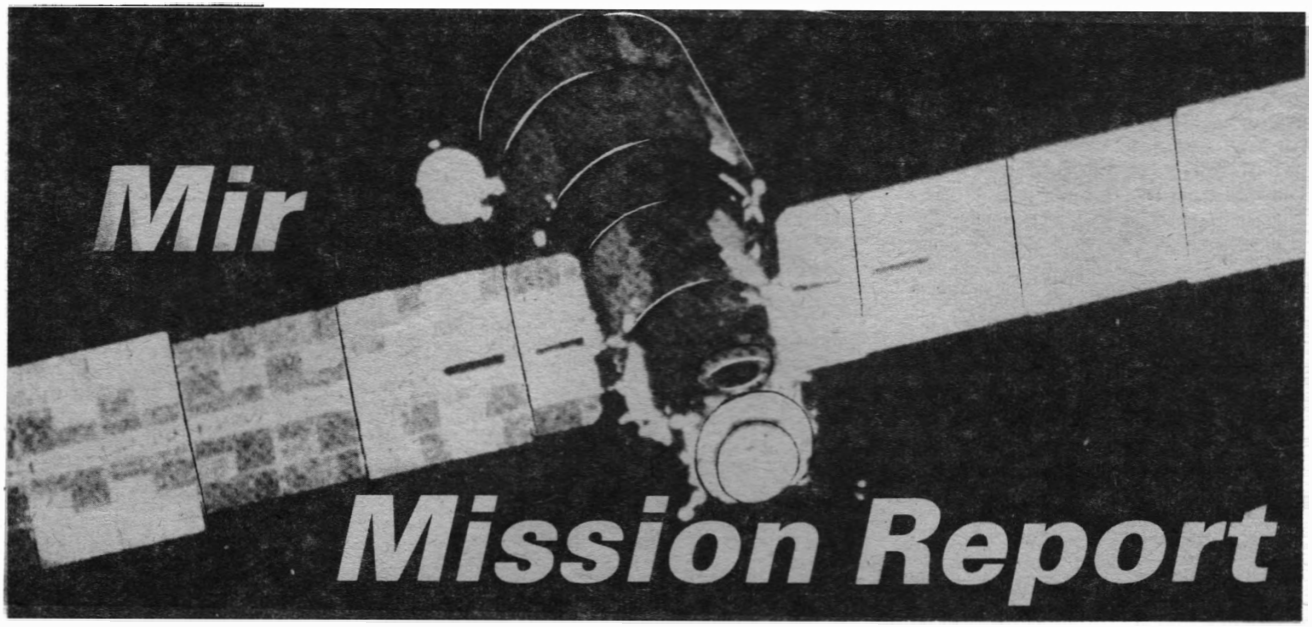

This month the Mir space station celebrates its third anniversary in orbit and two years of continuous occupation by Soviet cosmonauts. During 1988 the space station received visits from three international crews, most recently French cosmonaut Jean Loup Cretien. 1989 will see the addition of a large module to the Mir complex, and the first in-orbit test of the Soviet version of the Manned Manoeuvring Unit. Neville Kidger reviews the latest developments onboard the Mir space station.

TTM Telescope Repaired

On October 6, 1988 TASS revealed that cosmonauts Vladimir Titov and Musa Manarov on the Mir complex were preparing for an EVA which would complete the job of replacing the detector block of the British/Dutch TTM shadow mask X-ray telescope. The detector had failed late in 1987 and the Soviet side had suggested that a repair be effected, according to Dr. Gerald Skinner of the University of Birmingham who helped develop the telescope.

By Neville Kidger

On June 30 the cosmonauts had attempted to effect the replacement of the detector but had encountered difficulties.

According to Birmingham University's Dr. Omar al-Emam, who together with Dr. Skinner had attended a Flight Control Centre at Kaliningrad to help and advise the Soviets during the repair, the two men were heard literally "fumbling" their way along the outside of the Mir/Kvant exterior with the large "platform" containing their tools and the replacement detector block.

The Dutch scientists at Utrecht had refurbished the detector block from a ground version. It was then flown to Mir. Some of the tools were delivered by the Soviet/Bulgarian crew early in June.

Once at the site of the telescope, located in an unpressurised portion of the Kvant module, as a part of the Roentgen X-ray observatory, the cosmonauts discovered that there were more clips to undo than they had been told about. Dr. al-Emam said that the ground version, which the Birmingham team had used to prepare their briefings contained fewer items than the flight model. The Birmingham pair advised the Soviet controller to instruct Titov and Manarov to ignore most of the clips.

However, when the cosmonauts began to cut through some retaining screws they said that the screw heads were covered in resin. After undoing two of the screws the resin caused difficulties with the third. There was some doubt as to the origin of the resin. Shortly after this the station passed out of contact for an hour, Dr. el-Emam said.

When contact was resumed the two cosmonauts had cleaned off the resin with a saw blade and undone the screws. They had also cut some stainless steel clips.

The next task was the insertion of a key into a clamp which secured the detector and then use a lever to open the clamp up. However, after inserting the key partially, struggling to insert it fully, one of the cosmonauts began "screaming and shouting" and said "Oh, the tool's just come off in my hand. It just sheared off!"

Dr. al-Emam thought that a combination of rotational pressure and leverage had caused the tool to shear. The cosmonauts were told to attempt to undo the clamp for about 15 minutes, but if they failed to undo it they were to return to the docking unit from where they had begun the EVA.

The station then drifted out of radio contact again for about an hour. When contact was resumed the two were back at the airlock hatch having failed to remove the clamp. The original timeline for the EVA gave the men nine minutes to obtain samples of the dust-like coating that had overlain the station's windows but that activity was dropped to concentrate on measuring some attachment points for the installation of an anchor point which would be used during the Soviet/French EVA in December. Two French specialists were at the control centre to monitor this activity.

Later, Dr. al-Emam said, the group and the Soviet controllers considered another EVA, possibly for July 5, but decided against it because the outcome could not be guaranteed to be successful. It was decided to postpone the second attempt until a further evaluation had been made.

New EVA Suits

The second TTM repair EVA was apparently substituted for one that was already planned to test out new generation spacesuits.

According to G. I. Severin, chief

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spacesuit designer, the new suit is able to be used in an untethered mode. It contains an add-on module which is attached under the suit's backpack, which has its own power source, radio and telemetry equipment. It is "more convenient in the preparation for egress," the Soviets said. It allows for greater palm flexibility and the sleeves and lower soft elastic section can be replaced. The suit's duration was also being extended, making it possible to work in open space for 6–7 hours with 2–3 hours in the airlock.

The chief feature of the suit – the add-on module – allows the wearer to become autonomous of the station's life-support system and permits the wearer to conduct EVAs with a manoeuvring unit.

However, for the TTM EVA, scheduled for October 20, the add-on module would not be used.

Second TTM Repair Attempt

In the week leading up to the EVA the men conducted checks of the new suits as well as continuing their standard routine of experiments and medical examinations. The two cosmonauts were attempting a year-long stay in space and had been joined on August 31 by Dr. Valeri Polyakov.

For the second repair attempt only Dr. Skinner was at the control centre representing the Birmingham team. He was accompanied by a TV team from Central News who were allowed access to both the control centre and, later, Star Town.

Both the Mir multiple docking unit and the Soyuz TM-6 Orbital Module were depressurised for the October 20 EVA due to the amount of equipment that the cosmonauts had to take outside. Dr. Polyakov was sealed inside the Soyuz descent cabin. The spacecraft could be returned to Earth automatically with Polyakov aboard in the event of an accident with the spacewalkers.

Titov and Manarov opened a hatch of the unit at 0659 (all times GMT). The hatch was located at the six o'clock position as seen from Mir's front, according to the FCC display.

Moscow TV began a live transmission at 0715 when Manarov was outside being passed the equipment by Titov. The first TV pictures from the complex showed one of the men waving to the camera from some distance down the station. During the trip to the TTM location, one of the men complained that he had to clamber between handholds that were spaced too far apart.

During the EVA a video relay was broadcast from Star Town to FCC which showed two spacesuited "experimenters" conducting the same operations with the TTM as the two cosmonauts in orbit. Dr. Skinner told this writer that the Soviets did not identify these two men to him.

Dr. Skinner and two Soviet colleagues monitored the EVA from a side room away from the main control room.

The Birmingham team had supplied seven tools for the work and had devised three techniques to break open the clamp. The simplest way was the insertion of a small key into the clamp's lock.

Soviet TV showed photographs of the tools because the only examples of the tools were in space.

The new detector featured handles which made it more convenient for the cosmonauts to work with in their bulky gloves. It also featured a new fastening, a special alignment mark to place it into position and a new clamp design for easier opening. The original detector was not designed for replacement in space.

In addition to the USSR ground station network there were five support ships involved in communications. One ship each was off the coasts of Canada, Brazil and West Africa. The others were in the South Pacific Ocean and the Mediterranean Sea.

At 0850 a report came from orbit that the new key had worked and that the clamp was opened. The detector was removed and the cosmonauts began to install the new one. However, as Dr. Skinner and his colleagues listened on a loudspeaker in the side room, it was becoming obvious that another problem had emerged – the detector did not slide into position first time.

After a few anxious minutes there came a jubilant "hooray" from one of the cosmonauts. It signalled that the detector had been slipped into place and it was then clamped. One of the cosmonauts radioed an "unofficial" report that the detector was in place. The work had been accomplished an hour ahead of schedule.

With their primary task accomplished Titov and Manarov set about a number of others. Once back at the airlock they installed an anchor point to be used during the December EVA and also installed a short-wave aerial. The aerial is to be used for communications between the station, ship and Earth-based radio amateurs. It also provides another line of communications between the men and Earth in the event of a major communications breakdown or in "non-standard" situations.

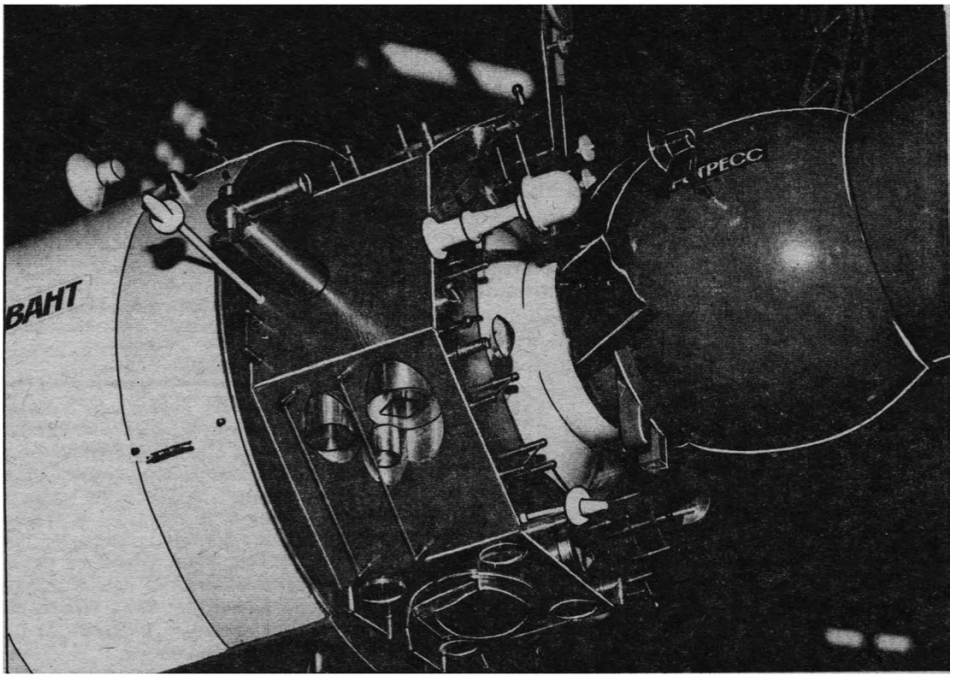
Finally, the men wiped the space station's windows free of the "dust" film that covered them. The samples were to be returned for analysis. The EVA was ended after 4 hours and 12 minutes.

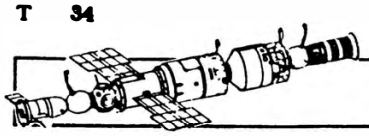
Speaking on TV Dr. Skinner said that the trip had been worthwhile now that the detector had been replaced. It began returning data shortly afterwards.

Continuation of the work

During the following days the cosmonauts and controllers worked with the battery of telescopes and, on October 25, Tass said that over four work-

The telescopes of the Kvant astro-physics module are visible on this Soviet model of the Mir complex. It was in this area that cosmonauts Titov and Manarov had to work during their space walk to repair the TTM telescope. A Progress supply craft is shown docked to Kvant.
P.J. Fulford





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ing sessions with Roentgen a detailed analysis of the three brightest X-ray sources in the galactic centre had been conducted by the Institute of Space Research. Spectrograms of these sources showed that the telescope battery's resources had been substantially widened after the replacement of the TTM detector.

On October 27 the Soviets said that Titov and Manarov were using the Chibis suit to simulate gravity and examine their cardiovascular systems. Such sessions are normally increased towards the end of long flights. Work on astrophysics investigation, observations of the flux of particles in near-Earth space and Earth observations occupied the cosmonauts' scientific time. On one occasion, the men sent TV pictures to Earth so that specialists could assess the state of winter crops in farmland areas of southern USSR.

Early in November the men conducted technological work with the mirror-beam furnace and the Pion installation. Samples of aluminium and copper alloys and monocrystals of zinc were processed in the furnace.

Space Endurance Record Broken

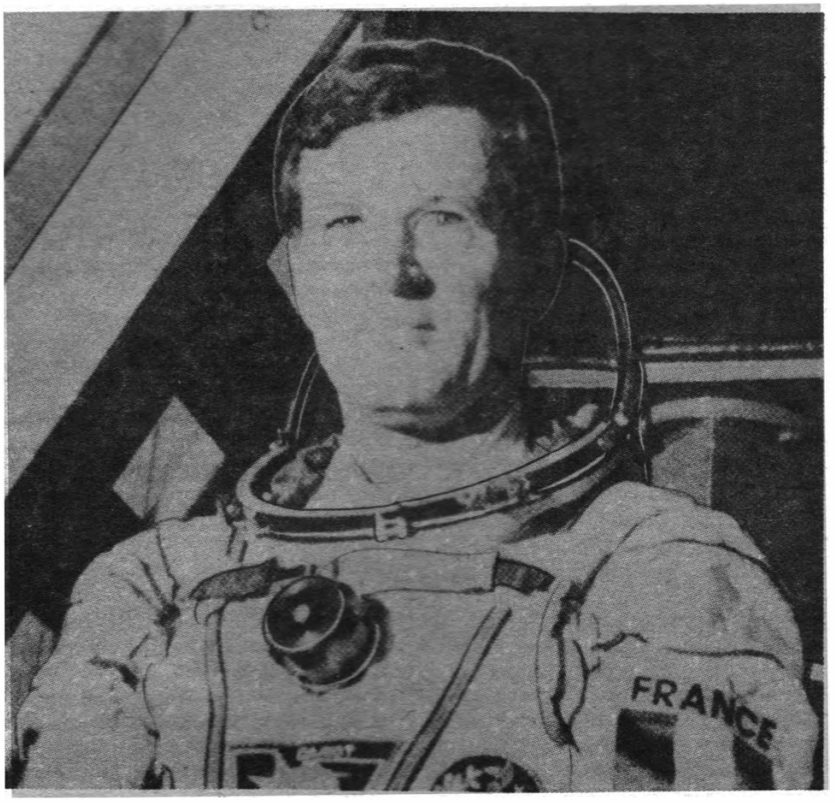
At 2256 on November 11 Titov and Manarov passed the single flight duration record for a space flight set by Yuri Romanenko in 1987. (That record of 326 days 11 hours and 38 minutes would not be officially exceeded until December 14 because the IAF demands a ten per cent increase over the previous record.) Anatoli Grigoriyev, director of the Institute of Medical-Biological Problems of the USSR Ministry of Health (where Dr. Polyakov and Dr. Arzamazov are based) said that no serious deviations had been observed in the health of either Titov or Manarov during their flight beyond the change in weight within the range of 1.5 to 2 kg. There was a forecast that both men would be in good health for their return.

On November 17 the Soviets said that the tanks of Mir's propulsion system were being refuelled by Progress 38. By November 22 the cargo ship had adjusted the station's orbit to one within the parameters of: height 388 × 343 km; period 91.6 minutes; inclination 51.6 degrees. Used equipment was being transferred into the cargo module of Progress 38 in preparation for its undocking.

That event occurred at 1213 on November 23 with the cargo ship being sent to destruction in the atmosphere at an unspecified time after this.

The next day, as preparations on Earth reached a climax for the launch of the Soviet/French visiting crew, the men on Mir concentrated on X-ray studies on the Vela constellation and other medical, technical and geophysical tasks.

Second Soviet/French Space Flight



French cosmonaut Jean-Loup Cretien became France's first man to travel in space twice when he was launched into orbit onboard the Soyuz TM-7 spacecraft. *Novosti*

The background to the second Soviet/French space flight was given in ***Spaceflight***, November 1988, p.418. A description of the joint experiments to be undertaken during the mission was also presented.

On November 10 details about the flight were given to a Moscow news conference.

Cretien said that the mission would "help solve some problems connected with the training of crews for future flights aboard the French spaceship Hermes."

The prime crew consisted of Soviets Col. Aleksandr Volkov and Sergei Krikalev and the French Brigadier-General Jean-Loup Cretien who made the first flight into space for France to Salyut 7 in 1982.

The three men would work with Titov, Manarov and Polyakov until December 21 when Titov, Manarov and Cretien would return to Earth. Volkov, Krikalev and Polyakov would then man the complex until late April 1989 when they would be replaced by another crew.

Volkov, having already made an EVA with Cretien, would conduct two more with Krikalev. These EVAs would see the men install new solar sensors to improve the characteristics of the orientation of the complex. Three cargo spacecraft would deliver scien-

• On November 25, 1988 it was reported that a permanent post office was to open on the complex. The joint Soviet/French crew was to deliver to the complex three cachets – one each to stamp the name of the post office and the date, a special commemorative inscription and a French souvenir emblem. Titov would be designated as "post office chief" and would be given a certificate as such. When he departed, the honour would pass to his successor as Mir commander.

Unfortunately for collectors, however, the amount of mail that would be handled by the men on Mir would be "strictly limited" and include letters of the cosmonauts and "special correspondence". The "spatial postmen" would be unable to meet requests for commemorative postmarks but, the Soviet Ministry of Communications said, to console collectors there would be a special stamp issued to commemorate the joint flight about to start. (See p.70)

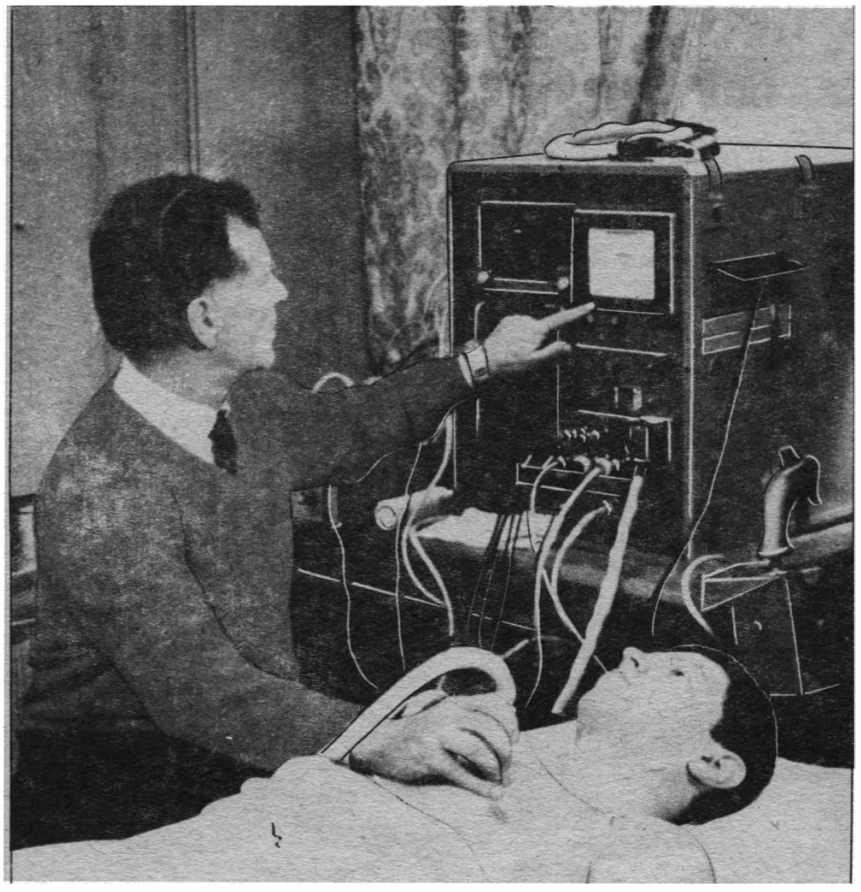
tific equipment and life-support facilities.

Near to the end of their mission a "reequipment" module would be launched and would dock with Mir's front axial docking unit. It would then be transferred to one of the radial ports by means of a small manipulator on the module.

The Salyut-class module, shown to the Central News TV crew and Dr. Gerald Skinner in October, features a compartment of a new configuration for EVAs – with a 1 m diameter hatch for exit to space as opposed to Mir's 0.8m diameter hatches. The crew would activate the module for future use.

It was then planned for the back-up crew of Col. Aleksandr Viktorenko and Aleksandr Serebov to take over the station. (Cretien's reserve, Michel Tognini, may make a flight in two years.) According to one western source, the Soviets have halted year-long flights for the present at the request of the Soviet medical institutes.

Speaking at the press conference Aleksandr Dunayev, the head of the Glavkosmos agency, said that Soviet estimates of the cost of the joint flight were $21 million. He said that ten per cent of this would be compensated for by utilisations of the French-supplied equipment which would remain on Mir and in payment for the stay of Soviet specialists abroad. Although the French did not pay any money for the actual flight, one estimate of the cost to the French side is $30 million.



Jean-Loup Cretien tests the echograph experiment on his back-up, Michel Tognini, during pre-flight training. *CNES*

Presidential Presence

The launch of the Soyuz TM-7, with the Soviet/French crew was delayed from November 21 to November 26 so that French President Francois Mitterand could be present at the Baikonur Cosmodrome. He was to make a two-day visit to the USSR November 25/26.

The launch was also opened to many other correspondents from around the world.

On November 25 these correspondents met with Kerim Kerimov, the chairman of the State Commission which oversees the Soviet manned space programme. He told them that the joint crew was "the first international team in the history of practical preparations for a manned expedition to Mars."

When asked if Mir was to be a base for a manned interplanetary mission by international crews he said it was "irrespective" if the mission took place aboard Mir or a European space station. The task was just too complex for a single state. This stance reflects the oft-cited Soviet desire for international cooperation in certain spheres of space flight.

The correspondents were allowed to walk to the launch pad where the rocket with Soyuz TM-7 atop it was being checked out.

In another press conference the correspondents met the prime crew, which had been confirmed by Kerimov's commission that afternoon. During this Volkov said that one of the Progress ships would bring up to the complex manned manoeuvring units to be used outside the station. They would check them out but that it would fall to Viktorenko and Serebrov to test them outside the station.

In answering a flurry of questions about future Soviet/French missions Vladimir Shatalov, chief of the Star Town Training Centre said that it was possible Tognini would fly and that "it was not ruled out" that a Frenchman would fly in the Buran shuttle craft. "Hermes will not be ready for another ten years and French cosmonauts will have to keep in form somehow," Shatalov said.

A protocol was signed on November 26 which covered the placement of French devices on Soviet stations – possibly the Mir modules – and for a series of missions by French cosmonauts on month-long flights every two years.

Launching Soyuz TM-7

President Mitterand flew into Baikonur by Concorde from Moscow on November 26 accompanied by Soviet Foreign Minister Eduard Shevadnadze. He was taken to the cosmodrome and, in an exchange with the suited cosmonauts, expressed best wishes for the flight. Also at Baikonur was a member of the British pop group "Pink Floyd". One of the cosmonauts had said he liked listening to the group, so the group's record company and the Soviet Embassy in London reached an agreement to fly the cassette and extend the invitation to watch the launch. The group's guitarist is a keen space flight fan, say reports.

Before the launch President Mitterand was taken, along with some reporters, to see examples of Soviet space technology including a spacesuit with the manned manoeuvring unit and Buran.

Soviet TV and radio covered the preparations for the launch, announced beforehand as being timed for 1549 GMT, live. For the first time, the traditional TV coverage was interrupted for short advertisements for products from watches to banks!

As he lay in the Soyuz TM cabin,

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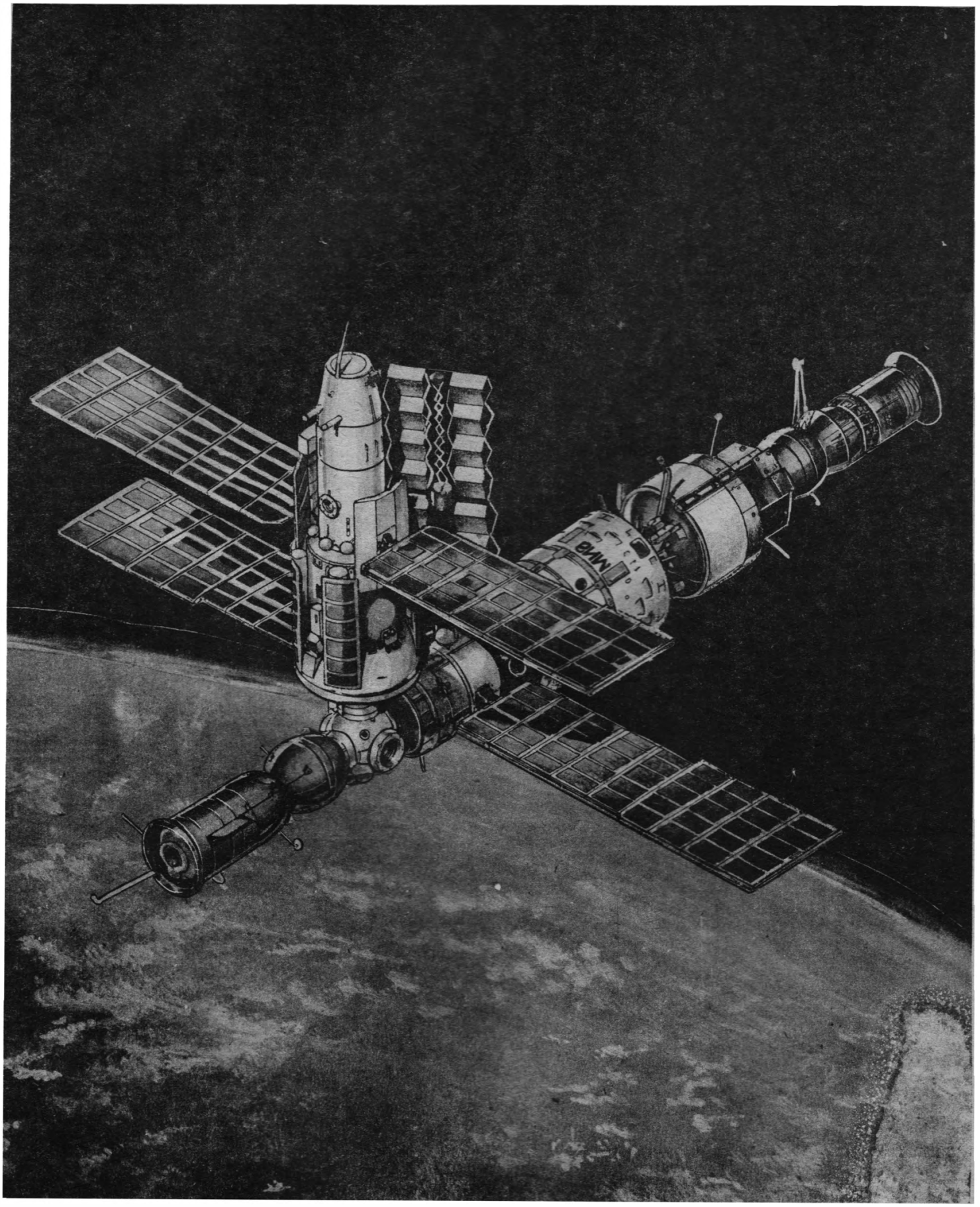

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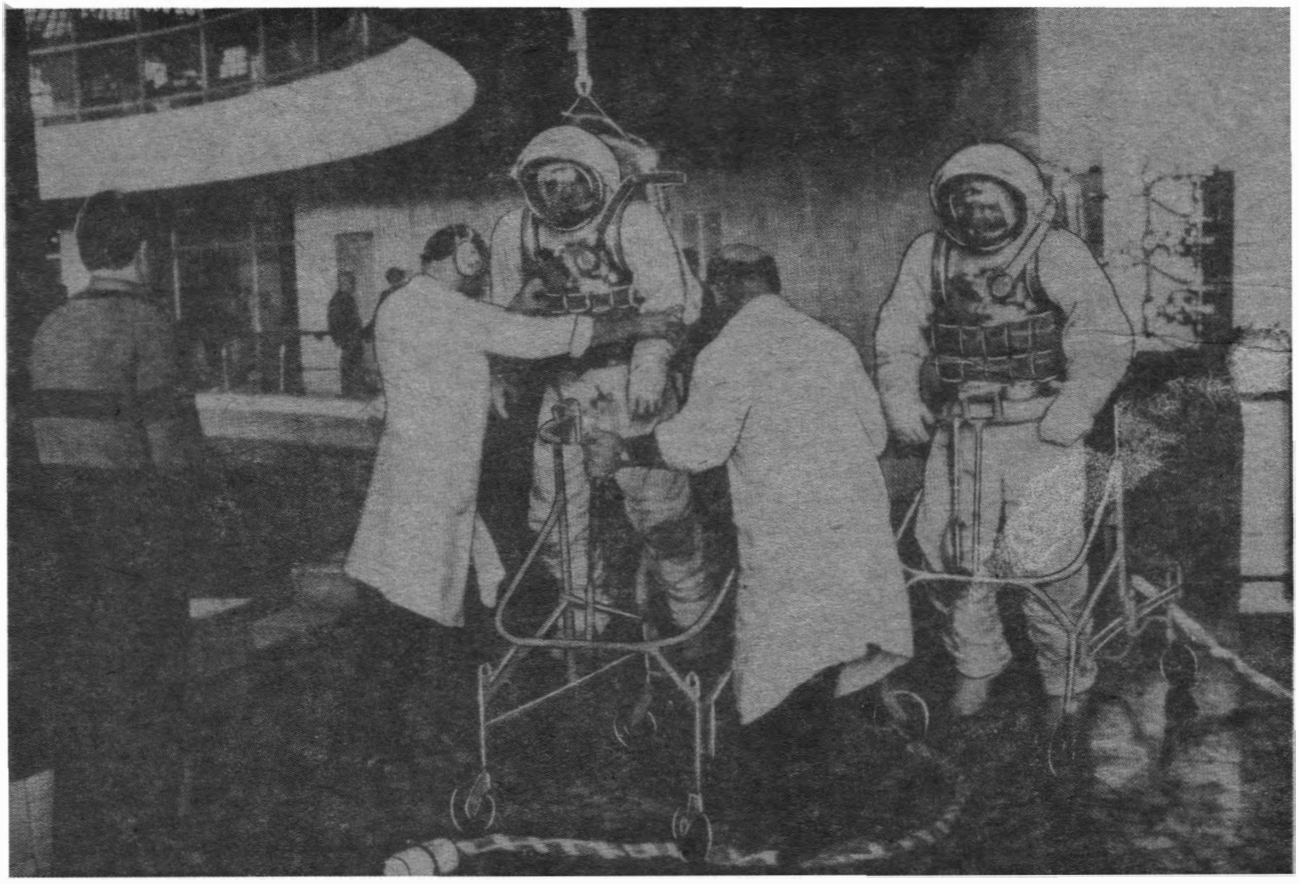


Jean Loup Cretien and Sergei Krikalev are about to be lowered into the neutral buoyancy water tank at Star City. The exercise was part of the training programme for the space walk to deploy the ERA structure. *CNES*

Volkov – call sign Donbass – read out a statement saying that the flight was proof of further cooperation between the USSR and France. Cretien said that he was honoured to be a part of the crew.

With journalists watching from a distance of 1.8 km and with Mitterand and Shevadnadze watching with aides from a special stand, the Soyuz TM-7 spacecraft was launched just before 1550 GMT into a clear dark sky.

(Soviet radio, broadcasting the launch, played a special song composed for the cosmonauts over which could be heard the voices of the controllers and Volkov passing off each milestone. The song was first used for Soyuz TM-4, according to analyst George Spiteri.)

An interesting facet of the launch coverage was a view of a small doll hanging in front of Soyuz's descent cabin camera. During the ascent, and onset of g-loads, the doll's string vibrated. Volkov continued to report that all was normal. At 1558 the third stage placed the ship into Earth orbit with a high point of 240 km. The crew were seen making a sudden movement as orbit was attained and the doll floated out of sight of the camera as weightlessness took over.

A painting by *Kristian Brugts* based on Soviet drawings. The 'reequipment' module is shown docked to Mir's top docking port. The module is expected to be launched before April.

During the first three orbits the cosmonauts ran checks on the spacecraft's systems and airtightness. They then discarded their spacesuits. During the fourth and fifth orbits two burns were made by the ship's engine to place the craft into a higher orbit – which Tass later said was 305 × 253 km; period 89.9 minutes; inclination 51.6 degrees.

The cosmonauts turned in for their first sleep in orbit between the 7th and 11th orbits.

The next working day began at 0900 on November 27. After breakfast the men began preparations for the second major manoeuvre of the approach which would be made during orbits 17 and 18. The plan for the approach the next day would see another burn during the 32nd and 33rd orbits. The Soyuz would automatically fly by Mir at a distance of 150 – 400m. Docking was planned for 1730 on November 28 on the TM-7's 34th orbit.

The docking was to take place outside of the radio visibility zone. But, at 1714 on November 28 Moscow radio interrupted its programmes to announce that docking was taking place. The event occurred at 1716 and at 1725 the hard dock was achieved with the Kvant port.

The Soviets said that the docking had been made automatically after analysis of the situation.

Whilst the pressure between the vehicles was being equalised and checks were being made, the crew of the complex prepared a "traditional meal" for their guests. This consisted of jellied salmon, quail meat, candied fruit and juices. (Some 70 items are now aboard Mir with a daily intake of 3,100 calories; the visitors delivered vegetable soups, meat and fish dishes, ham, Breton and campagnard pates, various dressings, cheeses and desserts. Ten French firms had worked on the foods.)

Just before 1900 the hatches opened and Cretien floated into the station followed by Krikalev and Volkov. During the formal welcoming ceremony, with all six men facing the TV camera statements of greetings from the Soviet and French leaders were read out and replies were given on behalf of the crews.

'Mir Mission Report' will continue to keep readers informed on activities in the Soviet space programme. A full report on the joint Soviet/French mission will appear next month.

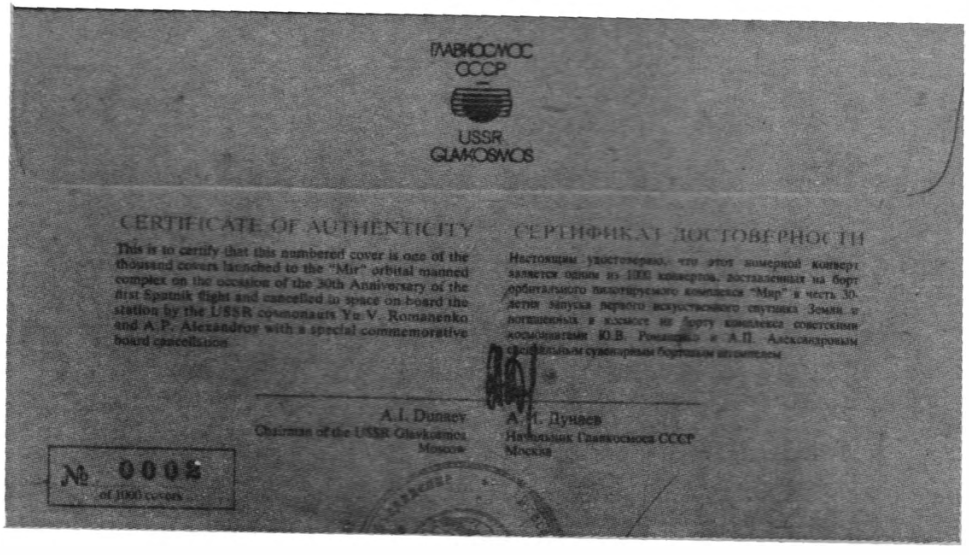
Т 38

Mail From Mir...

Established 1923

Mezhdunarodnaya Kniga

№ _____ _____ _____ 19 г.



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...A Unique Cover

SOVIETS in SPACE

Post Office in Space

In an unusual venture, the Soviet Union permitted an American stamp dealer to buy time and space for 1,000 envelopes (called "covers" by stamp collectors) to be carried to the Mir space station in an unmanned Progress vehicle and returned to Earth by a manned Soyuz. This is the story of the 1,000 US covers, carried by a Soviet space vehicle and sold in Europe and Asia.

By Lester Winick

Kurt Weishaupt has been a stamp dealer in the United States for 49 years, very few collectors have ever heard of him and only the top dealers of the world know him. He is a wholesale stamp dealer and supplies postal administrations, private firms, approval houses with their needs. If one country has ten million stamps that they have not sold, and another country has five million left over, Kurt will arrange a trade. If a cereal company needs three million stamp packets for a give-away promotion, Kurt only asks "What subject do you want?"

About one year ago, Mr. Weishaupt signed an agreement with Mezhdunarodnaya Kniga, the Soviet Union's export agency, to exclusively handle covers flown in space. Kurt knows the stamp market, and knows what collectors want on a cover. And he got it. The following report is completely documented by a video tape that tells the story of the 1,000 covers and each cover is accompanied by several Certificates of Authenticity from the Russian government agency

One thousand covers were prepared in New York, flown to the Soviet Union where they were hand addressed to the crew of the Mir orbiting space station. Then a 10 kopek stamp was affixed commemorating the 30th anniversary of the launching of Sputnik 1. Each cover was hand cancelled at the Moscow General Post Office on October 4, 1987 with a special pictorial cancel.

The covers were then flown 2,000 km to the Baikonur launching site. This is the complex where the first Sputnik was launched, where Yuri Gagarin became the first man to fly in space on April 12, 1961 and where Soyuz 19 was blasted into orbit to link up with the US Apollo capsule for the ASTP joint US–USSR cooperative flight. Space philately is so popular that the Baikonur launch site has its own post office and its own cancel.

A cancel was applied on November 21, 1987 at Baikonur for the launch of the unmanned Progress 33 spacecraft, which carried the covers in a special container as well as other needed supplies to the Mir space station.

For many years, the Progress series of space vehicles has carried mail to and from the cosmonauts in space. These letters were of a personal nature from the cosmonauts' families, and have no stamps, cancels or other postal markings on them. Official "mail" with instructions was also carried to the cosmonauts in space on the unmanned probes. To the best of my knowledge, there is none known in any collector's album, and it would be difficult to authenticate these covers as "flown in space."

A cancel was applied on November 21, 1987 at Baikonur for the launch of the unmanned Progress 33 spacecraft, which carried the covers in a special container.

The two cosmonauts on the Mir, Yuri Romanenko and Alexander Alexandrov then applied a special "Mir" space cancel on board the spaceship. The cancel is not dated since the men cancelled the covers in their free time on board and did not want to have the additional task of changing dates. It was a slow tedious job, since the covers and cancel had a tendency to float away while they were trying to shift covers, cancels and then personally autograph each cover.

On December 21, 1987, Cosmonauts Levchenko, Vladimir Titov, and Musa Manarov were launched into space, and rendezvoused and docked with the Mir space station two days later. Levchenko returned to Earth on December 29, 1987 along with Alexandrov, who had been aboard the Mir since July 1987, and Yuri Romanenko, who had spent a record 326 days in space. The three cosmonauts also brought back with them the thousand covers. Titov and Manarov remained on board the space station which is being permanently manned.

The three men and the covers floated to the blustery, wintery Karastan Steppes in their spacecraft, supported by a parachute. A helicopter picked up the cosmonauts, but the covers were immediately taken to the nearest post office which happened to be at Arkalyk airport, where another cancel dated December 29, 1987 was applied in the presence of local government officials.

Each of the covers is signed on the back by the Chairman of the USSR Glavkosmos A. I. Dunaev and a serial number applied. A Certificate of Authenticity in Russian and English accompanies each cover signed by A. Ya. Belostotsky, Deputy Director General of Mezhdunarodnaya Kniga.

The twelve minute film ends with the phrase that "A wide scope of commercial services in the sphere of space equipment and technology" is available from Glavkosmos.

The 1,000 covers were sold to three stamp dealers, Hermann Sieger in Federal Republic of Germany, Alberto Bolaffi in Italy and Meiso Mizuhara in Japan. The three firms set a retail price of $1,500 for each cover and some were wholesaled to the other dealers at $1,100 each. Several stamp dealers in Great Britain also handled the covers, but it is unknown if they have any available at this date. The covers were sold out within one month, and the resale market has already started by collectors who bought several covers as an investment.

Cosmonaut Anatoly Levchenko, 47, died August 6, 1988 "after a grave illness." He was one of two test pilots preparing to fly the Soviet space shuttle. Levchenko was an air force test pilot and joined the cosmonaut team in 1981. Due to the death of one of the cosmonauts involved in the recovery of the space covers, the price is expected to go even higher.

It should be noted, for the record, that an additional 38 covers were included in the flight, but these were given to museums and the families of the cosmonauts.

It was the marketing and negotiating skill of the American stamp dealer that gave space, airmail and postal history collectors a new flown souvenir cover to add to their collections.

One of the 1,000 covers to be carried to the Mir space station onboard a Progress vehicle. The cover has been signed by cosmonauts Yuri Romanenko and Alexander Alexandrov.
Lester Winick