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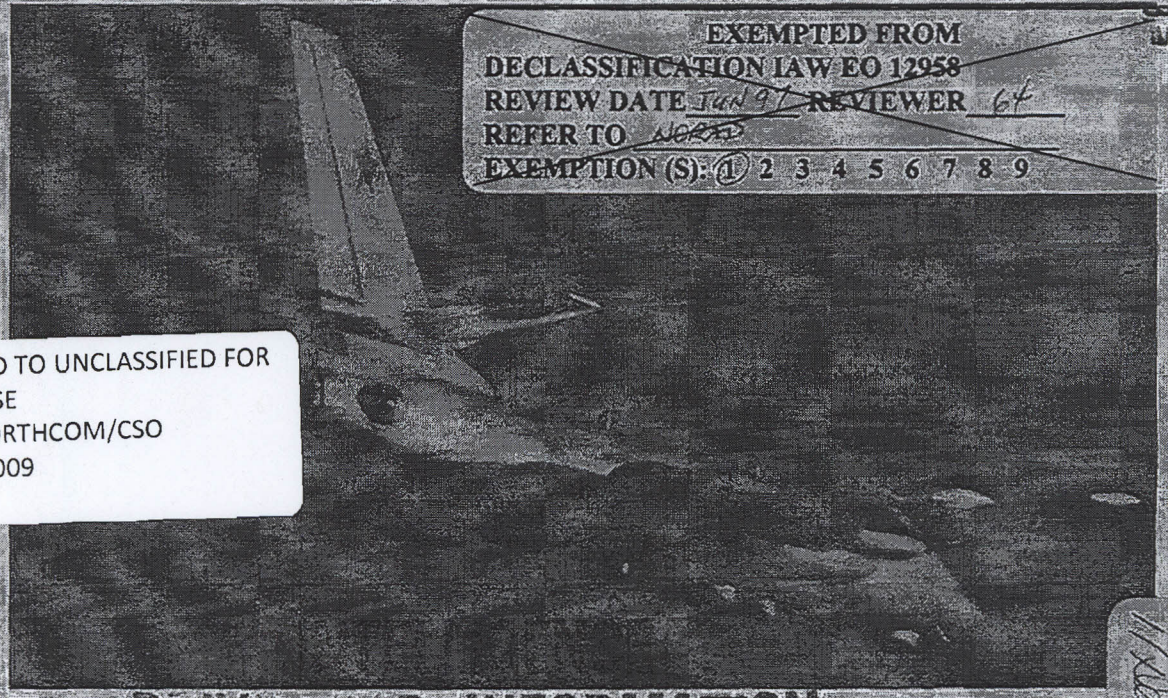

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NORAD Weekly Intelligence Review

Issue No. 50/64, 11 December 1964

The WIR in Brief

COVER: BADGER D, ferret aircraft (caption ~~SECRET~~; photo OFFICIAL USE ONLY)

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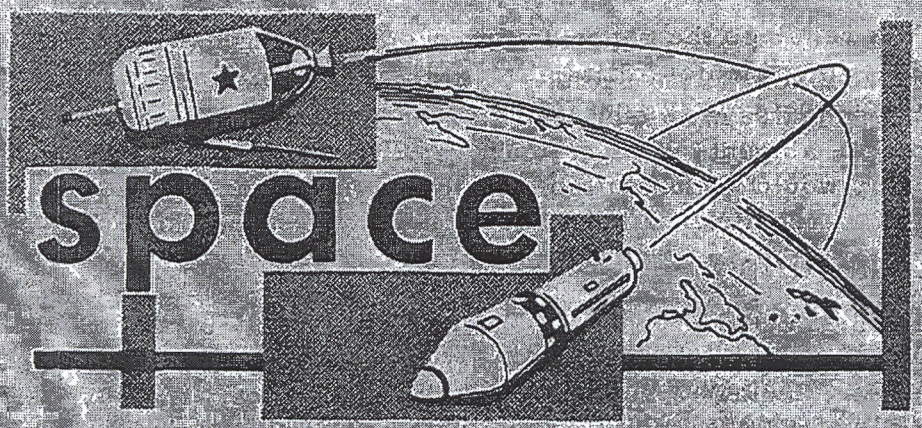

significant intelligence on space developments and trends

Cosmonaut Training Facilities Identified

The Soviet Cosmonaut Training Center has been identified: it is located at Monino (25 n.m. east-northeast of Moscow) in a secure area next to the Red Banner Air Force Academy. This facility has been referred to in Soviet literature as the "Scientific Center for Cosmonaut Training," the "cosmonaut training camp," and the "city of the celestial brothers."

At Monino the cosmonauts receive their preliminary training. The equipment reportedly includes that used in the physical conditioning of cosmonauts, such as a rotating wheel, but it may also have a centrifuge and at least one altitude chamber.

Previously identified cosmonaut training facilities: (Map on page 35.)

- Chkalovskaya (Shchelkovo) Airfield, where the cosmonaut maintains flying proficiency and is given training under weightless conditions.
- An installation at Tomilino, where cosmonauts are trained in a full-pressure suit in a centrifuge. Tomilino has also been engaged in the research and development of the spacesuit and of the equipment used for ejection of the cosmonaut during re-entry.
- Zhukovsky Air Force Engineering Academy, Moscow, where the cosmonaut takes his theoretical training in rocket engineering, astronomy, and physics.

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Soviets at Crossroads re Electrical Generators for Space Vehicle Systems

The Soviets are believed to have used nothing more sophisticated to date than solar cells and chemical batteries for supplying electrical power to the various systems -- instrumentation, telemetry, life support -- of their space vehicles.

Batteries apparently have served the Soviets well in their manned flights and, probably, in their photoreconnaissance vehicles (the Tyuratam Cosmoses), reliably furnishing moderate amounts of electrical power for relatively brief periods of time. Batteries would not be suitable for many space missions, however, because of their short life and their high ratio of weight per unit of power supplied.

Solar cells, which convert solar energy into electrical energy, have been used on many Soviet vehicles, but their performance record is mixed. They reportedly supplied power to the systems of Mars 1 for about 4.5 months, enabling it to maintain 2-way contact with the Earth over a distance of nearly 57 million n.m. before communications ceased. Electron 2, which was launched 30 January 1964, transmitted signals for a somewhat longer period of time but over much shorter distances. Communications from many Soviet space vehicles appear to have ceased prematurely, however, and it is likely that many of these failures are attributable to the failure of their solar cells. The Soviet record in this regard is less impressive than that of the US.

The operating lifetime of Soviet solar cells undoubtedly can be extended in time, but these devices will still suffer from restrictions on the size of the cells. A 1963 Soviet press article estimated that a 4-kw solar-cell system would require 130,000 cells, covering an area of 26 square meters (about 260 square feet). And even this power output is considered optimistic for production-run cells; it fails to allow for degradation in performance caused by protective cell covers and for normal degradation which follows exposure of the cells to solar radiation. Such a system would be expensive, complex, and cumbersome in relation to the amount of power produced.

The Soviets, therefore, already need systems which can generate moderate amounts of electrical power for long periods of time for vehicles which are already operational. In coming years, they will need long-lasting systems which can generate greater amounts of power for such missions as manned orbiting laboratories, manned lunar orbiters, permanent lunar bases, and manned interplanetary flights. In the distant future they may even need systems which can generate electricity for interstellar flights.

Since they are strong advocates of the direct conversion of power, the Soviets can be expected to exploit any possibilities offered by photoelectric, thermoelectric, thermionic, and magnetohydrodynamic methods. One Soviet press item has mentioned the use of radioactive isotopes as an energy source. The Soviets are also working with fuel cells.

An article in a November 1962 Soviet technical journal indicated that the nuclear reactor will be the main energy source in space vehicles of the future, but the author also said that there may still be a place for solar energy, using the Sun's heat to drive a turbogenerator. This would require the use of a large collector -- a reflector to concentrate the Sun's rays on

a container of working fluid; the heated fluid would produce electricity by driving the turbogenerator. One Soviet press article has suggested using a solar-powered mercury Rankine system for this purpose. (One US contractor has said that a Rankine cycle system using water as the working fluid is the proper choice.) The Soviets admit that such a system has not been used to date, owing to the serious technical problems involved, such as:

- Designing a large solar concentrator which can be launched in a compact form and erected in space. (An inflatable concentrator made of metal-coated plastic has been mentioned for this purpose.)
- Orienting the concentrator on the Sun.
- Compensating for the loss of solar energy when the space vehicle enters the shadow of the Earth, Moon, or planet.

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Palomar Data Indicates Zond 2 Headed for Mars; Course Correction Must Be Made Soon

Analysis of two photographic observations of the Soviets' space probe, Zond 2, by the observatory on Mt. Palomar, California, indicates that the Soviet vehicle is headed in the general direction of Mars, as announced by TASS. However, at least one course correction must be made soon if the miss distance is to be reduced to a reasonable value, that is, less than 50,000 n.m. The magnitude of the required correction is constantly increasing; if not made soon, it will exceed the estimated thrust capabilities of the probe's midcourse-guidance rocket engine.

The Soviets have said that Zond 2's mission is to perfect inflight systems which can function in a space environment. While stating that it is headed toward Mars, they have not admitted that it is intended to collect data on Mars. There is little doubt, however, that the vehicle's instrumentation and mission are probably the same as, if not more sophisticated than, those of Mars 1, which was launched 1 November 1962. The Mars 1 probe, the Soviets announced, weighed about a ton and was intended to collect data on the interplanetary space environment en route to Mars, to photograph the Martian surface, to detect organic ground cover (if any) on Mars by spectrographic methods, and to collect much other information on the red planet.

The TASS communique which announced successful launch and injection of Zond 2 reported -- uniquely for the Soviets -- that early telemetry indicated that the power supply was roughly half that expected. (This announcement obviously refers to RF energy; US press agencies have mistakenly related it to the rocket power available for midcourse guidance.)

The second TASS communique, however, which reported that 4 communications sessions had been held with the probe, also stated that radio communications with the probe were stable.

The Soviets could launch one or two more Mars probes before the launch "window" closes, about 15 December. In each case since mid-1960 when conditions have been favorable for launches to Venus or Mars, the Soviets have launched 2 or 3 probes. However, considerations of economy could force cancellation of additional probes at this time, though the propulsion units and probe vehicles may be ready and standing by. Cancellation could be ordered if Soviet space scientists already consider Zond 2 a failure and if they cannot guarantee the new political leadership in the Kremlin that they have isolated the causes of failure and corrected them in the standby vehicles. The Soviet space program, which has expanded to a remarkable degree this year, is a substantial drain on the ailing Soviet economy; the top leadership may be disinclined to expend expensive missiles and probes on missions which have few prospects for success.

Zond 2 Positions. Palomar accomplished two observations of Zond 2 on 1 December. Celestial coordinates of the probe were as follows at the time of observations:

	Right Ascension	Declination
0810Z	129.027 hours	Minus 3.850 degrees
1020Z	128.650 hours	Minus 4.194 degrees

The internal error of these observations is estimated at plus or minus 0.03 degrees. Zond 2 at these times had the brightness of a star of the 17th-19th magnitude. The parameters of its heliocentric orbit are now being developed.

The second TASS announcement about the probe said that at 2200 hours Moscow time (2000 hours Greenwhich), the probe was 710,000 kilometers (377,000 n.m.) from the Earth, above a point described by geographical coordinates 128 degrees East, 5 degrees North.
(Mt. Palomar, TASS, NORAD)
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Some Photorecce Satellites Apparently Perform Roll Maneuver for Added Coverage

The camera systems of Soviet photoreconnaissance satellites (Cosmos-series vehicles launched from Tyuratam (TT)) are believed to be aimed along the Earth trace of the satellite ordinarily.

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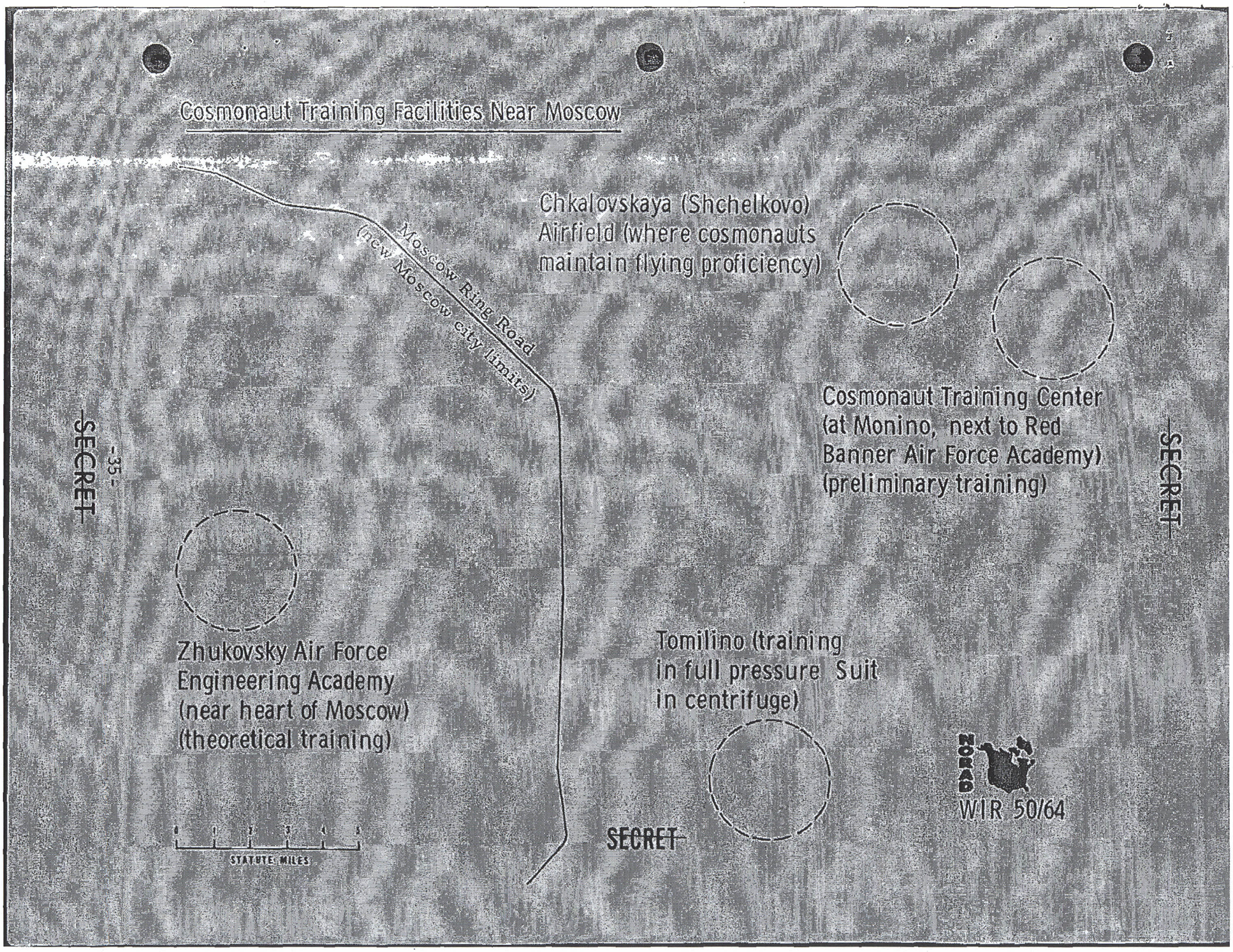
Cosmonaut Training Facilities Near Moscow



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