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NORTH AMERICAN AIR DEFENSE COMMAND

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WEEKLY INTELLIGENCE REVIEW (U)

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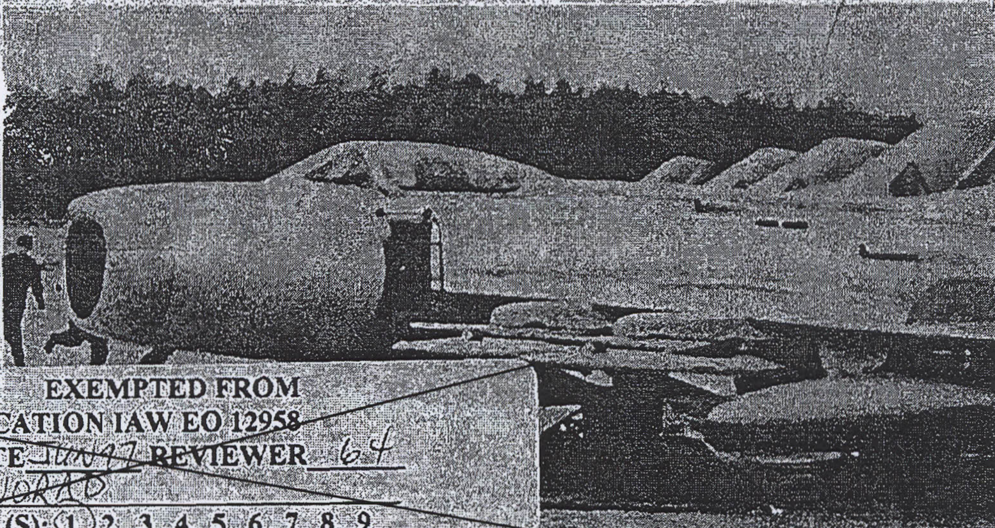

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NORAD Weekly Intelligence Review

Issue No. 11/65, 12 March 1965

The WIR in Brief

Space

COVER:	FARMER fighters and AAMs of East German Air Force (UNCLASSIFIED)
NOTE:	Pages 28, 29, 32, 33, 36, 37, 40, and 41 of this issue are blank.

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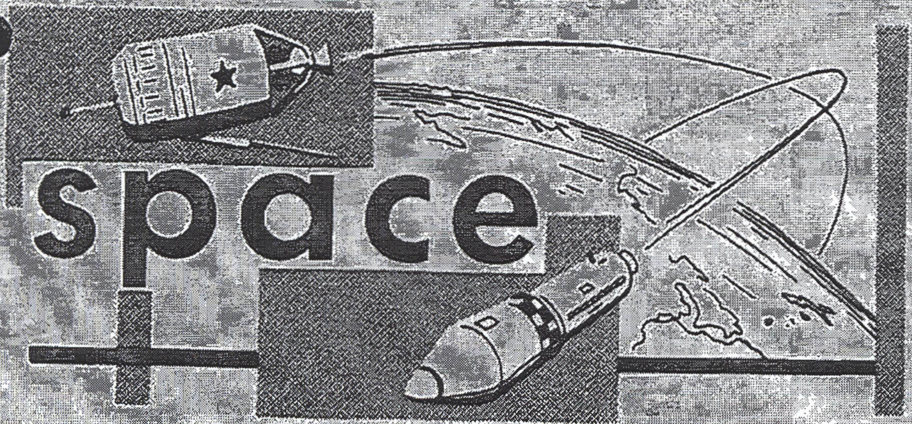

significant intelligence on space developments and trends

Soviet Research on Radiation Hazards Lags in Some Areas

A complex of radiation hazards -- protons, neutrons, electrons, heavy nuclei, alpha particles, and X rays, all of widely varying energies and fluxes -- awaits man in space. These appear in the form of: (Charts on page 34.)

- Cosmic radiation -- streams of protons, alpha particles, and heavy nuclei issuing from outside the solar system. (Diagram on page 35.)
- The Van Allen belts -- regions of charged particles trapped by the Earth's magnetic field.
- Protons from solar flares, which are intense but occur intermittently.
- The "solar wind," a constant but relatively weak stream of particles.

Some of these hazards have been avoided to date by launching manned ships into low orbits (below the Van Allen belts) during periods when no solar flares are expected. But man will have to find other means of coping with radiation if he is to fly to the Moon and to other planets. To this end, research is under way in both the US and the USSR to measure and map the various radiation hazards, to determine their effect on the human body, to learn how to predict intermittent hazards (such as solar flares), to set acceptable levels of risk, and to develop protective measures.

Soviet concern over radiation hazards to manned flight is evident in numerous statements by Soviet scientists and by the Soviet press, in Soviet research of space radiation, and in steps taken to date to prevent radiation injury to Soviet cosmonauts.

The Soviet program is on a par with Western research in several areas, but in some areas it lags behind.

THE SOVIET PROGRAM

<u>The Nature and Extent of Radiation Hazards.</u> Soviet scientists have made extensive studies of the nature and extent of space radiation. Their studies

of the Van Allen belts fall far short of US achievements (pp. 6-9, WIR 7/65). However, their studies of radiation during low-orbit flights, though not unique, are comparable with those of the US. They have consistently lagged behind US scientists in publishing data, analyses, interpretations, and theories about space radiation.

Dosimetry. Dosimetry has played an important role in assuring the radiation safety of Soviet manned flight. Before sending their first man into space, the Soviets measured the probable radiation hazard by launching a series of recoverable satellites which carried dosimeters and biological specimens. Both instantaneous and cumulative dosages were registered and telemetered to ground stations for study. Further, each manned flight appears to have been preceded by an unmanned dosimetric "pathfinder." Finally, dosimetry was also carried by all the manned vehicles.

Soviet dosimetric instrumentation was probably adequate but apparently was not uniform among the various groups of scientists responsible for dosimetry of various flights.

Radiobiology and Relative Biological Effect (RBE). A large share of modern radiobiological research is aimed at determining the effects of various types of radiation on the human body.

RBE research -- measurement of the biological effect of a given amount and type of radiation -- came into its own with the advent of national atomic energy programs. Most of the world RBE literature is dominated by US and UK research. Soviet work in this particular area lags Western work and, on the whole, the Soviets are dependent on non-Soviet RBE values.

Soviet planning of biological experiments for satellites has been wide in scope and adequate in depth. One criticism has been that some radiobiological experiments were sent into orbits too low (below the Van Allen belts) to expect any results. Nevertheless, the Soviet program is yielding some definite results for many kinds of experiments.

Solar Flare Predictions. Well aware of the hazards which can be posed by solar flares, especially proton events, the Soviets set up a flare-prediction network in the early days of the space age. Soviet progress in this area has been comparable with but no better than the West's (p. 6, WIR 43/64). Major flares cannot at present be predicted reliably more than two days in advance.

Levels of Acceptable Risk. In a program, such as manned flight, where definite risks are involved, the level of acceptable risk which is compatible with mission goals must be decided. There is, naturally, some disagreement -- both in the US and in the USSR -- on the amount of radiation which man can absorb safely. Levels which the Soviets consider permissible tend to be lower, initially, than those set by the US, but the Soviets usually raise their limits to US limits and they will probably do so in their space program. The level of risk assumed officially by the USSR for manned flights is 25 rems per year for short flights and 15 rems per year for flights of more than a year's duration. There is some evidence that they would permit higher emergency doses -- up to 100 rems.*

Shielding. An unshielded man would receive a lethal dose of radiation in a 1-minute exposure to the Van Allen belts or to a solar flare. One estimate has been made that an unshielded trip to the Moon and back during a solar flare could produce a dose as high as 22,000 rads (100 ergs per gram of irradiated object) but that an aluminum capsule thick enough to provide 6 grams of shielding per cubic centimeter would reduce the dose to about 100 rads. Soviet reports indicate that the Vostok manned vehicle may provide almost this much protection. Weight limitations, however, are still of paramount concern in the design of space vehicles, and the Soviets realize that, because of this, shielding alone cannot provide complete radiation protection. They are, nonetheless, keeping close track of Western shielding work and making studies of their own.

The shielding problem is compounded by differences in the characteristics of various types of radiation. Thickening the shielding increases the protection against most types of radiation, but increases the dose from cosmic rays because of interaction of cosmic particles (heavy nuclei) with the shielding itself.

Chemical Protection. Soviet scientists and publications have consistently reported that Soviet cosmonauts are provided antiradiation chemicals. One exception is N.M. Sisakyan, a top-ranking Soviet radiobiologist, who once said that Nikolayev and Popovich (Vostoks 3 and 4) carried none, but this statement has been contradicted by other Soviets. Just as consistently, the Soviets have refused to identify the compounds carried. Only a few compounds are known which provide any protection; these have been described in Soviet literature. Unfortunately, these medicines produce undesirable side effects. There is no evidence that the Soviets have or soon will develop effective, useful antiradiation compounds.

Prospects: The Soviets have not been reckless with the health or lives of their cosmonauts. They will probably continue to take all reasonable

*rem -- roentgen equivalent mammalian, a product of the rad (radiation intensity) and RBE (relative biological effect).
The rad is a unit of measurement of the absorbed dose of ionizing radiation, corresponding to an energy transfer of 100 ergs per gram of irradiated object.
The RBE is a ratio of the biological effect of a given kind of radiation to the effect produced by the same dose of 200 kev X-ray.

precautions to eliminate or reduce to acceptable levels all the risks involved in space flight, including the radiation hazards.

For those manned space flights which the Soviets are likely to undertake in the next few years -- studies of the effects of weightlessness on man's physical and mental efficiency, and practice in rendezvous, docking, and the erection of space stations -- radiation safety can be insured through measures currently used:

1) Confining flights to low altitudes.
2) Launching dosimetric "pathfinders" and, possibly, biological satellites into the orbits to be flown by the manned vehicles.
3) Predicting solar flares, so that cosmonauts may be recovered before the flares erupt.

Manned lunar flights, however, raise radiation problems by an order of magnitude of difficulty. The two main risks are, of course, the Van Allen belts and solar flares. The Soviets may be able to avoid the belts by a suitable choice of trajectories, though this procedure could place constraints on choice of launch times or dates. Solar flares may be avoidable if it becomes possible to predict major flares 6-7 days in advance -- the term of the first lunar flights. Otherwise, the Soviets will be forced to rely on shielding, which increases payload weight and the demands on propulsion, or on medicinal protection, which today is not equal to the task.

Manned interplanetary flights, which will last more than a year, raise the radiation hazard by still another order of magnitude. There is no question but what interplanetary ships will be exposed to solar flares: the problem is to predict their probable number and their intensity and duration. A high degree of protection -- shielding or medicinal, or both -- will be essential. If complete protection cannot be afforded, then it may be necessary to confine interplanetary flights to the Sun's "quiet" periods, which are about 11 years apart (e.g., about 1975, 1986, and 1997). Here again, the Soviets can be expected to pave the way with dosimetric "pathfinders" and, possibly, biological satellites, to determine by empirical means the levels of radiation encountered and the adequacy of protection available. Such missions undoubtedly will be combined with or flown aboard unmanned interplanetary exploration flights.
(CIA, NORAD)
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Cosmos 59 a Routine TT Launch, Probably for Photoreconnaissance

Cosmos 59 which was launched from Tyuratam (TT) at about 0900Z, 7 March 1965, appears to be a routine TT launch of a recoverable photoreconnaissance vehicle, although the new vehicle may carry instrumentation for the accomplishment of other missions as well. Its orbital parameters have been reported as follows:

	By SPADATS	By TASS
Inclination	65.0 degrees	65 degrees
Period	89.8 minutes	89.7 minutes
Apogee	323.4 kilometers (173 n.m.)	339 kilometers (182 n.m.)
Perigee	206 kilometers (111 n.m.)	209 kilometers (112 n.m.)

Cosmos 59 was launched by the usual SS-6 ICBM booster-sustainer and injected into orbit by the heavy Venik upper stage. Vehicles injected by the Venik are believed to carry a camera system of high resolution (5-8 feet). Cosmos 59 will probably be recovered about 15 March.
(SPADATS; TASS; NORAD)
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Video Suggests Cosmos 57 Was to Be Precursor of Manned Rendezvous

Cosmos 57, which was launched 22 February and disintegrated sometime during Orbit One, or early in Orbit Two, previously has been suspected of being the precursor of a manned flight of some kind (pp. 7-8, WIR 9/65), the same as Cosmos 47 last October was a forerunner of the multimanned Voskhod flight 6 days later. Cosmos 57 had the same orbital parameters and electronic features as Cosmos 47, except that the former's orbital period was slightly longer, which should have allowed it to remain in orbit longer.

50X1 and 3, E.O.13526

The Voskhod of last October carried a TV installation which gave a similar view of the instrumentation compartment, according to Red Star of 27 October 1964.

The instrument compartment of Cosmos 57 was strikingly similar, according to video signals, to the shape of the end of Sputnik 3 (see photo on page 38), the Soviets third space vehicle (launched 15 May 1958), except that the instrumentation at the small end of Sputnik 3 had been replaced on Cosmos 57 by a hemispherical cap. The lower part of the conical section appeared to be girdled by paneled louvres; protrusions near the top of the conical section and one on the hemispherical cap were probably antennas.

<u>Tumbling of Cosmos 57.</u> Video signals from Cosmos 57 picked up by Alaskan stations during Zero Orbit, shortly after launch, indicate that the vehicle was stable in orbit; for instance, no change in the lighting pattern of the vehicle could be distinguished. Video signals picked up about 70 minutes later by Middle East stations, however, indicated that the vehicle was tumbling rapidly about its pitch axis. Cause of the tumbling is not known; one possible avenue of determining the cause was closed with the loss of [redacted] after Zero Orbit. Some of the possibilities include failure of:

- Attitude control.
- Attempted deorbit.
- Attempt to change orbit.

<u>Prospects.</u> The Soviets, in order to gain confidence, could well repeat the Cosmos 57 operation soon.
(Various ELINT sensors)
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The Radiation Hazard in Space

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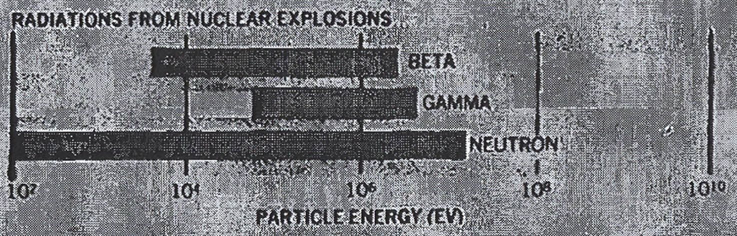

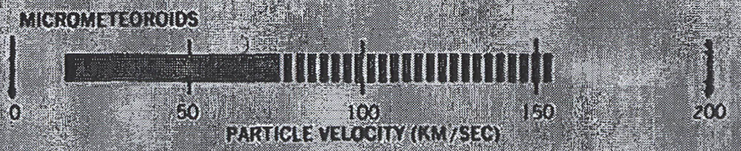

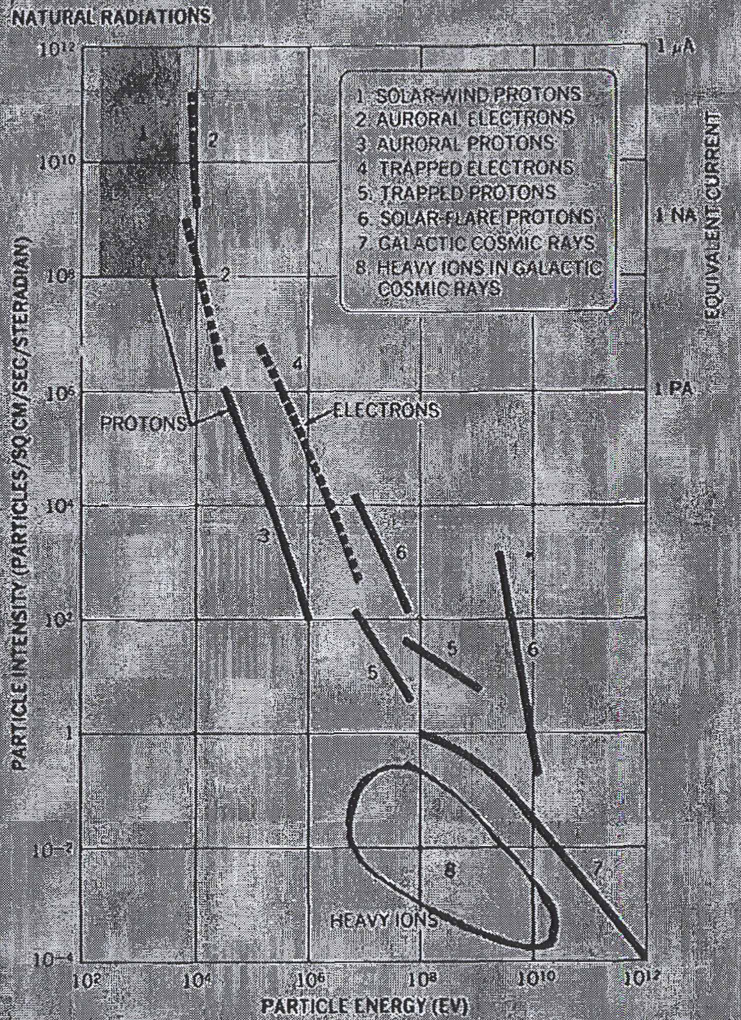

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Van Allen Belts, Particle Energies and Fluxes, Fall 1961

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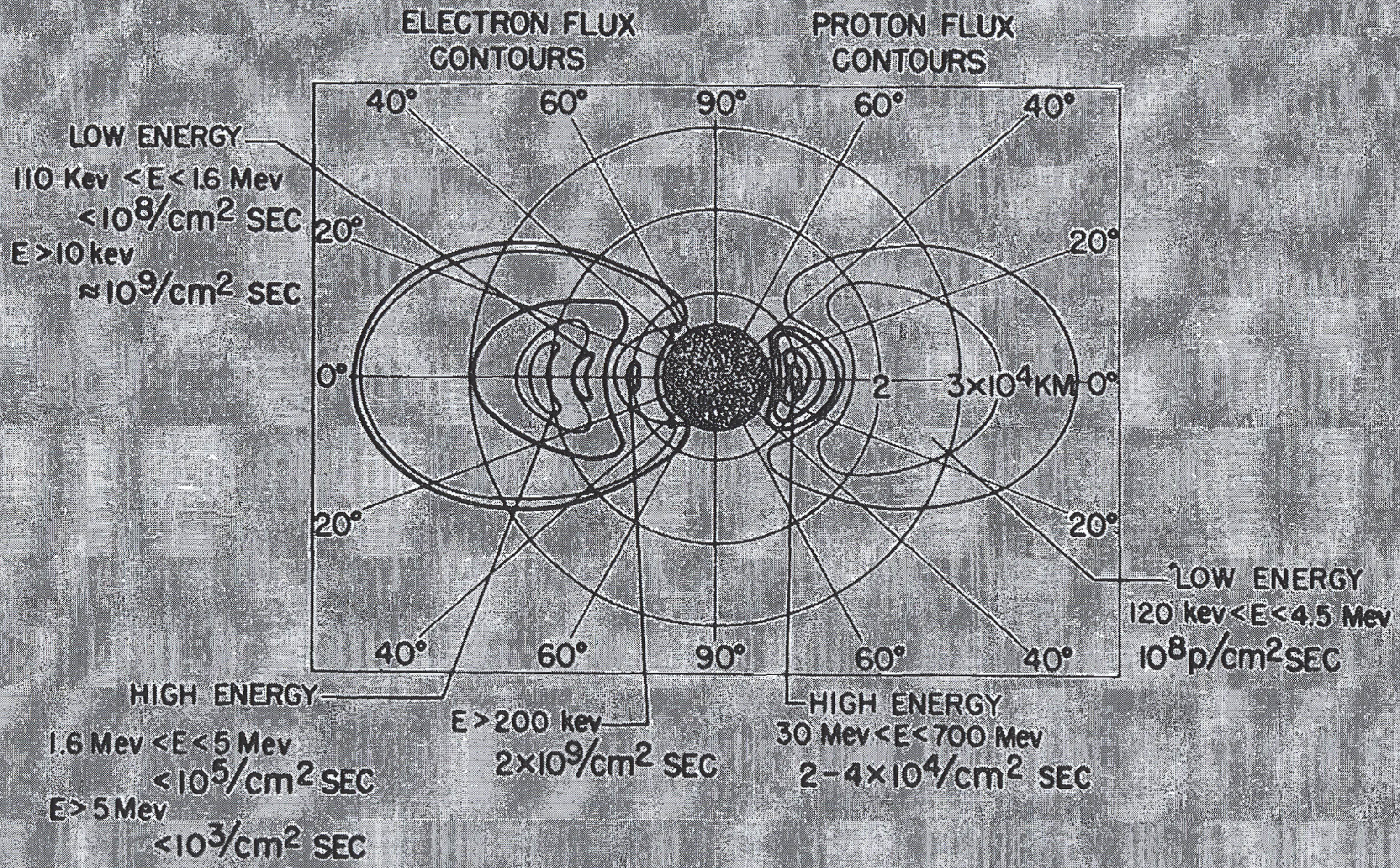

Space flights in low orbit (less than 250 n.m.) can avoid the Van Allen Belts altogether. Flights to the Moon and other planets can avoid them with suitable choice of launch times and orbital inclinations.

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Sputnik 3 (model displayed in New York) (photo and this caption are UNCLASSIFIED)

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