NORTH AMERICAN AIR DEFENSE COMMAND

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WEEKLY INTELLIGENCE REVIEW (U)

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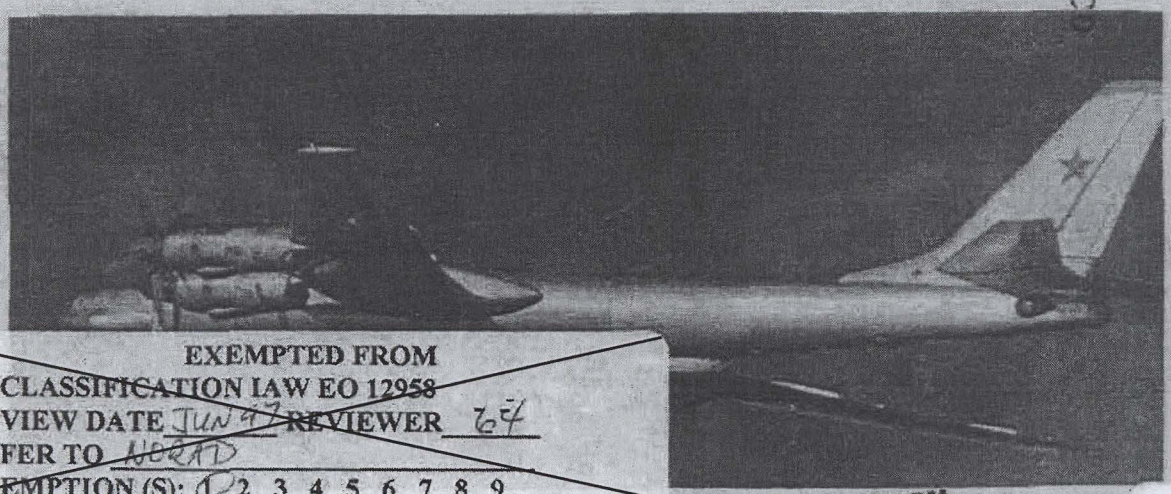

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17 Mar 67

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NORAD Weekly Intelligence Review

Issue No. 11/67, 17 March 1967

The WIR in Brief

[redacted]

Portion identified as non-responsive to the appeal

Correction to Missile Firing Log

The first two missile firings listed at the top of page 9, WIR 9/67, 3 March 1967, should be deleted. In their place should be inserted the 3 following firings:

2202Z, 03 Feb	Vertical firing from Kapustin Yar
1247Z, 04 Feb	Vertical firing from Kapustin Yar
1417Z, 06 Feb	Vertical firing from Kapustin Yar

(NORAD)
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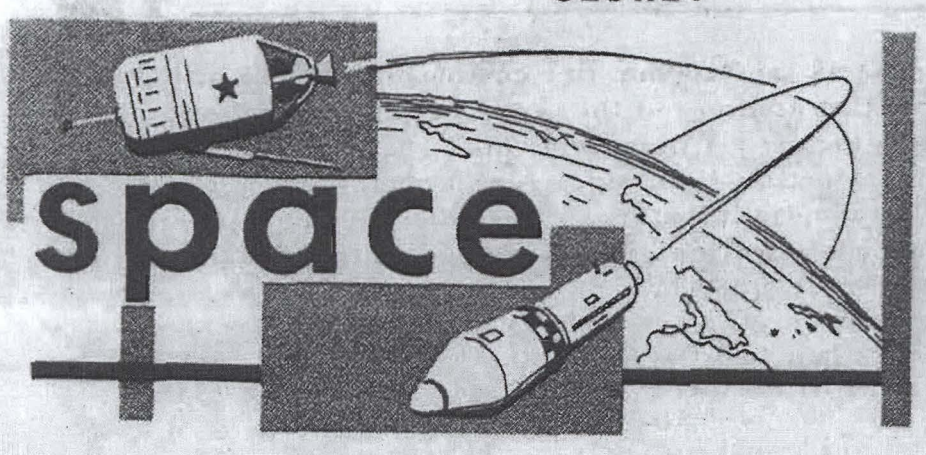

significant intelligence on space developments and trends

Cosmos 146 May Have Tested Propulsion and Payload Systems for Manned Circumlunar Flight

The launch of Cosmos 146 from Tyuratam at about 1132Z, 10 March, may have been a test of a new space propulsion system and possibly a spacecraft which will figure in a manned circumlunar flight, probably this year.

Cosmos 146 was launched by the SL-9 propulsion system with an added 3rd stage. The 2-stage SL-9, the largest known Soviet propulsion system, has been used previously only to orbit the 12.2-metric-ton Proton-series scientific payloads. This is the first time that a 3d stage has been added to the SL-9.

50X1 and 3, E.O.13526

After injection into orbit, the 3d stage remained attached to the payload for the first 16 revolutions. During the early part of the 17th revolution, [redacted] suggesting that the 3d stage had been relighted, [redacted] Since Cosmos 146 was not then being tracked by US radars, it is not possible to determine what occurred. However, the re-ignited 3d stage may have redirected and accelerated the payload into a steep high-speed re-entry trajectory in a test of the protective characteristics of a heat shield. On the other hand, it also is possible that it may have injected the payload into a highly eliptical high-energy deep-space trajectory to test the relight phase of the 3d stage. In any event, US surveillance systems failed to detect Cosmos 146 thereafter, but they did detect and track two associated spheres (one 3 feet in diameter, the other 4 feet) in an orbit higher than the original one. This circumstance tends to support the deep-space-trajectory hypothesis.

TASS said only that Cosmos 146 was performing the usual Cosmos mission of studying the near-Earth space environment. But the satellite's orbit was too low and its lifetime too brief for it to conduct any useful space research. Use of the huge SL-9 launch system also casts doubt on the veracity of the Soviet announcement.

It is more likely that Cosmos 146 is the latest in a series of space events leading to manned circumlunar flight with each Earth re-entry.

- The first 4 SL-9 launches (Protons 1, 2, and 3, and one failure) appear to have been primarily tests of a propulsion system capable of sending a 14,000-15,000 pound vehicle into circumlunar trajectory with Earth return. The cosmic-ray studies of the Protons were probably a secondary mission.
- The Cosmos 133 and Cosmos 140 events (28 Nov 66 and 7 Feb 67) appear to have been systems tests of a payload, possibly a modified Voskhod, which would be suitable for the postulated circumlunar flight. (These were launched by the smaller SL-4 system.) (See WIRs 7/67 and 48/66.) (See drawing on page 32.)

Cosmos 146 appears to have been the next step -- test of the combined propulsion and payload systems -- toward the climatic manned circumlunar flight.

It is estimated that the SL-9 propulsion system with an optimized third stage would be adequate to launch a modified Voskhod weighing approximately 14,000 lbs and with two men aboard into a circumlunar flight.

Prospects. The recent apparent acceleration in tempo of testing of systems which seem to be related to a forthcoming manned circumlunar flight suggest that the Soviets are strenuously seeking to solve remaining problems as rapidly as possible, with a view to executing this prestige-laden mission some time this year, to mark the 50th year of Communism in the USSR.
(NORAD) (Chart on page 33.)
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Cosmos 147 is Soviets' 4th Recce Satellite of 1967

Cosmos 147, which was launched from the Tyuratam Missile Test Range at about 1210Z, 13 March, is the fourth Soviet military reconnaissance satellite launched this year. It carries a medium-resolution camera system and, probably, ELINT collection equipment. It will probably be de-orbited on 21 March.
(NORAD)
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technical intelligence NOTES

items of interest on technical developments around the world

Portion identified as non-responsive to the appeal

Advanced Chemical, Antimatter, Antigravity Propulsion Systems Unlikely in Near Future

(A summary of an FTD study of estimated Soviet capabilities for introducing certain unconventional means of propulsion, excluding nuclear and electric.)

The weight of missile payloads and of spacecraft is severely limited at present by the relatively small amounts of thrust available from currently used chemical propulsion systems. For example:

- A vehicle gross weight of 440,000 pounds, 87.5% of its propellant, is required in the case of the SS-9 to propel a 12,500-pound re-entry vehicle a distance of 5,000 n. m.
- Neither the US nor the USSR is able at present to probe any planets of the solar system except for the two closest ones, Venus and Mars.

Scientists, consequently, are looking into the prospects for using unconventional energy sources -- known and theoretical -- which might yield thrusts which exceed present-day levels by possibly several quantum jumps.

Some of these sources include:

- Energetic particles which occur naturally in the upper atmosphere.
- Atoms, molecules, and stabilized free radicals in excited or metastable states.
- Antimatter.
- Antigravity.

Energetic Particles in the Upper Atmosphere. The Earth's upper atmosphere, thanks primarily to continuous solar activity, is in effect a reservoir of energetic particles which, when recombined chemically, theoretically could be used for propulsion -- primarily for cruise-type vehicles, such as missiles or hypersonic aircraft.

The big advantage of this type of propulsion is that the range of a vehicle, when operating within the upper atmosphere, would not be limited by the amount of fuel it could carry: the fuel supply would be immediately available in the medium in which the craft operates. The vehicle would "collect" its fuel -- the energetic particles -- simply by the ram effect of its flight through the upper atmosphere. Its engine would compress the particles and recombine them chemically through the application of heat: expansion of the resulting hot gases would be fed through a nozzle to supply thrust in the desired direction.

The Soviets presumably could have considered this fuel source, for they have since 1958 been collecting upper-atmosphere data that would be needed for developing this type of propulsion. However, Soviet data published in 1963, in agreement with Western data, indicated that the energy content of the upper atmosphere amounts to only one millionth of a calory per 10 cubic centimeters. This is only one tenth the amount which Western scientists consider necessary for propellant use.

Data which the Soviets have obtained since 1963 with flights of mass spectrometers through the upper atmosphere could have produced some refinements in the earlier estimates, but as recently as 1965 the Soviets were still quoting the data published in 1963.

All the evidence indicates that any attempts to obtain propulsion from energetic particles in the upper atmosphere would be impracticable. Soviet efforts, therefore, to exploit this source are not likely.

Atoms, Molecules, and Free Radicals in Metastable (Excited) States. The energy available from a given chemical reaction theoretically could be multiplied many times if the reactants could be prepared in electronically excited states. (The reactants are said to be metastable if the excited states can be made to persist; at present they can be maintained only for brief fractions of a second.) Potential energy storage of this type may be 10-100 times the amount available from the ordinary chemical reaction. Chief candidates for

such use are hydrogen radicals and other species of light atomic or molecular weight. The problems have been to concentrate, stabilize, and store these radicals.

The Soviets are known to be giving extensive support to research in the various areas of physical chemistry which could bear on the development of free radicals and metastables as propellants. There is, however, no evidence available which suggests that this work is associated specifically with a propellant program, although, of course, a concealed program to this end might exist. The Soviets, in such a case, probably would not admit that the program existed.

The existence of such a program -- or progress therein -- might be detected if and when it is learned that the Soviets have succeeded in achieving long lifetimes of relatively high concentrations of metastables in a condensed phase. Similarly, theoretical justification for relatively high concentrations of low atom-or molecular-weight species would be a useful indicator.

The evidence available to date suggests that Soviet application of free radicals or metastables to propulsion is more than 20 years on in the future, barring unforeseen breakthroughs.

Antimatter. Research on the fundamental nature matter has brought about the production, among other things, of particles which are opposite in electrical charge to their normal counterparts, such as:

- Positrons, which are like electrons but have positive instead of negative charges.
- Antiprotons, which are like protons except that they have negative instead of positive charges.

These particles, and any combinations of them, constitute antimatter.

Antimatter is of theoretical interest for propulsion, since simple contact between ordinary matter and antimatter causes the annihilation of both, with a consequent release of enormous quantities of energy -- well beyond that encountered in nuclear and thermonuclear explosions. This energy would be released in the form of photons; the propulsion device would be known as a photon engine.

Photons generated by matter-antimatter contact, unlike ordinary propellants, could not be forced to flow through nozzles to provide thrust: they would fly off in all directions. Those expelled rearward from the focus of the photon engine would create thrust; those emitted in a forward direction might be absorbed, to heat an auxiliary propulsive fluid (such as the hydrogen used in nuclear heat-transfer propulsion) and to provide auxiliary space power.

The Soviets are studying antimatter, and they have mentioned it as a potential propellant, at least in "popular-science" type articles. (One of these, which appeared in Nedelya of 21-27 April 1963, was discussed in WIR 33/63.) But serious Soviet studies of antimatter more than likely are

oriented mainly to the study of the fundamental nature of matter. One Soviet scientist, I. S. Shklovskiy, told a conference of Soviet scientists in May 1964 that at least one type of photon rocket -- "interstellar rockets moving with relativistic speeds" -- most likely will never be built.

The fact is that grave problems confront any attempt to use antimatter as a propellant.

Since antimatter is not known to be stored in nature, it must be synthesized. Accelerators with energies of more than 5.6 billion volts are required. The Soviets have such equipment, but antiparticles are produced with relatively low efficiency.

Moreover, the problems of isolating and storing antimatter are even more limiting than the problems of producing it. There has been no specific indication that the USSR is concerned with the storage of antimatter in the concentrations and for the lengths of time required for propulsion, although many storage techniques under study could have such an application.

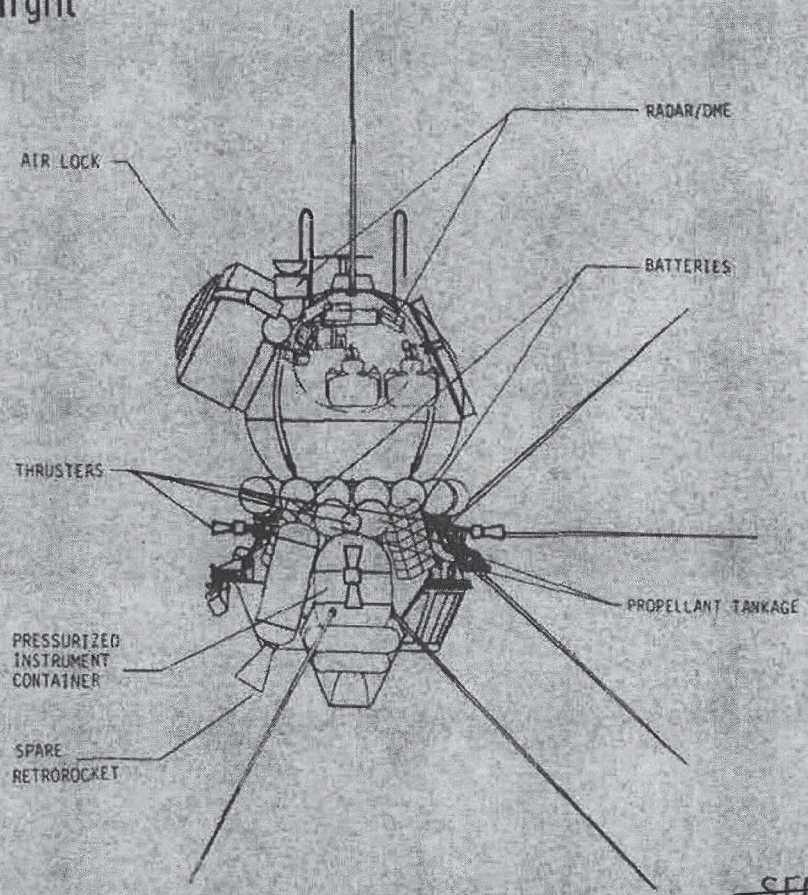
Barring unforeseen breakthroughs, no serious Soviet consideration to the use of antimatter for propulsion is expected within the next 20-30 years.

Antigravity. The status of antigravity is even more tenuous than that of antimatter, both regarding basic understanding and any applications that can be seen for it. (Antigravity, if it exists, would be a force -- natural or contrived -- by which bodies of matter would repel instead of attract each other.)

In the USSR, as in the US, fundamental studies are under way to acquire a more adequate understanding of gravity itself, which would be prerequisite to an understanding of antigravity or developing a means of generating it. However, the harnessing or control of gravity, or of so-called antigravity, for propulsion is expected to be outside Soviet capabilities for the next 20-30 years, unless unforeseen breakthroughs are achieved.
(FTD; NORAD)
~~(SECRET)~~

A Postulated Voskhod -- Modified to Carry 2 Men on a Circumlunar Flight

FTD



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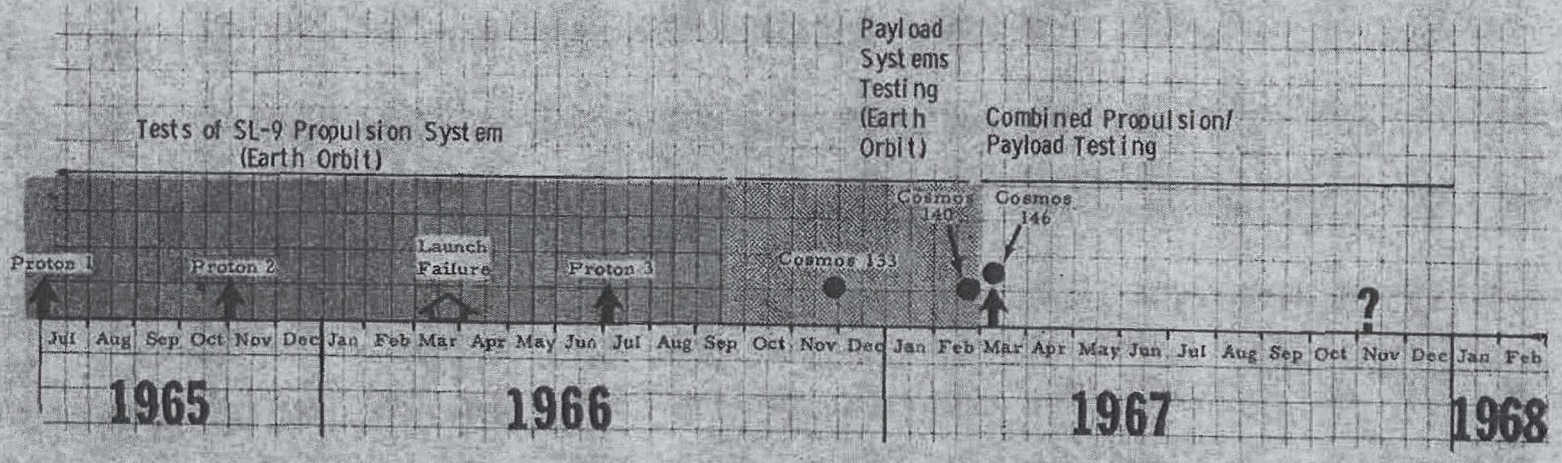
Steps Toward Manned Circumlunar Flight by the Soviets Quicken



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