SPACE

Space, Past, Present and Future

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See Front Cover

➤ THE UNITED STATES is moving into space with three times the number of satellites launched by the Soviet Union but the Russians still are ahead in the race to get a man to the moon.

More than 100 spacecraft have been boosted into space by the U.S. as compared to the 27 launched by the USSR since the Space Age was ushered in by the orbit of Sputnik I on Oct. 4, 1957. In addition to superiority in numbers, the United States has advanced ahead of the Russians in communications and weather satellites, solar and geophysical satellites, and instrument and design sophistication. Both countries have launched planetary probes—in 1962 the U.S. sent Mariner II on a Venus fly-by, the Soviets sent a vehicle toward Mars.

Soviet cosmonauts hold the record for time and distance in space and ability to launch, maneuver and recover a manned vehicle from orbit. Soviet superiority in manned space flight is largely the result of greater rocket power than the U.S. now possesses.

The most the United States can manage now is about two tons with the 360,000-pound-thrust Atlas. By the most optimistic estimates, in 1964 the U.S. may be able to match present Soviet capability to put ten tons in orbit with a booster of 1.5 million pounds of thrust.

By 1965, the U.S. hopes to have an advanced Saturn rocket developed with seven times the power of the present Soviet giant engine. But expectations are that Soviet technology will also continue to advance in this area. Barring a sudden breakthrough, therefore, it seems likely that a Russian will reach the moon in this decade before an American.

Seen on this week's front cover is an artist's concept of an orbital station that engineers at Douglas Aircraft Company, Inc., believe could be used by 1970 as a rendezvous and launch point for lunar shuttle vehicles, reusable spacecraft and homeward-bound planetary vehicles.

Experts here have predicted that within the next two years, the Russians will have built a permanent platform in space from which launches to the moon and beyond can be made and will have achieved orbital rendezvous of manned vehicles.

While the U.S. is striving to overtake the Russians on their way to the moon, it will, at the same time, work to keep the lead it has achieved in other areas of space explorations. The nation's space agency, the National Aeronautics and Space Administration, will early next year launch a Nimbus meteorological satellite in a near-circular orbit at 500 miles altitude. This will provide additional information about the behavior of the atmosphere that will improve weather prediction.

An OGO (Orbiting Geophysical Observatory) is scheduled for orbit late in 1963 and will carry aloft a series of individual experiments to probe earth-space relationships.

In the spring, Astronaut Leroy Cooper will ride a Mercury capsule into orbit for 24 hours. This will end Project Mercury. The Gemini two-man space program will follow. The flights will take relatively the same orbital path as the Mercury flights. Week-long manned flights are part of the Gemini program for 1964.

Relay, a communications satellite similar to Telstar, is scheduled for launch by NASA in December 1962, to be followed by Syncom in 1963, which will be the first communications satellite to be placed in a 22,000-mile synchronous orbit.

The Department of Defense will continue to place in orbit surveillance and warning satellites and test other systems for space that may have a military capability.

U.S. scientists are working on the concept of reusable rocket boosters and recoverable vehicles so that money may be saved on earth and space will not become dangerously cluttered with broken-down, worn-out spacecraft.

Looking to the future, NASA has under consideration now a proposal for which it may seek funds next year for a six-month study of a 21-man space station that would have parking facilities for seven Apollos at its hub. This concept is not expected to be developed until the 1970's. In this decade, however, orbital laboratories from which rendezvous can be achieved may be developed. In the latter part of the 70's, NASA officials look ahead to a manned landing on Mars, reconnaissance of Venus and a search for life on other planets. In the last 20 years of this century, U.S. space experts are hopeful a station on Mars will have been established from which advanced manned expeditions will be launched. U.S. satellites will be orbiting Jupiter, Mercury and other planets. Preliminary analytical work for these projects is under way although they have not been authorized and there is no funding for them.

1962 Space Calendar

The following are the principal satellites and probes launched during 1962 (up to Dec. 1): * indicates in orbit, ** still transmitting in orbit. Orbital distances closest to (perigee) and farthest from (apogee) earth, moon or sun are shown in miles. The time for an orbit is shown in minutes. Figures are from NASA information. Unsuccessful launches are in general not listed. See end of list for notes on DISCOVERER and COSMOS satellites.

*RANGER III (U.S.) Jan. 26, 1962—Permanent orbit around sun. Objective of lunar impact not achieved due to excessive injection velocity from parking orbit which put satellite in orbit around sun. 91,503,314 miles from sun. 108,133,854 miles from sun. 406.439 days.

**TIROS IV (U.S.) Feb. 8, 1962—Up to one year. Placed in circular earth orbit. Data from TV cameras are used to prepare cloud analyses for operational weather analysis and forecasting for distribution over domestic and international weather circuits. 471-525 miles. 100.4 minutes.

MERCURY ATLAS VI, "Friendship 7," (U.S.) Feb. 20, 1962-Feb. 20, 1962—After three orbits, with Astronaut John H. Glenn Jr. as pilot, spacecraft was recovered in Atlantic. Flight provided first test of Mercury systems in orbit with live astronaut aboard. 100.3-162.7 miles. 88.2 minutes.

**OSO-I (Orbiting Solar Observatory) (U.S.) March 7, 1962—Satellite placed in near-circular earth orbit with devices to conduct 13 different experiments for study of solar electromagnetic radiations, investigate dust particles in space and thermal radiation characteristics of spacecraft surface. 343.5-369.8 miles. 96.15 minutes.

RANGER IV (U.S.) April 23, 1962-April 26, 1962—Impacted moon at a point estimated at 229.3 degrees east longitude and 15.5 degrees south latitude. No scientific data obtained.

**ARIEL (U.S. and U.K.) April 26, 1962—No estimate given. First international satellite. Contains six British-designed experiments launched by American Delta booster in elliptical earth orbit to investigate the ionosphere and its relationships with the sun. 242.1-754.2 miles. 100.9 minutes.

MERCURY ATLAS VII, "Aurora-7," (U.S.) May 24, 1962-May 24, 1962—Piloted by Astronaut Scott M. Carpenter for three orbits around the earth, spacecraft with pilot was recovered. Pilot obtained data on behavior of liquid under weightless conditions and made important observations on aurora and airglow. 100-166.8 miles. 88.3 minutes.

**TIROS V (U.S.) June 19, 1962—Still in orbit. Earth orbit achieved and excellent photos for hurricane research transmitted. 367-604 miles. 100.5 minutes.

**TELSTAR I (U.S.) July 10, 1962—Used successfully to test broadband communications in space and revealed effects of radiation from artificial radiation belt on semiconductors. 593-3,503 miles. 157.8 minutes.

VOSTOK III (USSR) Aug. 11, 1962-Aug. 15, 1962—During more than 64 orbits, the longest experience of manned space flight to date, Cosmonaut Andrian Nikolayev floated in a weightless condition for over three hours without restraints, transmitted live television to Soviet ground stations and after leaving spacecraft via ejection capsule parachuted to earth near Karaganda, Kazakhstan. 105.6, later 107.4-156, later 137.2 miles 88.5 minutes after launch; later 88.13 minutes.

VOSTOK IV (USSR) Aug. 12, 1962-Aug. 15, 1962—Placed manned satellite in orbit 4.03 miles from orbiting Vostok III, launched a day earlier. During more than 48 orbits, Cosmonaut Pavel Popovich was in close visual and radio contact with Vostok III and also tried free floating for three hours in weightlessness. Precision recovery made near recovery area, six minutes after landing and recovery of Vostok III. 111-158 miles. 88.5 minutes.

**MARINER II (U.S.) Aug. 27, 1962—Expected to come within 20,300 miles of Venus by mid-December at 35,924,898 miles from earth. The 447-pound gold- and silver-plated vehicle will travel about 182 million miles in an attempt to get close enough to Venus to discover secrets of the atmosphere of Venus and whether life as we know it on earth could exist on the "mystery planet." Success will depend on its communications system which at year's end was operating 24 hours a day transmitting information on cosmic dust, solar gas, charged particles and magnetic fields en route to Venus. After passing Venus, Mariner II will continue to transmit for a period and then will be another artificial satellite orbiting the sun.

**TIROS VI (U.S.) Sept. 18, 1962—Estimated useful lifetime six months. Launching marked the sixth straight success of Project Tiros and the eleventh of Thor-Delta three-stage rocket, and moved the program out of the research phase into routine operational basis. Tiros VI, placed in a near circular orbit, is taking pictures of all of earth except the polar regions. 423.4-444.4 miles. 98.7 minutes.

**ALOUETTE (U.S. and Canada) Sept. 29, 1962—Up to one year. A 280-pound satellite to study communication phenomena in the ionosphere. 620-638 miles. 105.4 minutes.

**EXPLORER XIV (U.S.) Oct 2, 1962—Up to one year. Launched in highly elliptical orbit to measure energetic particles in magnetosphere and outer space, and to determine their relation to magnetic fields in earth and interplanetary space. 174.2-61,190 miles. 36.4 hours.

MERCURY-ATLAS VIII, "Sigma 7," (U.S.) Oct. 3, 1962-Oct. 3, 1962—Six-orbital ride of Astronaut Walter Schirra demonstrated ability of pilot to resume controlled flying after a period of drifting and was a further check of life-support systems for prolonged manned space flight planned for future. 100-176 miles. 89 minutes.

RANGER V (U.S.) Oct. 18, 1962-Oct. 18, 1962—Failed in attempt to impact the moon apparently because of defect in panels of solar cells to power maneuvers in space and transmit information to earth. In solar orbit.

**EXPLORER XV (U.S.) Oct. 27, 1962—Estimated 60-day lifetime. To study artificial radiation belt created by U.S. nuclear bomb explosion in the upper atmosphere on July 9. 193.7-10,760 miles. 5.2 hours.

**ANNA (U.S.) Oct. 31, 1961—Unknown. Blinking Army, Navy, NASA and Air Force satellite launched in near-circular orbit to gain geographic information and improve mapping capabilities for better navigation. 668.98-732.22 miles. 107.8 minutes.

DISCOVERER satellites—Seventeen Discoverer launches have been made (up to Dec. 1) by U.S., most of them of short duration and for secret military purposes with data largely unannounced.

COSMOS satellites—The USSR has launched (up to Dec. 1) 11 Cosmos satellites to investigate upper atmosphere layers and space, generally similar in purpose to U.S. Discoverers.

Bringing Space Age Up to 1962

The Space Age began Oct. 4, 1957, when the first Sputnik went into orbit. Since then men have gone into orbit, many satellites for many purposes have been launched, probes have hit the moon and traveled near planets, and plans are being made to reach the moon.

As a record of the major achievements of 1957, 1958, 1959, 1960 and 1961 this condensed space calendar is presented. Only the major achievements are included, especially those still orbiting or of historical significance. * objects still in sky. ** still transmitting. See SNL 80:221 Sept. 30, 1961, for full list through that date with orbit data, etc. The 1962 calendar continues this list.

SPUTNIK I (USSR) Oct. 4, 1957-Jan. 4, 1958—Measured atmospheric density, temperatures. 142-558 miles. 96.2 minutes.

SPUTNIK II (USSR) Nov. 3, 1957-April 14, 1958—Biomedical experiments, measured solar influence on upper atmosphere densities, cosmic rays. 140-1,038 miles. 103.7 minutes.

*EXPLORER I (U.S.) Jan. 31, 1958 to 1961-1963—Discovered Van Allen radiation belt (believed most significant find of the International Geophysical Year). 217-1,100 miles. 106.2 minutes.

**VANGUARD I (U.S.) March 17, 1958-2158—Found earth is pear-shaped, tested vehicle and satellite. 404-2,451 miles. 133.9 minutes.

EXPLORER III (U.S.) March 26, 1958-June 27, 1958—Data on radiation belts, micrometeor impacts, temperatures. 117-1,741 miles. 114.7 minutes.

SPUTNIK III (USSR) May 15, 1958-April 6, 1960—For studying atmospheric pressure, composition; concentration of ions; magnetic fields; cosmic rays. 135-1,167 miles. 106 minutes.

EXPLORER IV (U.S.) July 26, 1958-Oct. 23, 1959—Data of radiation belts, spatial relationships, analyzed earth's magnetic field. 157-1,388 miles. 110.1 minutes.

PIONEER I (U.S.) Oct. 11, 1958-Oct. 12, 1958—Determined radiation band, first observation of hydromagnetic oscillations of earth's magnetic field. Space probe.

PIONEER III (U.S.) Dec. 6, 1958-Dec. 7, 1958—Discovered second radiation belt around the earth. Space probe.

PROJECT SCORE (U.S.) Dec. 18, 1958-Jan. 21, 1959—First time human voice beamed from space, relayed messages from U.S. ground stations. 110-920 miles. 101.46 minutes.

*LUNIK I (USSR) Jan. 2, 1959-indefinite—To study interplanetary matter, solar radiation, magnetic fields of earth and moon. Solar orbit: 90.8-122.5 million miles from sun. 450 days.

*VANGUARD II (U.S.) Feb. 17, 1959-1969—For studying cloud cover 344-2,052 miles. 125.4 minutes.

*PIONEER IV (U.S.) March 3, 1959 in continuing solar orbit—Important data on solar radiation, tested long-range tracking. 91.8-106.2 million miles from sun. 398 days.

EXPLORER VI (U.S.) Aug. 7, 1959-June, 1961—Televised first pictures of earth's cloud cover, detected electrical ring current, mapped Van Allen belt and earth's magnetic field. Position uncertain.

LUNIK II (USSR) Sept. 12, 1959-Sept. 13, 1959—Hit the moon, studied magnetic fields of earth and moon, particles in space, cosmic rays.

VANGUARD III (U.S.) Sept. 18, 1959 to 1989-1999—Surveyed earth's magnetic field, located edge of Van Allen belt, accurate count of micrometeorite impacts. 317-2,320 miles. 129.8 minutes.

LUNIK III (USSR) Oct. 4, 1959-mid-April, 1960—Photographed moon's far side. Circled moon and earth. 24,840-292,000 miles. 15 days.

*EXPLORER VII (U.S.) Oct. 13, 1959 to 1979-1989—Data on radiation and magnetic storms, first micrometeorite penetration of sensor in flight, detected weather patterns. 344-669 miles. 101.1 minutes.

*PIONEER V (U.S.) March 11, 1960 for 100,000 years—Set long-range communications record (22,500,000 miles), data on solar flare effects, particles and magnetic fields. Solar orbit: 74.9-92.5 million miles from sun. 311.6 days.

*TIROS I (U.S.) April 1, 1960 to 2010-2060—Took more than 22,000 pictures of cloud covers relayed by TV, data for meteorological satellite system. 429-467 miles. 99.1 minutes.

*TRANSIT I-B (U.S.) April 13, 1960-1961—Data for global navigational satellite system. 229-412 miles. 94.9 minutes.

SPUTNIK IV (USSR) May 15, 1960-Sept. 5, 1962—Tested life support systems for manned space flight. 175-305 miles. 92.3 minutes.

*MIDAS II (U.S.) May 24, 1960-1963—Tested infrared scanner system for detection of missile launchings. 297-314 miles. 94.3 minutes.

*TRANSIT II-A—GREB (U.S.) June 22, 1960-2010—Two satellites fired at once, data for navigational satellite system. Transit II-A 389-649 miles. 101.6 minutes. Greb 381-657 miles. 101.6 minutes.

*ECHO I (U.S.) Aug. 12, 1960-indefinite—First passive communications satellite, voice and telephone transmission 823-1,095 miles. 116.9 minutes.

*COURIER I-B (U.S.) Oct. 4, 1960 for several years—Data for military communications system. 611-743 miles. 106.8 minutes.

*EXPLORER VIII (U.S.) Nov. 3, 1960-1970—Data on ionosphere composition, micrometeorites. 262-1,409 miles. 112.5 minutes.

*TIROS II (U.S.) Nov. 23, 1960 to 2010-2060—Data for meteorological satellite system. TV pictures of clouds. 378-461 miles. 98.2 minutes.

*SAMOS II (U.S.) Jan. 31, 1961 for undisclosed time—Observed space, earth and its atmosphere. 295-341 miles. 94.9 minutes.

*SPUTNIK VIII—VENUS PROBE (USSR) Feb. 12, 1961—Sputnik VIII decayed Feb. 25, 1961, leaving the Venus probe in polar orbit for indefinite time, having been launched from the satellite toward Venus for long-range communication, observation of space. Solar orbit: 66.8-94.7 million miles from sun. 300 days.

*DISCOVERER XXI (U.S.) Feb. 18, 1961 for undisclosed time—For engineering, atmospheric and infrared radiation studies. Agena engine restarted in space for the first time. 154-516 miles. 95.5 minutes.

*EXPLORER X (U.S.) March 25, 1961 for uncertain time—Data on interplanetary magnetic fields. Original orbit: 100-145,000 miles.

VOSTOK I (USSR) April 12, 1961-April 12, 1961—Manned spaceship recovered after one orbit, tested man's reactions in space. 108.76-187.66 miles. 89.1 minutes.

*EXPLORER XI (U.S.) April 27, 1961 to 1962-1964—Orbited a special telescope for mapping gamma rays from cosmic sources. 302-1,113 miles. 107.9 minutes.

**TRANSIT IV-A—GREB III AND INJUN (U.S.) June 29, 1961-1962 (Transit); indefinite (Greb and Injun)—Three satellites, two not separated, data for navigational gathering satellite system, on solar X-rays and on cosmic rays. Transit 547-620 miles. Greb and Injun 548-619 miles. 103.8 minutes.

*TIROS III (U.S.) July 12, 1961-indefinite—Data for meteorological satellite system, TV pictures of clouds. 457-510 miles. 100.3 minutes.

*MIDAS III (U.S.) July 12, 1961 for indefinite time—Tested system for detection of missile launchings. 2,084-2,197 miles. 161.5 minutes.

VOSTOK II (USSR) Aug. 6, 1961-Aug. 7, 1961—Manned spaceship, studied effects on man of long orbital flight, recovered in 18th orbit. 110.3-115.3 miles. 88.6 minutes.

*EXPLORER XII (U.S.) Aug. 15, 1961-indefinite—Data on solar wind, interplanetary magnetic fields, particles in space, Van Allen belts. 165-47,858 miles. 26 hours and 24 minutes.

*MIDAS IV (U.S.) Oct. 21, 1961- —Polar orbit achieved and West Ford dipoles ejected. Perigee and apogee, not available. 172 minutes.

*DISCOVERER XXXIV (U.S.) Nov. 5, 1961- —Polar orbit achieved but capsule not recovered due to on-orbit malfunction. 134-637 miles. 97.2 minutes.

*TRANSIT IV-B (U.S.) Nov. 15, 1961—5 years estimated lifetime—Two satellites orbited: Transit, to develop all-weather navigation system, investigate earth's shape; *TRAAC, to test gravity system for attitude control and obtain data on inner Van Allen belt. SNAP nuclear non-fissionable power supply furnished current for two Transit transmitters. Transit: 582-700 miles; 105.6 minutes.

MERCURY-ATLAS V (MA-5) (U.S.) Nov. 29, 1961-Nov. 29, 1961—Provided two-orbit ride for space chimpastronaut Enos to test all Mercury systems. 99.6-147.5 miles. 88.5 minutes.

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MILITARY SCIENCE

ABC's of U.S. Missiles

➤ MISSILES, upon which the United States and the Free World have pinned their hopes for security, vary in size, kind and power. From A (Alfa) to Z (Zuni) and from the depths of the ocean to outer space, these swift-moving vehicles are on guard 24 hours a day against an enemy attack.

Much talked about, they are, however, little known and often misunderstood. Following are some of the questions most frequently asked about missiles and the answers.

What is a missile?

Technically, a rock, bullet or arrow or any weapon thrown or propelled through space is a missile. But the missiles spoken about today are those vehicles which have in common an airframe, a fueled power plant, a guidance system and a payload capacity.

What kinds of missiles are used for military purposes?

There are two basic kinds of missiles: ballistic and air-breathing.

How do these differ?

A ballistic missile has its own oxidizer for fuel combustion and does not rely upon aerodynamic surfaces to produce lift. It follows a ballistic trajectory (like a bullet from a rifle or a shot fired from a cannon). It does not have fins or wings. It can operate beyond the atmosphere.

An air-breathing missile has an engine requiring the intake of air for combustion of its fuel and cannot operate in outer space.

What kinds of ballistic missiles are there for military use?

There are ICBM's (Inter-Continental Ballistic Missiles), IRBM's (Intermediate Range Ballistic Missiles), mobile MRBM's (Medium Range Ballistic Missiles), and ALBM's (Air Launched Ballistic Missiles), as well as short-range ballistic missiles.

What are the characteristics of an ICBM?

It is a missile with sufficient range to strike a strategic target such as an industrial site, a missile base or a military installation from one continent to another. Its minimum range is about 5,000 miles. U.S. ICBM's include the Atlas, Minuteman and Titan. All are operational and deployed at various bases in the United States. The Atlas and Titan I are propelled by liquid rocket fuel and are surface to surface missiles. The Minuteman is solid fueled and can be launched from underground silos.

What distinguishes an IRBM?

The range of an IRBM is limited to from 300 to 1,500 nautical miles (345 to 1,725 statute miles). U.S. operational IRBM's are Thor, Jupiter and Polaris. The Thor and Jupiter are both liquid fueled and surface to surface. Thors are deployed in England. Jupiters are in Italy and Turkey.

The Polaris, underwater and surface to surface, is solid fueled. Sixteen operational Polaris missiles are deployed on five submarines.

(Continued on page 390)