ASTRONOMY

Observatories in the Sky

Telescopes are about to be put into orbit to observe the heavens from far above the limiting screen of the earth's atmosphere and to make discoveries impossible from earth.

By DAVID F. NOLAN

See Front Cover

➤ MANY OF TOMORROW'S great astronomical observatories will be located not on earthly mountaintops, but hundreds of miles above, high in the sky.

Already, astronomers are finding that it is possible to learn more from observations made by an "eye in the sky" than can be learned from years of groundwork. High above the interfering barrier of the earth's atmosphere, an orbiting observatory can watch the goings-on in the universe with an unobstructed view.

Satellites such as Tiros, Mariner and OSO (Orbiting Solar Observatory) have already given us information about our own world and solar system far beyond that attainable with earthbound instruments. Future developments planned by the National Aeronautics and Space Administration in cooperation with private experimenters will yield data of value to astronomers, astrophysicists, geophysicists and other scientists.

Information from these flights may well open up whole new fields of knowledge not yet dreamed of.

Even now, as plans are being made to put a man on the moon or Mars, programs are also under way for a wide variety of experiments using the many specialized observatories being developed. The purpose of these experiments is to gain a better understanding of the earth, its atmosphere, magnetic and gravitational fields, and its relationship to other astronomical bodies, particularly the sun and moon.

Satellite observatories which have been developed or are under development are the Orbiting Geophysical Observatory (OGO), Orbiting Astronomical Observatory (OAO), Orbiting Solar Observatory (OSO), Ranger and Mariner. Each of these will be used in several different ways.

A full-scale mockup of a proposed advanced orbiting solar observatory developed by Republic Aviation Corporation, Farmingdale, N. Y., is seen on this week's front cover.

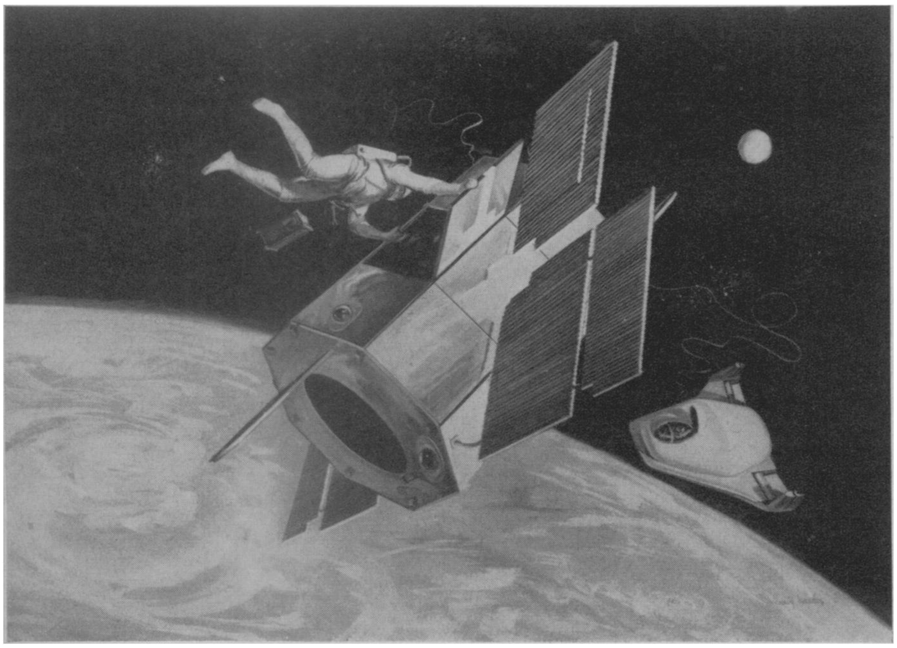
Two Roles Planned

For the Orbiting Geophysical Observatory, two roles are planned. In one, it will be called the Eccentric Orbiting Geophysical Observatory (EGO), and in the other, the Polar Orbiting Geophysical Observatory (POGO).

As the names indicate, in the first role it will be sent into an extremely eccentric orbit—one which is 170 miles from the earth's surface at closest approach and 69,000 miles at maximum; in the second it will orbit perpendicular to the equator, passing over the poles.

EGO will take about 43 hours to complete one orbit and, among other things, will study the Van Allen radiation belts and make measurements of the earth's shape from interplanetary space. POGO will provide an opportunity for prolonged examination of the polar regions and of the ionosphere, the layer of ionized air surrounding the earth that reflects radio waves.

The Orbiting Solar Observatory (OSO) and its projected descendant, the Advanced Orbiting Solar Observatory (AOSO, also called Helios), will be used in the study of our solar system's most important body—the sun.



National Aeronautics and Space Administration

INSPECTION IN ORBIT—Far above the earth's atmosphere, artist's conception shows an Orbiting Astronomical Observatory (OAO) being inspected by an astronaut, connected to his spaceship by cable for safety reasons.

Continuing Sun Study

This study, which has been going on since Galileo's time, entered a new era on March 7, 1962, when the first Orbiting Solar Observatory was launched. Previous to the launching of OSO I, attempts had been made to observe the sun from a vantage point above the atmosphere by using balloons, rockets and the early general-purpose satellites.

However, the success of these attempts was limited, particularly in learning about high-frequency radiation. This radiation is strongly absorbed by the ionosphere, and cannot be adequately studied except from above the interfering layer.

X-rays and high-energy ultraviolet rays in particular are being studied by the Orbiting Solar Observatory. These forms of radiant energy are extremely important to life here on earth, exerting great influences as they do on the biological processes of life itself, on communications and on many other facets of our existence. For instance, it is the invisible but energetic ultraviolet rays that cause sunburn.

The OSO and AOSO satellites will enable us to learn more about these important forms of radiation. Already, OSO I has more than tripled our knowledge about solar X-rays and has vastly increased our understanding of the sun's ultraviolet output.

AOSO and OAO

The Advanced Orbiting Solar Observatory (AOSO), to be launched in 1967, will further this work and will study earth-sun relationships in particular, in order to see how the sun's behavior affects conditions in the atmosphere and on the earth's surface.

AOSO will be about ten feet long and 40 inches in diameter, and will weigh about 1,000 pounds. Designed to carry a 20-inch telescope 10 feet long, it will have pointing accuracy sufficient to track a golf ball at a distance of one mile. AOSO will be placed in a nearly polar orbit, so as to be in almost constant sunlight.

Orbiting observatories will be used to explore beyond the limits of the solar system, too. The Orbiting Astronomical Observatory (OAO), scheduled for 1964 or 1965, will be used to study the origin and development of the universe as a whole.

OAO is expected to provide more and better clues about the nature of the universe than have ever been discovered before, because it can be used to make continuous observations for a long time, free from the limits imposed on earthbound observatories by the earth's rotation and atmosphere. Using OAO, stellar radiation in the infrared and ultraviolet portions of the spectrum, the regions just beyond our limits of vision, can be studied far more thoroughly than has been previously possible.

Information about stars and other celestial bodies which cannot be seen at all from earth—even by using radio telescopes and other modern astronomical equipment—will be available to the Orbiting Astronomical Observatory.

Experiments scheduled for the first OAO launchings include studies planned by the Smithsonian Astrophysical Observatory, the University of Wisconsin, Goddard Space Flight Center and Princeton University.

Of these, the Smithsonian and Princeton projects are of particular interest. The primary object of the Smithsonian experiment, project Celescope, is to make a new map of the sky, similar to the "star atlases" now in existence but much more complete. It will be made in the ultraviolet portion of the spectrum, and is expected to include 50,000 stars. It will be used to learn more about the stellar energy distribution throughout the universe.

The Princeton project, which will also deal extensively with ultraviolet radiation, will be aimed at learning about the origin and eventual fate of the universe. Studies of cosmic dust and gas clouds will play an important part in this project.

Future Possibilities

Other uses for the spaceborne "flying eyes" include close-up observations of nearby bodies such as the moon, Mars and Venus. Already, the Ranger satellite has given us valuable information about the moon, and Mariner II has done the same for Venus. Future projects will involve further investigation of these bodies and close-up views of Mars, Jupiter and other members of the solar system.

These investigations are valuable not only to scientists, but also pay off in dollars and cents. As a result of information gained from the Mariner II Venus probe, we can safely scratch Venus off our list of places to visit in the near future. Instead, future flying observatories can be sent below the cloud-cover to spy on Venus' 800-degree surface.

Likewise, valuable information can be gleaned by close-up inspection of Mars, Jupiter and other outer planets. This information will help decide if and when we should visit these planets, and how to go about it.

All factors taken into consideration, orbiting observatories are the biggest boon to astronomers and astrophysicists since the invention of the telescope. They are the next-best thing to a personal expedition to the world above the sky—better, in some cases.

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ENGINEERING

Canal Route Problems

Monumental problems of politics as well as engineering hinder the construction of a second canal connecting the Atlantic and Pacific Oceans—By Barbara Tufty

➤ THIRTY POSSIBLE ROUTES for a second canal connecting the Atlantic and Pacific Oceans are being considered.

They are all possible, but pose monumental problems of engineering skill, earth formation, and other geological and climatic factors, to say nothing of politics involved.

These possible routes have been investigated and compounded in various reports by engineers and geologists since 1931 in efforts to solve the Panama Canal problem and accommodate larger and more modern ships.

From a geological point of view, the best site continues to be in Panama, where the Isthmus of Panama narrows to about 30 miles. From a political point of view, a feasible site would cut across the Isthmus of Tehuantepec in South Mexico. This relatively low country, with no large lakes, stretches about 130 miles from the Gulf of Campeche on the east to the Gulf of Tehuantepec on the west.

Both of these routes could contain sea-level canals—canals that would flow directly from sea to sea, without the use of intermediate lakes and hence locks, as the present Panama Canal is devised.

Other proposed routes run through Nicaragua, one of the six independent republic countries of Central America, and Colombia in South America. The Central American countries extend southeastward in an S-shaped curve which is 1,300 miles long and ranges from 30 to about 300 miles wide.

Seven routes were investigated in Nicaragua, through the valleys of the Deseado and San Juan Rivers to Lake Nicaragua, where ships could sail across 100 miles of fresh water. One of these routes skirts the south shore of the lake and could be considered for sea-level operation.

Eleven routes in Panama include one where the isthmus is about 40 miles wide, and many near the site of the present canal where the width is only about 35 miles. Another site could be about 45 miles east of the Panama Canal, where the isthmus diminishes to its narrowest width.

Other routes, known as the Tuyra River routes, lie partly in Panama and partly in its neighbor's land, Colombia.

Six routes were investigated in Colombia, where the land widens again to form the massive South American continent.

The present 51.2-mile-long Panama Canal, constructed during the years of 1904 to 1919, contains a series of locks which raise and lower ships to fresh water lakes standing at altitudes above sea level. Ships coming from the Atlantic Ocean are raised by stages of locks to Gatun Lake 85 feet above sea level. The ships then traverse the 24-mile lake, pass through the Gaillard Cut for eight miles and are lowered through the Pedro Miguel locks to the Miraflores Lake which lies 54 feet above sea level. They then are lowered through the Miraflores Locks to the Balboa Harbor at sea level, and sail on to the Pacific Ocean. Ships sailing to the Atlantic take the same route in reverse.

Physical limitations on this system have long bothered engineers and shippers. The limit of commercial ships is 102 feet in width, 800 feet in length and a draft of 37 feet, or the amount the bottom of the ship sticks down into the water. The eight-hour passage of a ship from one ocean to another is slowed by many factors such as congestion of traffic, number of daylight hours for safe navigation, necessity of sailing in single line if the lock gates and other hydraulic operating facilities need overhauling.

Experts say that a new sea-level canal would solve many of these problems. There would be practically no limit to the size or number of ships and deeper channels could always be dredged. Once a sea-level canal is constructed, it is much less costly to operate, engineers point out. It is unnecessary to maintain a large staff and if severely damaged, a sea-level canal could be restored to usefulness much sooner than a lock canal.

One important problem in building such a canal would be the enormous costs, which possibly could be reduced by using atomic energy to excavate the land. However, economic and political rather than geological factors will determine the site of another possible canal.

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SPACE

Space Plans Not Delayed By Glenn's Resignation

➤ ASTRONAUT John H. Glenn Jr.'s resignation from the space program to run for the Democratic nomination for U.S. Senator from Ohio has two angles from the standpoint of the space program. Col. Glenn has already performed his major space service through his piloting in the first U.S. space orbit.

Although it has been estimated that it costs the Government many tens of thousands of dollars to train an astronaut, it can be considered that this in Glenn's case can be charged up to the National Aeronautics and Space Administration program so far.

It is unlikely that Col. Glenn, even if he had not entered politics, would be called upon to participate in another space flight as an astronaut. NASA has a sufficient number of astronauts in training for future flights without risking the life of an astronaut who has made a successful flight.

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