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**FOR RELEASE: SUNDAY
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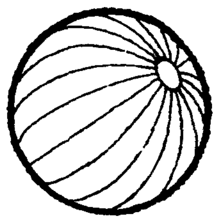
PROJECT: PAGEOS



(To be launched no earlier than June 23)

CONTENTS

-0-

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PAGEOS SATELLITE

TO GIRDLE GLOBE

FOR EARTH MAPPING

A 100-foot "balloon" satellite, designed to obtain information for precision mapping of the Earth's surface, will be launched by the National Aeronautics and Space Administration no earlier than June 23.

The aluminum-coated Passive Geodetic Earth-Orbiting Satellite (similar to Echo I launched Aug. 12, 1960) will be photographed by a network of 41 ground observing sites around the world. It will be called PAGEOS I if successfully placed in orbit.

A Thrust-Augmented Thor-Agena-D launch vehicle will be used to boost the inflatable sphere satellite into a circular, polar orbit about 2,600 miles above Earth. It will be launched in a southeasterly direction from the Western Test Range, Cal. with an inclination of about 87 degrees to the equator.

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PAGEOS will carry no instruments. By reflecting sunlight, the satellite will provide an orbiting point source of light to be photographed over a projected five-year period to determine the location of continents, land masses, islands and other such geographic points in relation to each other. In orbit, it will be as bright as the star Polaris.

The photographs will be taken from positions in dark areas of the world as the satellite's reflection from the Sun, below the horizon, is visible for several minutes.

The spacecraft will circle the Earth at a velocity of 13,700 miles an hour, and its orbital period will be about three hours. In each 12-hour span, PAGEOS will pass over every area of the globe as the Earth revolves on its axis.

The orbital course of PAGEOS will provide many opportunities, during its five-year lifetime, for the satellite to be photographed simultaneously against a star background by two or more cameras located at stations 2,500 to 2,800 miles apart.

The interconnected series of camera positions will cover the entire Earth's surface, enabling scientists to determine geometrically each camera position within a single reference system.

The resulting network of spatially-oriented triangles will be useful in locating any point on Earth, as measured from the center of mass, within 51-96 feet of its true position.

The distance between two surface points 3,000 miles apart could thus be obtained to an accuracy of 32 feet.

PAGEOS will remain in orbit after this series of Geodetic Measurements have been completed.

PAGEOS is fabricated of one-half-mil (one-half thousandth of an inch)-thick Mylar plastic coated with a micro-thin film of vapor-deposited aluminum. The metal coating will reflect sunlight and radio waves and will protect the satellite from the damaging effect of ultra-violet radiation.

It will be packed inside a canister for launch, then will be inflated in orbit. The satellite weighs about 125 pounds.

About 10 pounds of benzoic acid and 20 pounds of anthraquinone, inflating compounds, are dusted on the inside of the satellite before it is folded and packed in a magnesium canister. The two halves of the canister, which is 28 inches in outside diameter, are laced together by Rayflex cord for the flight into space. The canister assembly weighs 40 pounds.

At launch, the canister containing the folded sphere is mounted on an aluminum adapter atop the launch vehicle, and enclosed by a heat shield as it travels through the atmosphere.

Total weight of the spacecraft system, including the inflatable sphere, inflation powders, canister assembly, and adapter for mounting the canister to the launch vehicle, is about 247 pounds.

As the launch vehicle reaches orbital velocity, the canister is automatically ejected. The two halves are separated by an explosive device placed around its laced middle, permitting the folded satellite to inflate to spherical shape.

The inflation process is accomplished as the benzoic acid and the anthraquinone turn to gas and expand in the solar heat, aided by the expansion of the small amount of residual air inside the sphere.

The inflation gases will leak out during the first two weeks in orbit, when PAGEOS travels in continuous sunlight, but the satellite is designed to retain its spherical shape for the duration of the mission.

The PAGEOS project, one phase of the U.S. National Geodetic Satellite Program, will mark the first use of an orbiting satellite employing the principles of geometry to map the Earth's surface completely.

A prime objective of the program is to encourage international participation in ground-based observations, data acquisition, and data analysis. A "PAGEOS Experimenter's Information Manual" will be published to provide the information required for participation in the worldwide observation project.

The U.S. National Geodetic Satellite Program is based on recommendations of the Geodetic Satellite Policy Board composed of representatives of NASA, Department of Defense, and Department of Commerce. The three agencies are principal participants in the program along with the world scientific community. NASA has overall management responsibility.

The program involves two types of geodesy: 1. the geometric, which concerns the use of PAGEOS to map the Earth's surface within a three-dimensional reference system, and 2. the gravimetric, measurement of variations in the Earth's gravitational field.

Launch of the first geodetic satellite in the program, Explorer XXIX (GEOS-I), took place Nov. 6, 1965, from the Eastern Test Range at Cape Kennedy. The second GEOS satellite, similar to the first, is scheduled for launch in 1967 to make detailed studies of the gravitational field of the Earth. It will support geometric observations from cameras spaced about 1,000 - 1,200 miles apart, enabling an evaluation of its five geodetic instrumentation systems.

NASA's Office of Space Science and Applications has prime responsibility for the U.S. Geodetic Satellite Program. The Department of Defense, (U.S. Army Corps of Engineers, Army Map Service) and the Department of Commerce (Environmental Science Services Administration's Coast and Geodetic Survey) are responsible for the tracking network.

The PAGEOS project is managed by NASA's Langley Research Center, Hampton, Va., with data acquisition under Goddard Space Flight Center, Greenbelt, Md. Lewis Research Center, Cleveland is in charge of the launch vehicle, with launch management under the Kennedy Space Center's Unmanned Launch Operations (ULO). The 6569th Aero-Space Test Wing of the U.S. Air Force will conduct the launch under the direction of ULO.

The PAGEOS spacecraft was constructed by the G. T. Schjeldahl Co., Northfield, Minn. and the Goodyear Aerospace Corp., Akron, Ohio fabricated the canister assembly and adapter.

Douglas Aircraft Co., Santa Monica, Calif. built the first stage Thor booster. The Agena-D upper stage was built by the Lockheed Missile and Space Co., Sunnyvale, Calif.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS)

PAGEOS BACKGROUND

In August 1964, NASA approved a Passive Geodetic Earth-Orbiting Satellite (PAGEOS) project, proposed by the Langley Research Center, Hampton, Virginia as part of the U.S. National Geodetic Satellite Program. A satellite similar to Echo I (a 100-foot balloon developed by Langley and launched August 12, 1960) was proposed for the PAGEOS geodetic study program.

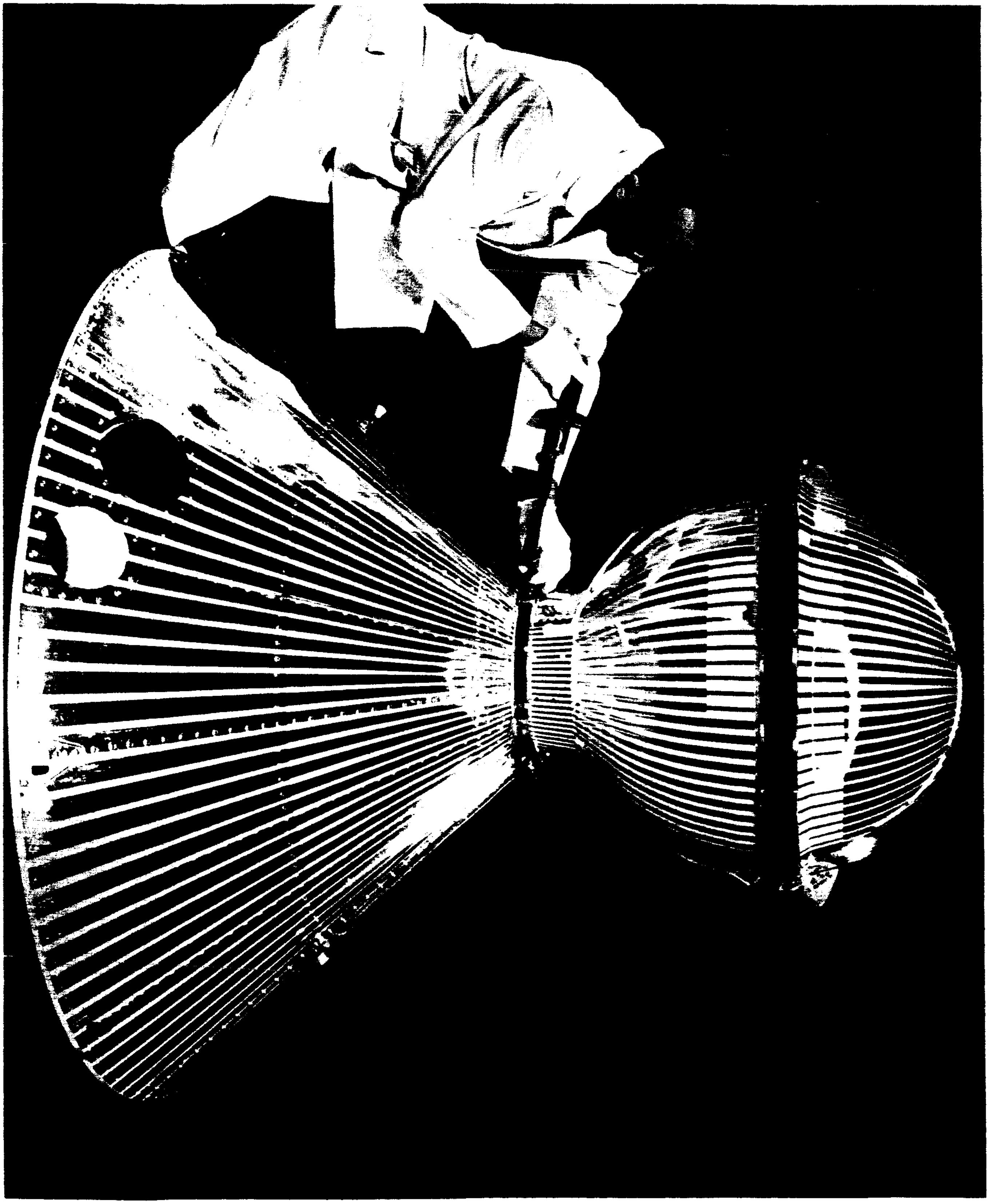
This recommendation was based on the successful experience of the United States in the use of Echo I for various scientific purposes.

Echo I proved it was feasible to use a satellite as a passive reflector communications system on a global basis. In its six-year lifetime so far, Echo I has been used to obtain basic information on the characteristics of space. In addition it has been successfully employed for geodetic triangulation measurements by the United States and foreign countries.

Studies conducted in 1964 indicate that Echo I is still essentially spherical and that its very thin coating of vapor-deposited aluminum has retained a high degree of reflectivity, but it cannot be used for the PAGEOS project. Scientists say the orbital inclination is too low to cover the network of tracking stations near polar latitudes and its altitude is too low to span the distances across continents and oceans -- a capability required for worldwide geodetic applications.

<u>PAGEOS Inflation</u>

The sphere will be in continuous sunlight for the first 14 days or longer, to insure the effective operation of the inflation system.



THE FOLDED AND PACKAGED PAGEOS SATELLITE

Sunlight plays an important part in the inflation of the sphere. The benzoic acid inflation powder turns into gas at a temperature of about 115 degrees F. Unless in sunlight, the temperature of the satellite will be well below this value. In continuous sunlight the sphere's temperature will average about 240 degrees F.

Most of the benzoic acid is expected to leak out of the inflated satellite in a few hours, leaving the less volatile anthraquinone to sustain a small positive pressure for about two weeks after this time it too will have escaped. The leakage predictions are based on the results, as estimated by scientists, of the bombardment of the satellite by meteoroids.

Even though the inflation gases leak out during the first two weeks, the satellite is designed to retain its spherical shape at least for the duration of the present five-year scientific mission.

Photogrammetric Observations

As PAGEOS orbits 2600 miles above the Earth it will appear from the ground as a fast-moving star as the sun beyond the horizon reflects on the sphere's mirror-like surface against the dark sky.

As the satellite becomes visible to at least two of the widely separated camera stations around the world, simultaneous photographs will be made against a star background. The reflected sunlight from the satellite's surface produces a point image on the photographs similar to the star images in the background.

Using geometric techniques, a space-oriented triangular plane is formed by the camera stations and the satellite. On a subsequent pass, similar photographs are made and the base line of the triangle is determined. As other camera stations are brought into use, additional base lines are computed. They then, form a network of triangles covering the entire surface of the Earth.

The 69 triangles which will be produced during the five-year mapping experiment will reveal the shape of the Earth. To establish the size of the globe, the lengths of one of the base lines of several of the triangles is measured by conventional ground-based techniques. Once several base lengths are established, the dimensions of all other base lines can be computed, resulting in a more accurate determination of the size and shape of the Earth.

Inflatable Sphere Assembly

The PAGEOS fabrication process is similar to that devised for Echo I.

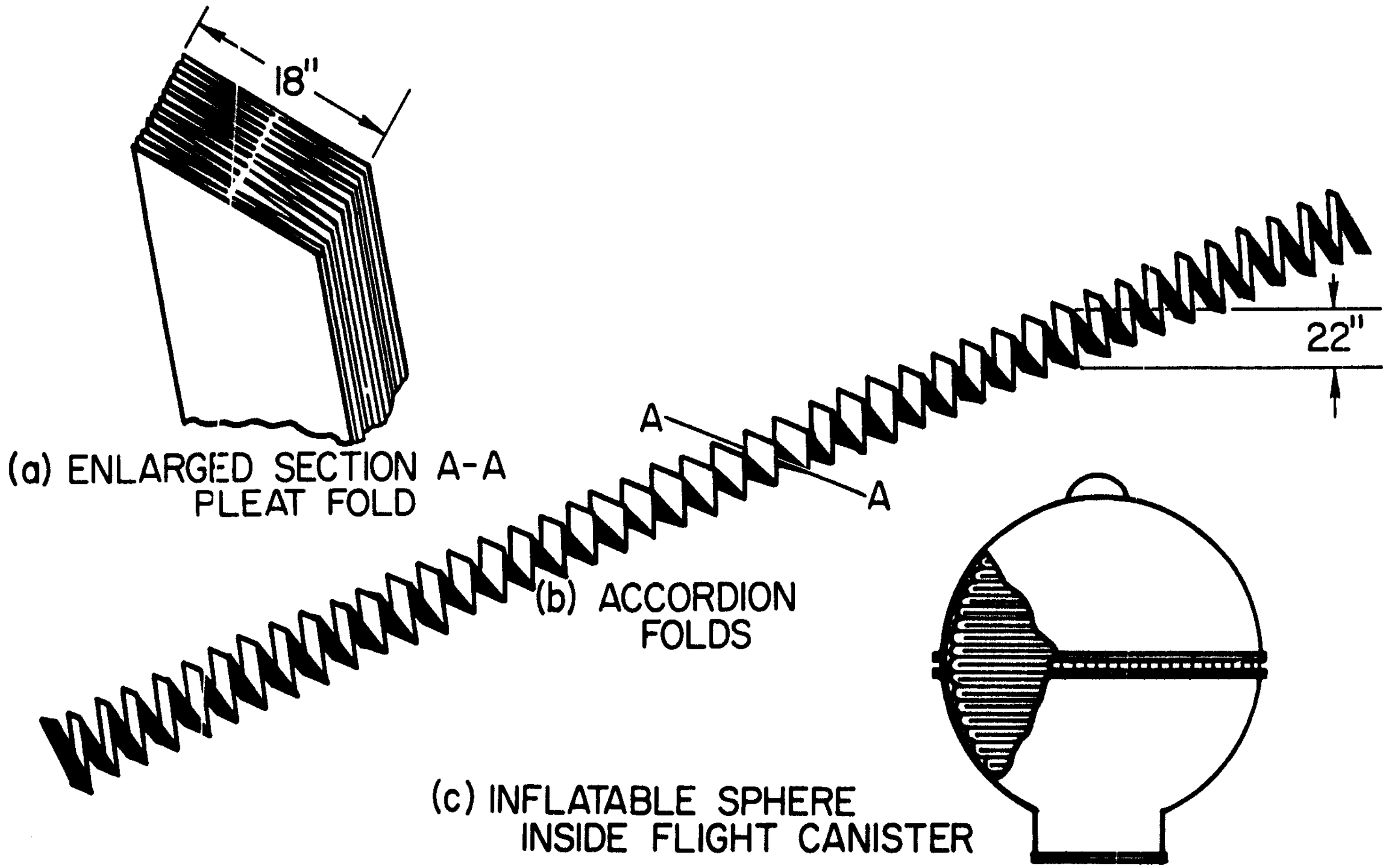
PAGEOS is constructed of 84 gores or panels of Mylar plastic film, .0005 (one-half thousandth) of an inch thick. Prior to fabrication of the sphere, the gores are coated on the outside with approximately 2,200 angstroms of vapor-deposited aluminum. (An angstrom, a unit used in measuring the wave length of light, is the basis for measuring the thickness of the aluminum film because the deposit is so thin).

In the satellite fabrication process, the gores--each of which is about 45 inches wide at the "equator" and decreases to a point at the "poles"--are sealed together on the inside by inch-wide adhesive tape made of the same pliable plastic material. The gore ends are joined by pole caps which complete the spherical shape.

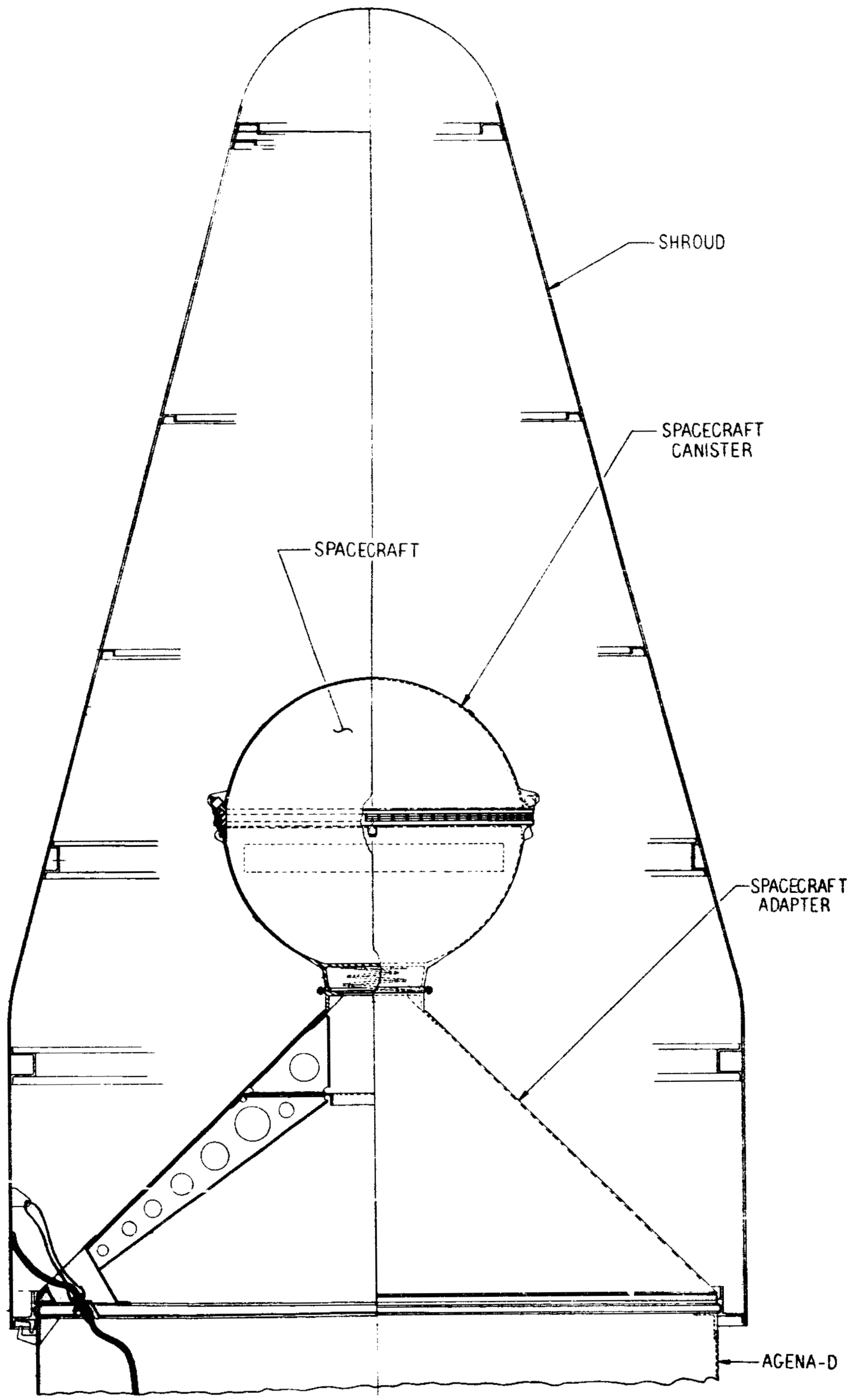
The completed sphere is packaged into the canister following scientifically developed folding techniques. The initial folds, called pleat folds, are made in the direction of the gore seams.

Before the last gore-to-gore seal, following completion of the pleat folds, the inflation powders (ten pounds of benzoic acid and 20 pounds of anthraquinone) are dusted into the sphere along the lengths of the gores. Then the satellite is folded accordion-fashion across the gore seams, resulting in a generally spherical stack which is carefully hand-packed into the canister.

The volume of the sphere when folded inside the canister is five cubic feet as compared to 524,000 cubic feet and a surface area of 31,000 square feet when inflated in orbit.



Folding and Packaging of PAGEOS Satellite



PAGEOS SPACECRAFT AND SHROUD ARRANGMEENT

Spacecraft System

Total weight of the spacecraft system is about 247 pounds. This includes 125 pounds for the inflatable sphere; 30 pounds of inflation powder contained within the sphere at launch; 40 pounds of the canister, lacing, and the explosive device which will separate the two halves in orbit; and 52 pounds for the cone-shaped aluminum adapter for mounting the canister to the launch vehicle.

Canister Assembly

The canister halves are machined from magnesium forgings, with an inside dimension of 26½ inches in diameter and an outside dimension of about 28 inches. After the folder sphere is packaged inside the canister, it is laced together with Rayflex cord. A shaped charge is the explosive device used to cut the lacing and at the same time provide the propulsive force to separate the canister halves at the desired time in flight.

The assembled canister is placed atop the adapter for mounting to the launch vehicle. The PAGEOS adapter provides transition support from the approximate 10-inch canister mounting base at the top of the adapter to the 60-inch thrust face of the Agena-D.

Thermal control coatings are carefully applied to the exterior surface of the canister and adapter in scientifically designed patterns. These coatings maintain the temperature levels on the interior within prescribed limits while the spacecraft is traveling outside the Earth's dense atmosphere and before the satellite is inflated in orbit.

The fairing which encloses the spacecraft at launch shields it from aerodynamic heating damage during ascent through the atmosphere; the thermal control system provides protection after the fairing is ejected and the spacecraft is exposed to the varying heat and cold--depending on its position in flight in relation to the Sun.

One of the coatings used is white enamel paint, applied to control absorptivity on the side facing the Sun. The other, aluminum-coated adhesive tape, controls the emittance of heat.

Thermal control on the canister prevents excessive heating, which affects the satellite inflation rate, and excessive cold areas, which affect the performance of the batteries in the canister assembly.

On the adapter, thermal control protects the electronic equipment located in this area.

The internal pressure and external canister temperatures will be monitored from final assembly until canister in-flight ejection.

Department of Commerce - Department of Defense Participation

Using PAGEOS as a beacon in the sky, teams from the Coast and Geodetic Survey and the U.S. Army Map Service will extend precise geodetic surveys across continental and intercontinental distances to measure the size and shape of the Earth more accurately than ever before.

Eight teams of the Coast and Geodetic Survey and four of the Army Map Service will train highly-sensitive BC-4 cameras, housed in portable observatories, on the satellite as it passes in orbit 2,600 miles about the Earth.

By simultaneous observations of the satellite against a star background, these teams will determine the angles between adjacent stations, thus forming a world-wide satellite triangulation network of known geometric angles of some 40 stations, each permanently marked. Thus, through camera observation alone, the directions between all stations of the netowrk will be precisely determined.

The present system of satellite triangulation has an accuracy of one to 400,000. Using PAGEOS, it is hoped to improve Earth measurements to an accuracy better than one to 500,000. This means a measurement which is off by only one foot in 500,000 feet.

The 12 BC-4 satellite triangulation teams will each be composed of four to eight men. They will operate at night when the reflection of the Sun's rays from the passive satellite can be observed.

Each team will probably have to remain at a station from 6 to 18 months. They will operate on every continent, on virtually uninhabited islands, in the desert, in the tropics, and in the frigid wastes of the Arctic and Antarctic. As each party completes its operation, it will move on to another site each time leaving behind a permanent survey mark. Three or four teams will be stationed in Antarctica during the final year of the program.

The Coast and Geodetic Survey will obtain observations which will enable geodesists to reduce and analyze data which will result in the establishment of the world-wide geodetic net accurate to within one part in 500,000 and tying together major data. (A datum is a mathematical base which enables surveyors to define precise horizontal and vertical positions on Earth).

Satellite geodesy will allow world-wide positions to be refined to a still higher degree as the globe is measured on a total scale rather than by local increments. Using satellites, scientists have already been able to determine the polar flattening of the Earth with a precision about 10 times that of earlier determinations.

Description of Principal Investigators' Roles for PAGEOS

The following Principal Investigators have been assigned for the PAGEOS Project:

Capt. L. W. Swanson (Ret.) - USC & GS, ESSA, Dept. of Commerce

Dr. Ivan I. Mueller - Geodetic Sciences Dept., Ohio State University

Dr. Charles Lundquist - Assistant Director, Smithsonian Astrophysical Observatory.

The roles of each of these investigators and their organizations are summarized as follows:

Captain Swanson, Project Manager of USC & GS Geodetic Satellite Program, directs the agency's participation in the National Geodetic Satellites Program. USC & GS is responsible for establishing geodetic control throughout the U.S. and its possessions, and is involved in establishing world-wide geodetic control to aid in defining the shape of geoid and related scientific investigations of the Program. USC & GS participation in the PAGEOS Project is sponsored by the Department of Defense.

Dr. Mueller is Associate Professor of Ohio State University's Department of Geodetic Science. Under NASA sponsorship, Dr. Mueller is responsible for analysis of PAGEOS and other satellite data to define a unified world geodetic system. His investigations for the PAGEOS Project will include an analysis of the relationships of the existing principal geodetic datum used by various nations and the unification of these data to a world-wide geodetic system to provide a common reference network to which all geodetic and topographic data can be related.

Dr. Lundquist directs the Smithsonian Astrophysical Observatory's participation in the National Geodetic Satellite Program. Under NASA sponsorship, Dr. Lundquist will be responsible for obtaining PAGEOS observations with the Baker Nunn cameras and for analyzing other observational data obtained by the USC & GS and international observers for two purposes: 1. To determine the position for the 12 Baker-Nunn stations in a common coordinate system. 2. To determine relationships of the geodetic data involved, from knowledge acquired of station positions, various geodetic data, and direct positions derived from satellite analyses.

All observations of PAGEOS will be reduced by the observing agencies and transmitted to the Geodetic Satellites Data Service at NASA's Goddard Space Flight Center, Greenbelt, Md. The Data Service will store all observational data and disseminate them to the Principal Investigators and other qualified scientists on request. Data from PAGEOS and from other geodetic active satellites (GEOS-I etc.), also stored and disseminated by GSDS, will be used by the Principal Investigators to fulfill objectives of the program.

Launch Vehicle

The PAGEOS launch vehicle is a thrust augmented Thor (TAT) booster with three TX33-52 solid rocket motors, an Agena-D second stage and the PAGEOS spacecraft.

The TAT is primarily aluminum and needs no tank pressurization to be self-supporting. Its engines include a Rocketdyne main turbopump-fed liquid propellant engine, two Rocketdyne liquid propellant 1000-pound-thrust vernier engines and three jettisonable Thiokol solid rocket motors. Liquid propellants are RJ-1 hydrocarbon fuel (35,213 pounds) and liquid oxygen (67,600 pounds).

The main engine can be gimbaled in flight for control in pitch and yaw while the vernier gimballing provides roll and attitude control. The Thiokol solid propellant motors have 53,425 pounds of thrust with a total burn time of a little more than 40 seconds during the initial boost stage of the PAGEOS flight.

The Agena upper stage has telemetry, guidance and electrical power components mounted in module form to simplify checkout and on-the-pad servicing.

The Agena's engine is a dual-start Bell Aerosystems model 8096 designed for 240 seconds of operation at high altitudes and 16,000 pounds of thrust. The propellants are storable unsymmetrical dimethylhydrazine (UDMH) fuel and inhibited red fuming nitric acid (IRFNA) oxidizer. Propellant storage tanks are pressurized with helium to ensure proper pump operation.

At the end of the propellant tanks are sumps to contain the propellant during weightless coasting periods. The sumps contain a fine mesh screen permitting propellant flows into the sump during engine burn and inhibiting a return flow during the weightless coasting phases of Agena flight. These sumps eliminate the need for ullage rockets.

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Flight Sequence

The TAT rises vertically from Space Launch Complex 75-1-1 at the Western Test Range for about 2 seconds before beginning a programmed roll to the flight azimuth and pitching over to the PAGEOS trajectory. The three strap-on motors burn about 40 seconds with full thrust and are jettisoned 65 seconds after liftoff.

TAT main engine cutoff (MECO) occurs when the vehicle reaches its proper altitude and velocity (some 150 seconds after launch). Thor vernier engine cutoff (VECO), some nine seconds after MECO, signals the start of the separation sequence.

About 14 seconds after separation, Agena pitches down to prepare for its first burn, beginning about three minutes after liftoff. The engine hydraulic system controls the vehicle in pitch and yaw while roll remains under pneumatic control during the burn. The clamshell-style protective shroud is ejected during first burn at about T plus 194 seconds.

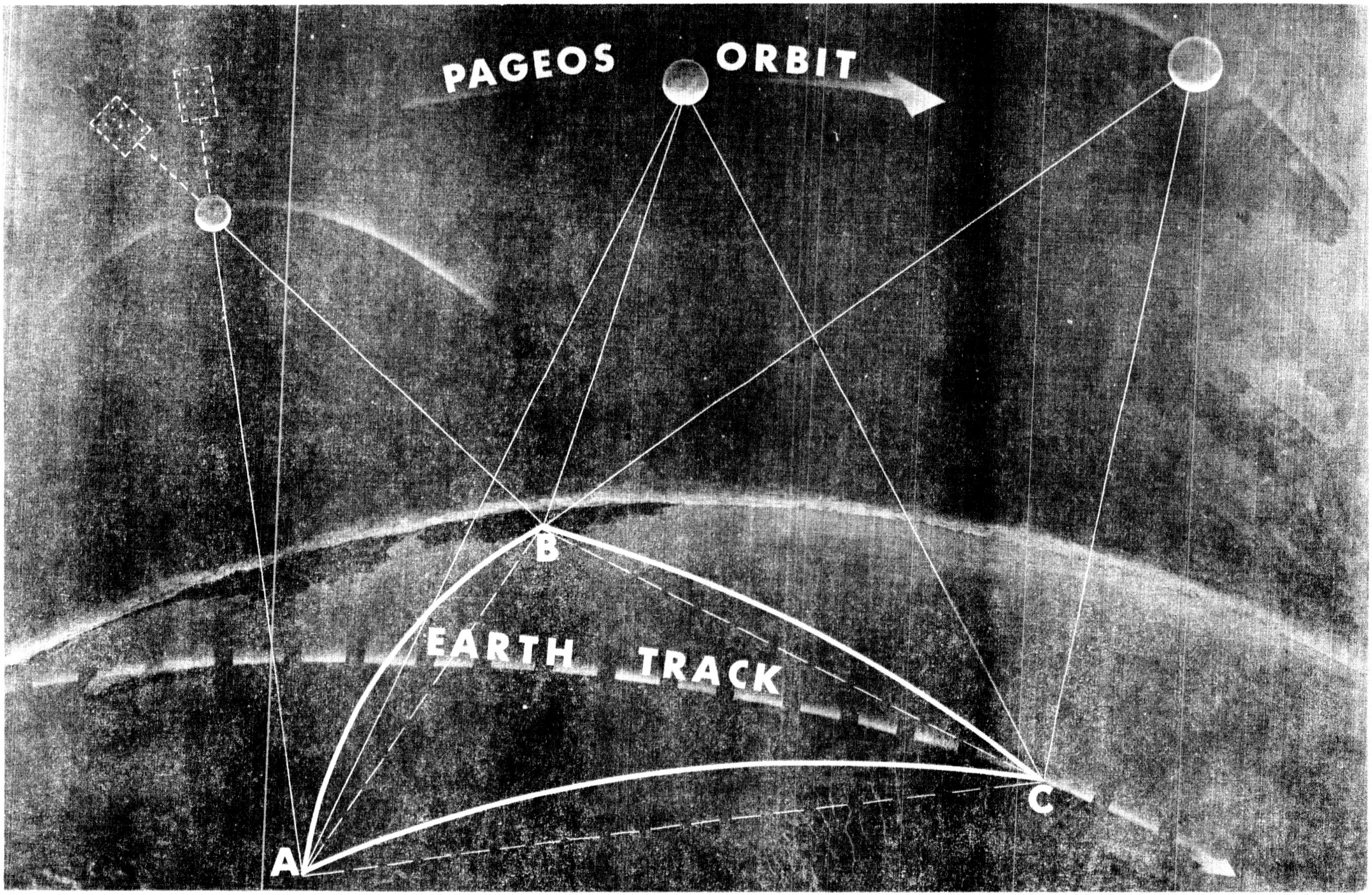
Agena's engine burns until it has increased the vehicle's velocity some 11,000 mph. The Agena velocity meter then shuts the engine off about 417 seconds into the PAGEOS flight.

Agena, carrying its now unshrouded PAGEOS payload, coasts from first-burn cutoff altitude around 110 miles to its orbital altitude of 2600 miles. About 73 minutes after liftoff, preparations for second burn begin. This second burn is short, about 11 seconds, ending when the velocity has increased some 1740 mph.

Agena/PAGEOS at this point is in the 2600-mile-high circular orbit required for the spacecraft. One hour and 15 minutes after liftoff, a spring-ejection mechanism places the payload canister in orbit ahead of Agena. Two seconds later, Agena begins to tumble to preclude the possibility of the empty Agena hitting the canister and spacecraft.

An explosive device around the middle of the canister separates the container halves, leaving the folded sphere to inflate in orbit. This occurs one hour, 15 minutes and 45 seconds after liftoff. PAGEOS begins to inflate some 85 seconds after the canister is ejected. At this point, PAGEOS should be 650 feet from Agena.

"PAGEOS" – PASSIVE GEODETIC SATELLITE



The Agena-D, which will follow the satellite closely during the first few orbits, is equipped with a Minitrack beacon. Its signals (136.050 mc) will assist in determining the sphere's initial orbit. This calculation is based on known attitude and separation velocities between vehicle and spacecraft canister.

Launch Vehicle Statistics

Height	TAT/Agena/PAGEOS	85 feet
Weight	TAT/Agena/PAGEOS	15,253 pounds
	TAT Booster	Agena upper stage
Height	56 feet	20 feet
Diameter	8 feet	5 feet
Weight	107,000 pounds	15,775 pounds
Propulsion	Rocketdyne main engine, two Rocketdyne verniers, three Thiokol strap-on solid rocket motors	one Bell 8096 main engine
Propellants	RJ-1 hydrocarbon fuel and LOX	UDMH fuel and IRFNA
Thrust	332,275 pounds at liftoff, 160,275 pounds of which are the three strap-on solid motors	16,000 pounds at altitude
Prime Contractor	Douglas Aircraft Co., Santa Monica, Calif.	Lockheed Missiles & Space Co., Sunnyvale, Cal.

Flight Sequence

Liftoff	0
Solid booster cutoff	43 Sec.
Eject solid motors	65 "
Thor main engine cutoff (MECO)	150 "
Thor vernier engine cutoff (VECO)	158 "
Thor/Agena separation	162 "
Start Agena first burn	185 "
Jettison shroud	194 "
End Agena first burn	417 "
Start Agena second burn	4355 "
End Agena second burn	4366 "
Separate PAGEOS spacecraft	4462 "

THE PAGEOS PROGRAM TEAM

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