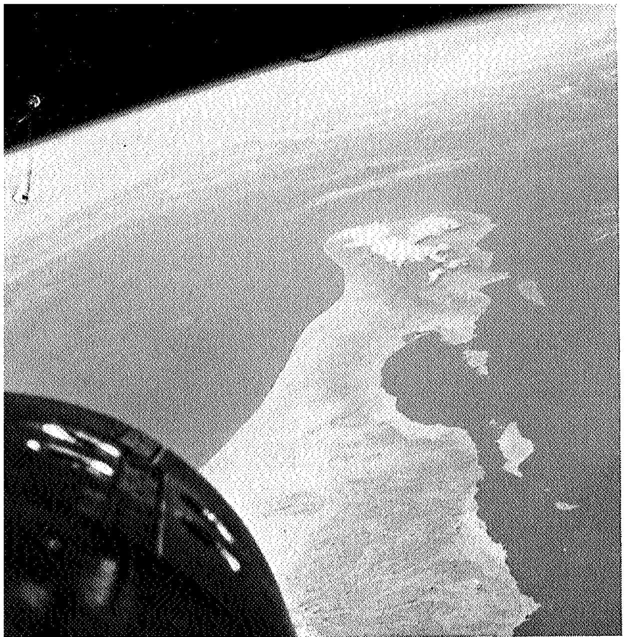

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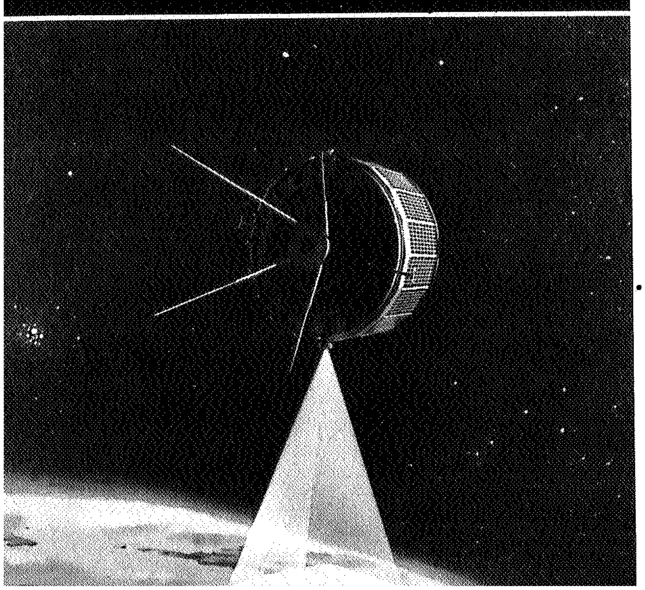


GODDARD '65

A YEAR IN REVIEW AT GODDARD SPACE FLIGHT CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

THE COVER—Top: Baja, California, as seen by Gemini Astronauts Gordon Cooper and Pete Conrad on June 3, 1965. This photo was one in a series taken by the astronauts for synoptic terrain studies being conducted by GSFC's Dr. Paul Lowman. Middle: The comet Ikeya-Seki as photographed on November 2, 1965 at 5:10 a.m. by GSFC physisist P. H. Verdone. Bottom: TIROS IX, the new "cartwheel" weather satellite launched January 22, 1965.

1965 GODDARD RECORD

Spacecraft	*Launch Date*	*Range*	*Vehicle*	*GSFC Support*
GT-2	January 19	ETR	Titan	Tracking
TIROS IX	January 22	ETR	Delta	Mission
OSO-II	February 3	ETR	Delta	Mission
SA-9 (Pegasus)	February 16	ETR	Saturn I	Tracking
Ranger 8	February 17	ETR	Atlas/Agena	Launch
Centaur 5	March 2	ETR	Atlas/Centaur	Launch
Ranger 9	March 21	ETR	Atlas/Agena	Launch
GT-3	March 23	ETR	Titan	Tracking
Early Bird	April 6	ETR	TAD II	Launch
Explorer 27 (BE-C)	April 29	Wallops	Scout	Mission
Fire II	May 22	ETR	Atlas/X259	Launch
Saturn 8 (Pegasus II)	May 25	ETR	SAI	Tracking
Imp C	May 29	ETR	Delta 32	Mission
GT-4	June 3	ETR	Titan	Tracking
TIROS X	July 2	ETR	Delta	Mission
SA-10 (Pegasus III)	July 30	ETR	Saturn	Tracking
AC-6	August 11	ETR	Centaur	Launch
GT-5	August 21	ETR	Titan	Tracking
OSO-C	August 25	ETR	Delta	Mission
OGO-II	October 14	ETR	TAT	Mission
GT-6	October 25	ETR	Atlas/Agena	Tracking
GEOS A Explorer 29	November 6	ETR	Delta 34	Tracking
Explorer 30	November 19	Wallops	Scout	Tracking
Explorer 31	November 29	WTR	TA-Thor Agena D	Mission
Alouette 2	November 29	WTR	TA-Thor Agena D	Tracking
GT-7	December 4	ETR	Titan	Tracking
FR-1A	December 6	WTR	Scout	Tracking
GT-6	December 15	ETR	Titan	Tracking
Pioneer 6	December 16	ETR	Improved Delta	Vehicle

CONTENTS

Frontispiece—Crossing of the Echo satellites over the Minuteman Statue in Concord, Massachusetts, was photographed on December 28, 1965. Echo I is traveling from botton to top of the photo, and Echo II is passing from right to left. Lights of a passing plane appear as a streak in the lower right corner. Echo I was 60 degrees above the horizon at about 800 miles altitude. Echo II was 16 degrees above the horizon and about 700 miles high. The curved scratches are tracks of stars as earth rotated.

CHRONOLOGY 1965

JANUARY 2
The Explorer XXII was tracked using LASER. The entire system functioned satisfactorily. The programmer placed the satellite on the crosshairs of the guiding scopes. The laser was fired at the satellite and a photographic recording was made on the oscilloscope to record the return beam. When the satellite pass was completed, range measurements were made. Eight filters were inserted in front of the laser to attenuate the laser beam.

EARLY JANUARY
OGO I continued to transmit data from all experiments except the rubidium vapor magnetometer portion of Experiment 4911 (Dr. Heppner, GSFC). The experiments were turned off on January 2 to save power prior to slewing the paddles on January 5. Operation of experiments has ceased due to unfavorable aspect of the sun which was to last until mid-February 1965.

EARLY JANUARY
Explorer XXII continued to transmit satisfactory ionosphere beacon and doppler signals.

EARLY JANUARY
The STADAN network monitored very weak signals from Nimbus I spacecraft during the preceding week.

EARLY JANUARY
Erection of the 85-foot steerable antenna for Canberra DAV (Orroral Site) was proceeding on schedule.

EARLY JANUARY
SYNCOM III operation in orbit continued to be normal. SYNCOM II was to be turned on January 10 after being off for forty-six days.

JANUARY 5
Bid opening for design-construction contract for Decontaminated Spacecraft Assembly Facility – Building #11.

JANUARY 5
Relay I operations for 5868 orbit revolutions are as follows: 1461 wideband experiments; 703 narrowband experiments; 187 demonstrations. The transponder has been operated for 335 hours over a period of 827 operations.

JANUARY 6
Photographic data from both TIROS VII and VIII and IR data from TIROS VII continued to be obtained, processed, and utilized. Status of data from active TIROS spacecraft was as follows:

Spacecraft	*VII*	*VIII*
Orbit	8,397	5,547
Picture total	95,573	62,377
Total usable (%)	87,901 (91.9)	57, 458 (92.1)
Nephanalyses	3,367	2,345
Storm Bulletins	537	649
IR Orbits received	3,245	—
IR orbits digitized	2,171	—
IR orbits non-digitizable	853	—
IR orbits in process	221	—
Grand total pf pictures	413,651	

JANUARY 12
STADAN reduced IMP-1 coverage from 100% continuous coverage to 1 continuous 10 hour period per week.

JANUARY 12-14
The first Improved Delta design review was held at Douglas Aircraft Corporation.

MID JANUARY
Programming of TIROS VIII was scheduled to support the launch of GT-2 scheduled for the latter part of January.

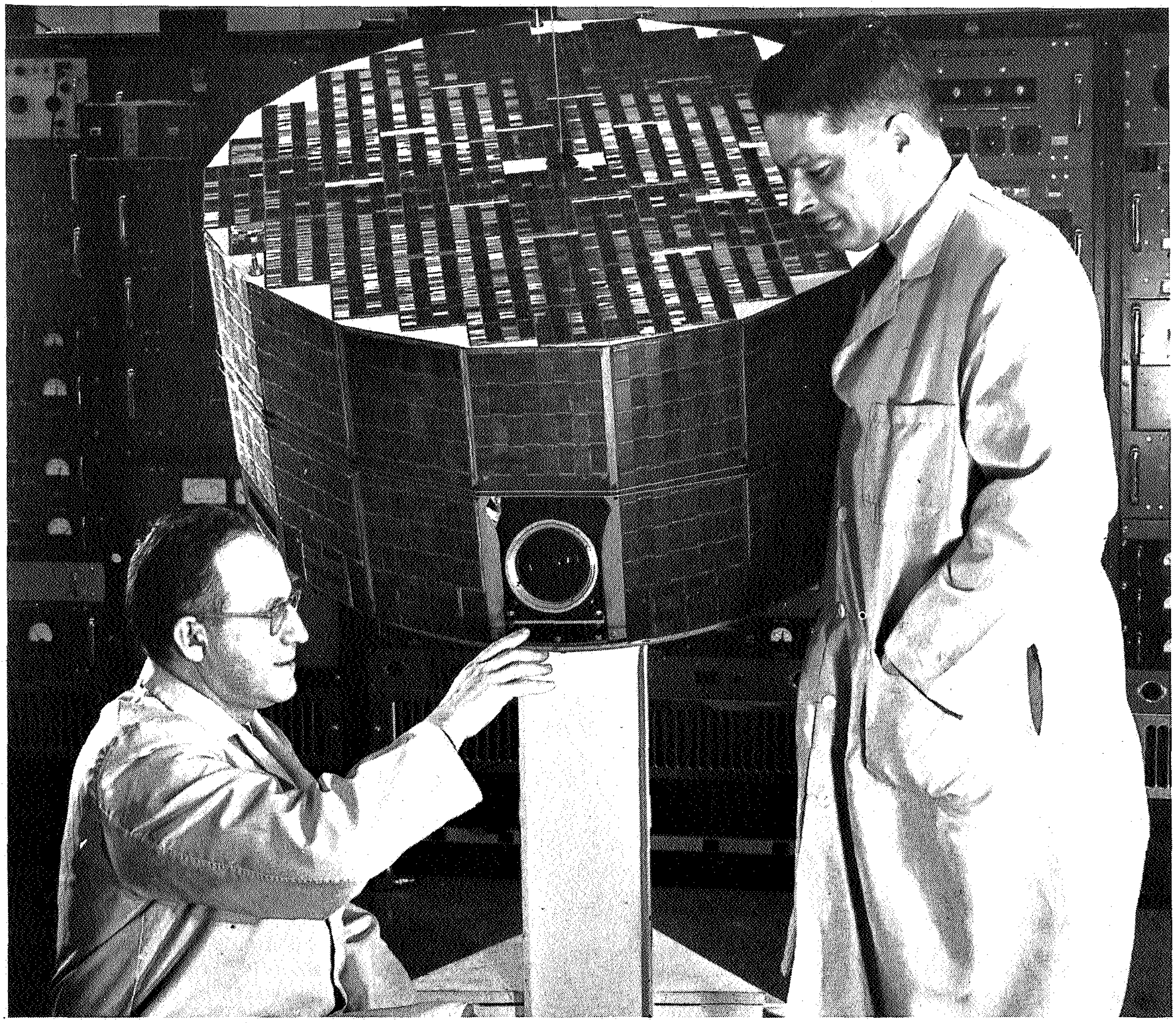
MID JANUARY
This month, GSFC started a series of rocket-launched acoustic grenade experiments at Point Barrow, Alaska to fulfill scientific requirements for upper atmospheric meteorological data within the Arctic Circle. Project Scientist was Wendell S. Smith.

Point Barrow, 1,100 miles from the North Pole, is 300 miles within the Artic Circle, at 71 degrees North Latitude. This compares with 58 degrees North Latitude for the Fort Churchill site in Canada which often is used for scientific rocket soundings.

The Point Barrow site will serve as a base for sounding rocket exploration and measurement of the structure and behavior of the atmosphere at altitudes of 30 to 100 kilometers (19 to 65 statute miles).

Wind direction and velocity, atmospheric temperature, density and pressure data will be obtained from the grenade experiments. These call for ejecting and exploding 12 acoustical grenades along the trajectory of a Nike-Cajun rocket.

The experiments will be continued on a quarterly basis with two or three each quarter. They will be coordinated with similar experiments at Fort Churchill, and NASA's Wallops Station, Va., to obtain nearly simultaneous measurements from different geographic areas during the various seasons.



Abraham Schnapf of RCA and Robert Rados (right) TIROS project manager take a final inspection look of the new cartwheel TIROS IX weather satellite before launch.

MID JANUARY
The GSFC Attitude Control Test Laboratory was substantially completed.

MID JANUARY
Alouette I Satellite was still producing over four hours of excellent quality data per day.

JANUARY 15
Construction of two Magnetic Quiet Buildings and two Magnetometer Shelter Buildings was completed.

JANUARY 19
The GSFC Data Operations Branch provided prime computing support for the Gemini GT-2 mission. The countdown commenced at midnight. After a short hold of approximately 4 minutes the GT-2 spacecraft lifted off at 14 0359 GMT on a launch azimuth of 105 degrees. At theoretical phase of SECO, MCC at Cape Kennedy, had a power failure which lasted for over 30 seconds cutting off data to the GSFC computers. At 346 seconds after liftoff the data was restored and the computers determined cutoff vectors on the IP and Burroughs/GE sources and determined an initial impact point for the spacecraft. From all indications the mission appeared highly successful.

JANUARY 19
TIROS VIII supported the Gemini launch.

JANUARY 20

TIROS VII was programmed for ice pictures of the Northern Islands of Japan in support of the Japenese/ National Academy of Science study.

JANUARY 21

On its first anniversary, Relay II continued to operate satisfactorily.

The spacecraft operations as of January 20 for 2700 orbit revolutions are as follows:

887 wideband experiments
854 narrowband experiments
118 demonstrations.

Transponder No. 1 has been operated for 202 hours and 25 minutes over a period of 347 operations and transponder No. 2 has been operated for 153 hours and 7 minutes over a period of 260 operations. Since launch, 1383 hours of radiation data have been taken.

JANUARY 22

The Satellite TIROS IX was launched from Cape Kennedy at about 02:52 a.m. Preflight nominal values for the principal elements of the orbit and values for these elements obtained from an orbit based on early Minitrack data were as follows:

	Preflight Nominal Values	*Values Based on Early Minitrack Data*
Period (minutes)	100	119
Perigee height (st. miles)	460	436
Apogee height (st. miles)	460	1,602
Inclination (degrees)	98	96

Since the orbit turned out to be more elliptical than anticipated, the Automatic Attitude Determination Program System was used as a primary method for determining the attitude of the TIROS IX spacecraft. This system was used during the maneuver sequence which brought the spin axis around into the wheel mode attitude. It was also used subsequently when the satellite was operating in this mode. Horizon sensor data from one of the VEE scanners and solar aspect data were used to determine the attitude during the maneuver sequence.

A new portion of the Automatic Attitude Determination System was developed for use in reducing and evaluating housekeeping status telemetry data from the TIROS IX satellite on a near real-time basis. This system performed satisfactorily.

Status of TIROS Satellites as of January 23, 1965

	Launch Date	*Useful Life*	*Pictures Taken*
TIROS I	Apr. 1, 1960	2-1/2 months	22,952
TIROS II	Nov. 23, 1960	10 months	36,156
TIROS III	July 12, 1961	4-1/2 months	35,033
TIROS IV	Feb. 8, 1962	4-1/2 months	32,593
TIROS V	June 19, 1962	10-1/2 months	58,226
TIROS VI	Sept. 18, 1962	13 months	66,674
TIROS VII	June 19, 1963	operating	95,573
TIROS VIII	Dec. 21, 1963	operating	62,377
TIROS IX	Jan. 22, 1965	operating	
		Total Apt Pictures	4,067

JANUARY 25

The Goddard Space Flight Center was assigned responsibility to develop a series of Radio Astronomy Explorers Satellite.

Designated as Radio Astronomy Explorers, two satellites (RAE-A and RAE-B) will be designed to investigate low-frequency (long wavelength) emissions from our galaxy, its planets, and the stars. The spacecraft will be launched into circular orbits at altitudes of about 3,700 miles.

The satellites will measure the intensity of the signals, their frequency, times of emission and, within limitations, define the regions of space in which they originate.

The first launch was not expected before 1967. The launch vehicle will be a Thrust-Augmented Improved Delta. Total weight of the spacecraft was expected to be around 280 pounds.

The radio astronomy satellites will provide the first mapping of our galaxy at frequencies below ionospheric cutoff.

Designs called for the development of two 750-foot V-shaped antennas mounted opposite each other, forming a giant X. They would be anchored to the basic spacecraft, a cylinder of about 40 by 40 inches, capped by two truncated cones.

JANUARY 27

The Explorer XXVI spacecraft completed 120 orbits. To date 161 hours of data have been processed and 133 hours shipped.

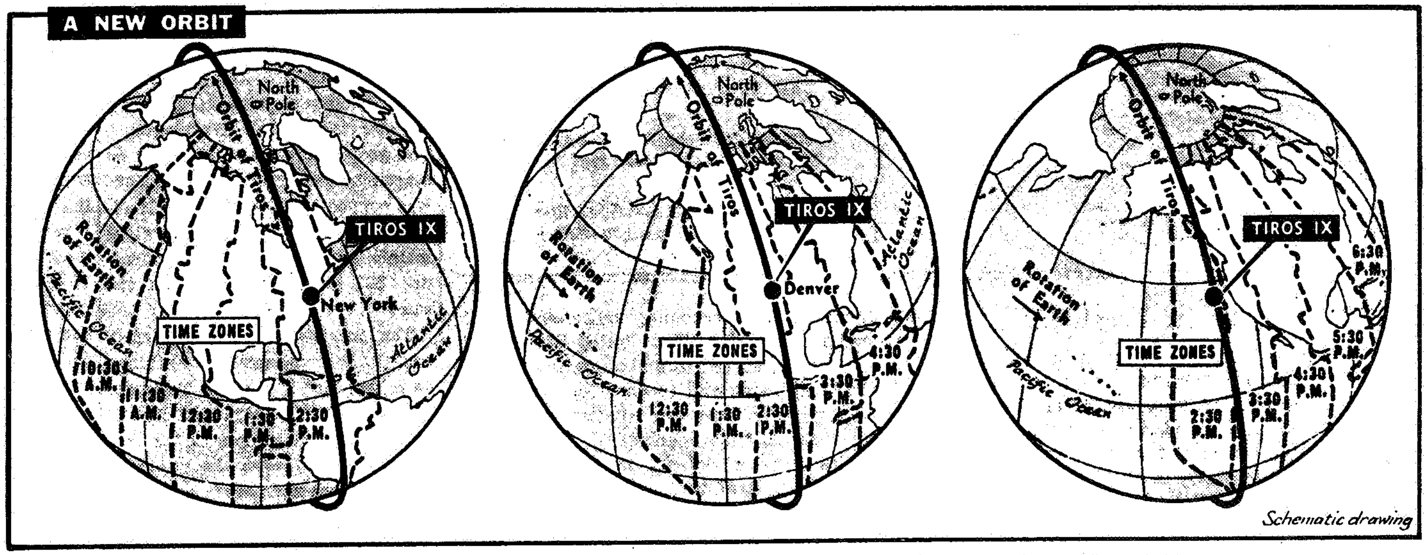
JANUARY 31

The Nutley ITTFL ground station operations with Relay was terminated.

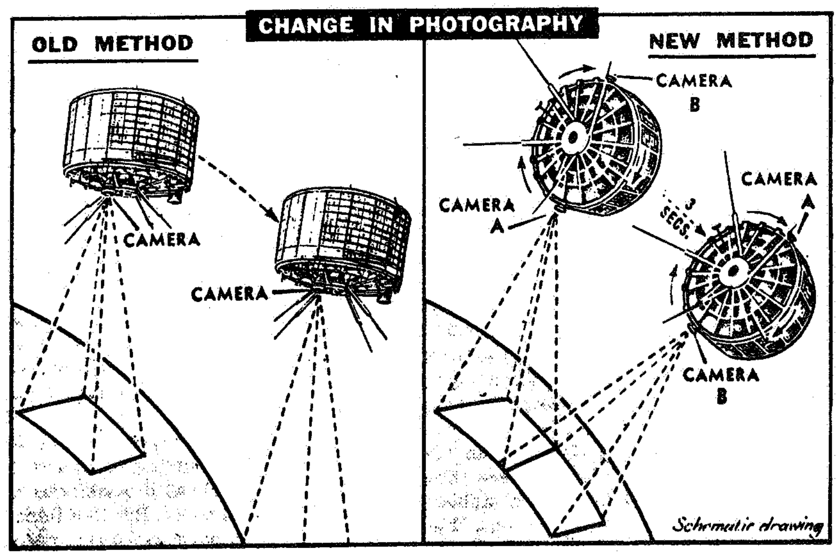
LATE JANUARY

The STADAN network continued to monitor for Nimbus signals at Quito and Blossom Point. No signals of useable quality were received.

A NEW TIROS—HOW IT INCREASES COVERAGE OF WORLD'S WEATHER



The United States launched last Friday a new Tiros weather satellite which is designed to photograph all of the earth's cloud cover every day compared with the 25 per cent coverage of earlier Tiros satellites. This increase is made possible by a combination of the craft's design and its polar orbit. Because of this orbit, the hour of the satellite's passage over any given part of the globe is always the same—approximately 2:30 P.M. in the daylight portion of the earth and 2:30 A.M. on the dark side. This hour was chosen as having the best light for photography during the daylight hours. The globes above show how the spacecraft, in three successive orbits, crosses the earth at always the same hour. With the satellite in a polar orbit, the earth, in effect, rotates beneath it, affording complete photographic coverage. The earlier Tiros satellites had orbital paths that did not reach the poles. Also, earlier satellites could not adjust in orbit to keep the cameras pointed toward earth. The new satellite rotates to enable its cameras to provide constant pictures. The two methods are illustrated in the diagrams at right.



New Weather Eye

The TIROS IX weather satellite launched from Cape Kennedy Friday included a number of significant advances in the already successful TIROS series, and several new astronautical techniques were employed.

The new satellite is a prototype for a projected system of TIROS Operation Satellites (TOS) planned for 1966. These will be used in weather forecasting, sea ice reconnaissance, locust control and storm warning.

One of the most intriguing new techniques, perhaps, is the so-called "2:30 o'clock orbit" into which the satellite was placed. Technically, it is called a "near-polar, sun-synchronous orbit." In practical terms, it simply means that at any point in the orbit, the local time directly beneath the satellite will always be approximately 2:30.

On the satellite's upward swing across the sunlit part of the earth, the time will be about 2:30 P.M. all the way. Conversely on the downward swing across the dark side of the planet, the time will always be about 2:30 A.M. The advantage, of course, is that the satellite will have ideal light conditions for its television cameras during the entire phase of the orbit.

LATE JANUARY

SYNCOM II and III continue to operate satisfactorily in orbit. SYNCOM II, drifting westward crossing the equator at 89° east longitude on January 28. DOD actual communications time usage of the spacecraft is 14 hours per day.

SYNCOM III continues to hover at the international date line. Its position allows communications acquisition from DOD stations located in the USA, Philippines, Saigon, Vietnam, and two ship-board terminals.

LATE JANUARY

Status of TIROS IX – Picture quality from both cameras was excellent. Pictures were being taken around the apogee hump (maximum altitude 1400 n.m.) instead of the nominal 400 n.m. altitude. Therefore, the camera was firing late and photography was tipped 18° aft of vertical. The picture format contained more space, horizon, and earth area than expected under the nominal conditions. Also, because of the high picture altitudes, the resolution at sub-satellite point was proportionally reduced to 6 n.m. per TV line from the predicted 1.6 n.m. resolution.

Particularly noteworthy in picture coverage by TIROS IX were excellent pictures of Antarctica, including the Ross Sea Ice Shelf, virtually the entire continent of South America, major storms over mid-USA, west coast of Mexico and Baja Penninsula, Alaska, and swath of pictures covering entire east coast of Africa from Mozambique to northern Egypt.

Spacecraft Status as of Jan. 27, 1965	*VII*	*VIII*	*IX*
Orbit	8,693	5,844	70
Picture total	97,376	63,932	1,460
Total useable (%)	89,634 (92.0)	58,926 (92.2)	—
Nephanalyses	3,429	2,395	74
Storm bulletins	554	651	19
IR orbits received	3,370	—	—
IR orbits digitized	2,320	—	—
IR orbits non-digitizable	885	—	—
IR orbits in process	165	—	—
Grand total of pictures	417,079		

JANUARY 31

The collimation tower at the Goddard Range and Range Rate Site in Madagascar was struck by lightning, causing damage to the synthesizer modulator and cabling. Needed replacement transistors were shipped.

FEBRUARY

The installation and checkout of the Goddard Range and Range Rate System on Madagascar was about 50% complete and the acceptance tests are to be performed during the week ending March 13.

EARLY FEBRUARY

Goddard Industrial Applications Office was designated "Technology Utilization Office."

EARLY FEBRUARY

A test was successfully conducted to demonstrate the feasibility of using telephone lines from remote stations to GSFC as a means of providing real-time data reduction for PFM and IMP telemeters.

According to plans coordinated by Ground Systems Manager Thomas Moore, a portable tape recorder in Building 14 was arranged to record an IMP II PFM signal sent from Woomera, Australia via the SCAMA telephone network. The output of a telemetry receiver at Woomera was arranged to be simultaneously recorded on a local tape recorder, and sent via SCAMA to Goddard. This will allow later comparison of the signals before and after transmission. The analog tape was taken from Building 14 to College Park where it was played back through the IMP line (F5) at 16 times the recorded speed, similarly to the routine high-speed IMP data processing. After some difficulty in establishing synchronism a buffer tape was made, printed-out on the Technitrol printer, and the performance parameters read visually from the print-out.

The quality of the telephone line was excellent in respect to impulsive and thermal noise levels; they were estimated to be more than 20 db below the signal. The equalization of the line with respect to amplitude response was undetermined and there is some indication that additional equalization will be necessary. Relative phase delay appeared to be well within the tolerance of the system, it being characteristic of PFM that it is nearly immune to this type of distortion.

Unequal transmission of the frequency bursts caused some trouble with the automatic gain control circuits of the comb filter, affecting synchronization. Further difficulty was occasioned by there being no time signal or servo control signal recorded on the analog tape at Goddard. These omissions have to be rectified during subsequent tests.

The signal from the satellite at a range of 92,000 km seemed to be very good, and was well above the normal threshold of the data processing equipment.

EARLY FEBRUARY

Both SYNCOM II and III were operating satisfactorily in orbit. SYNCOM III telemetry and command system was employed in successful VHF aircraft through the satellite to ground teletype tests. These tests were part of a series conducted by the Air Transport Association in conjunction with NASA Headquarters, Hughes Aircraft, Boeing Aircraft, and the Pan American World Airways, and supported by the SYNCOM Project Office.

EARLY FEBRUARY

Stereo tests via RELAY II were successfully completed on revolutions 2795 (2/2) and 2803 (2/3) by the FCC using the Mojave RELAY Test Station. This was the first time a communications satellite retransmitted a stereo broadcast.

EARLY FEBRUARY

The Nimbus I tracking records from Alaska for the 375 orbits of useful life of the spacecraft were reanalyzed by a group headed by George Harris in the Network Engineering and Operations Division. Auroral ionospheric effects were considered to be present when the signal level scintillations were greater than 1db peak-to-peak.

EARLY FEBRUARY

An average of 425 pictures per day taken by TIROS IX were being received with over 99% of them being meteorologically useful.

FEBRUARY 1

Advance notice to bidders was issued involving a construction contract for a road interchange, with the Baltimore-Washington Parkway, from the Goddard Space Flight Center.

Bid openings scheduled for March 23, 1965.

FEBRUARY 3

The Satellite OSO II was launched from Cape Kennedy at about 11:36 a.m. Preflight nominal values for the principal elements of the orbit and values for these elements obtained from an orbit based on early Minitrack data were as follows:

	Preflight Nominal Values	*Values Based on Early Minitrack Date*
Period (minutes)	96	97
Perigee height (st. miles)	344	343
Apogee height (st. miles)	344	393
Inclination (degrees)	33	33

FEBRUARY 4

The Space Science Steering Committee selected the following experimenters for Applications Technology Satellite—B:

1. W.L. Brown, BTL, Particle Telescope
2. J.C. Winckler, University of Minnesota, Electron Spectrometer
3. J.W. Freeman, Rice University, Ion Detector
4. F.B. Harrison, TRW-STL, Proton-Electron Spectrometer
5. P.J. Coleman, UCLA, Magnetometer
6. G.A. Paulikas, Aerospace, Omnidirectional Detector
7. R.C. Waddel, GSFC, Solar Cell Damage
8. J. Triolo, GSFC, Thermal Coatings

FEBRUARY 5

The IMP II spacecraft apparently provided good coverage of the February solar event. The spacecraft had been turned on about 40 minutes prior to the storm commencement (no data had been acquired for the previous twenty-four hours); nearly complete coverage was obtained through 0900 on February 9 when intermittent operation began.

FEBRUARY 9

The U.S. Senate approved bill designating March 16 each year as a day to honor the memory of the late Dr. Robert Hutchings Goddard of Auburn, Mass., as "THE FATHER OF MODERN ROCKETRY."

FEBRUARY 9

Six of the eight scientific experiments carried by the Orbiting Solar Observatory II have been turned on and were transmitting excellent data.

The two experiments not yet operating were the ultraviolet scanning spectrometer provided by Harvard University and the ultraviolet spectrophotometer provided by the Goddard Space Flight Center. Both experiments were turned on but irregularities in the data received were noted.

A program to determine the nature and probable cause of the irregularities was being worked out.

All other functions of the satellite — such as solar power supply, telemetry system, tape recorder, temperature control and command system—were normal. The spin-rate is 30 revolutions per minute. The pointing control system which aims the sail portion of the spacecraft at the Sun was exceeding its planned accuracy of one arc/minute.

The 545-pound OSO II was launched into a near circular orbit from Cape Kennedy, Fla., by a three stage Delta rocket Feb. 3. It was the heaviest satellite ever orbited by Delta.

FEBRUARY 12

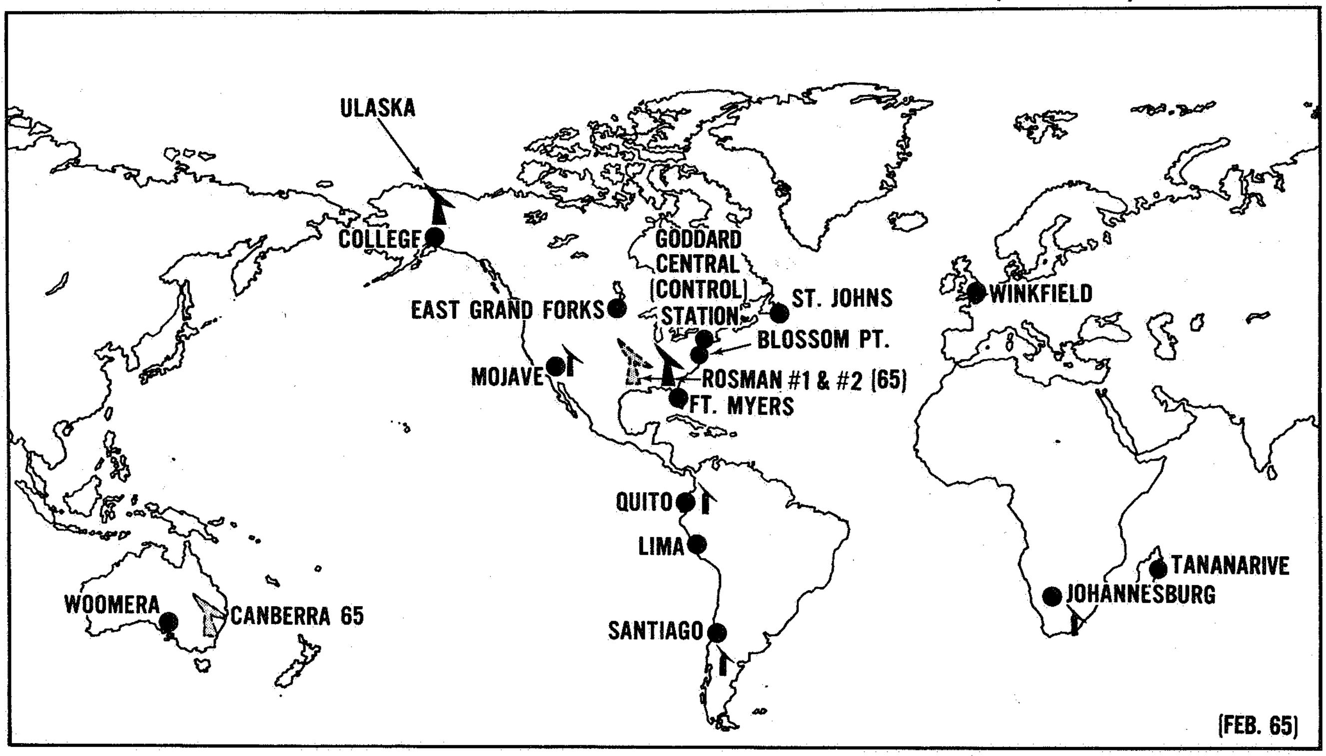
After almost seven years, Vanguard I appeared to be silenced. Though it may continue to circle the Earth for well over 200 years, its radio signals had weakened to a point that engineers thought the satellite may never be heard from again according to an announcement made by NASA.

The six-inch, 3.25-pound sphere, the second of the U.S. satellites, was launched by the U.S. Navy March 17, 1958, as a part of the International Geophysical Year program. It was sent into an orbit that ranged from about 405 to 2464 miles above the Earth by the Navy three-stage Vanguard rocket, from which the Delta launch vehicle was developed.

For more than six years it transmitted radio signals from space on its assigned 108-megacycle frequency powered only by six quartz-covered arrays of solar cells. Officially known internationally as 1958 Beta II, Vanguard I is circling the globe every 134 minutes and has an apogee of about 2,442 miles and a perigee of about 402 miles.

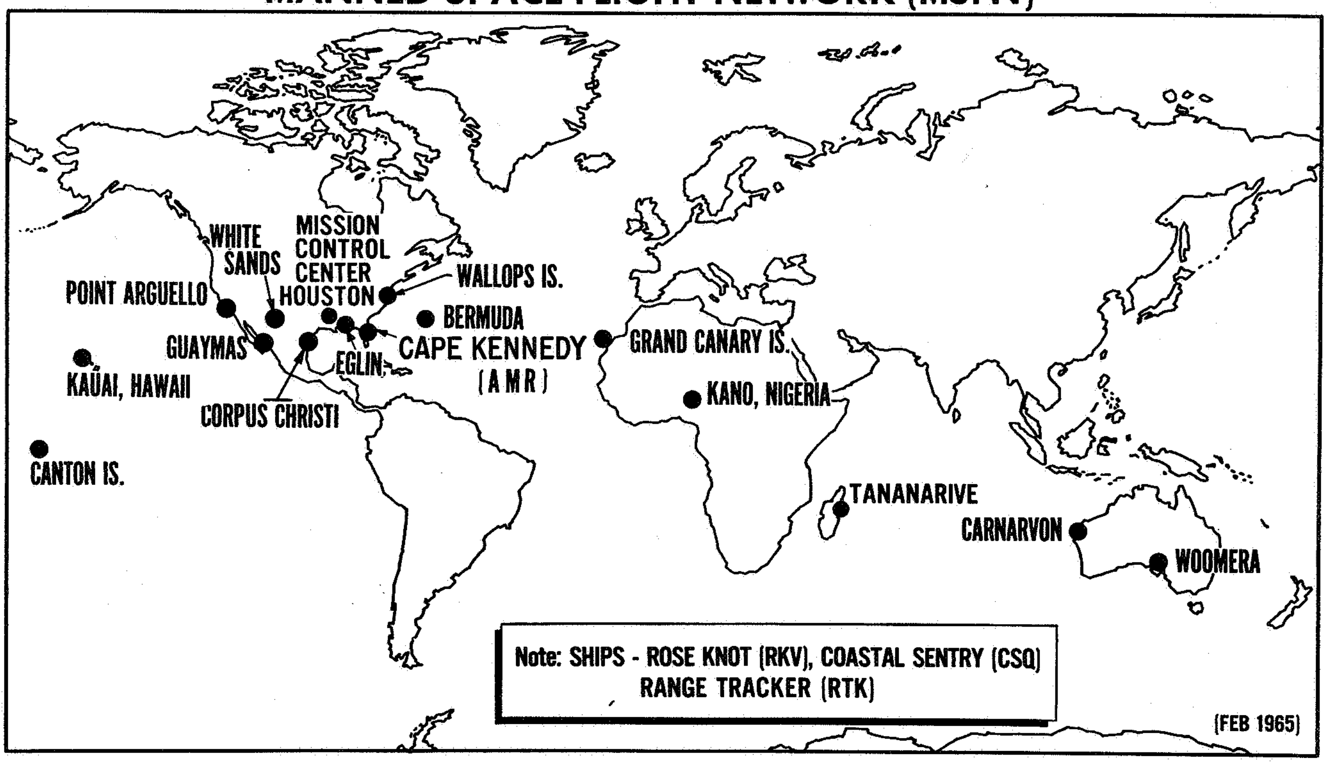
Although the primary purpose of the launch was a test of the performance of the Vanguard rocket, the small sphere it carried achieved such a remarkably stable orbit that it became one of the nation's most important satellites. Probably the most noteworthy of its many

SPACE TRACKING AND DATA ACQUISITION NETWORK (STADAN)



MINITRACK FACILITY — 40 FT PARABOLIC ANTENNA SYS. — DATA ACQUISITION FACILITY — PROPOSED DATA ACQUISITION FACILITY

MANNED SPACE FLIGHT NETWORK (MSFN)



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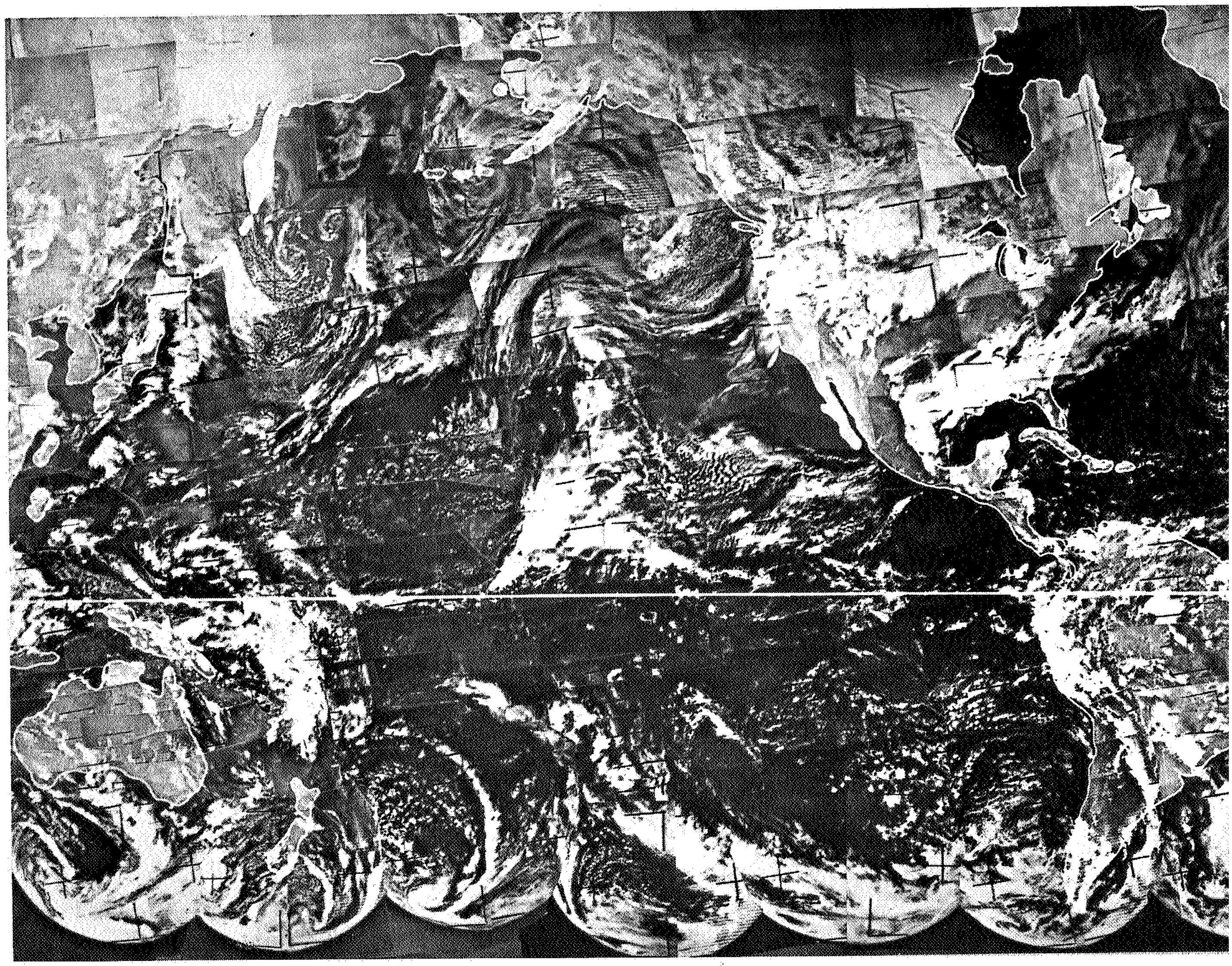
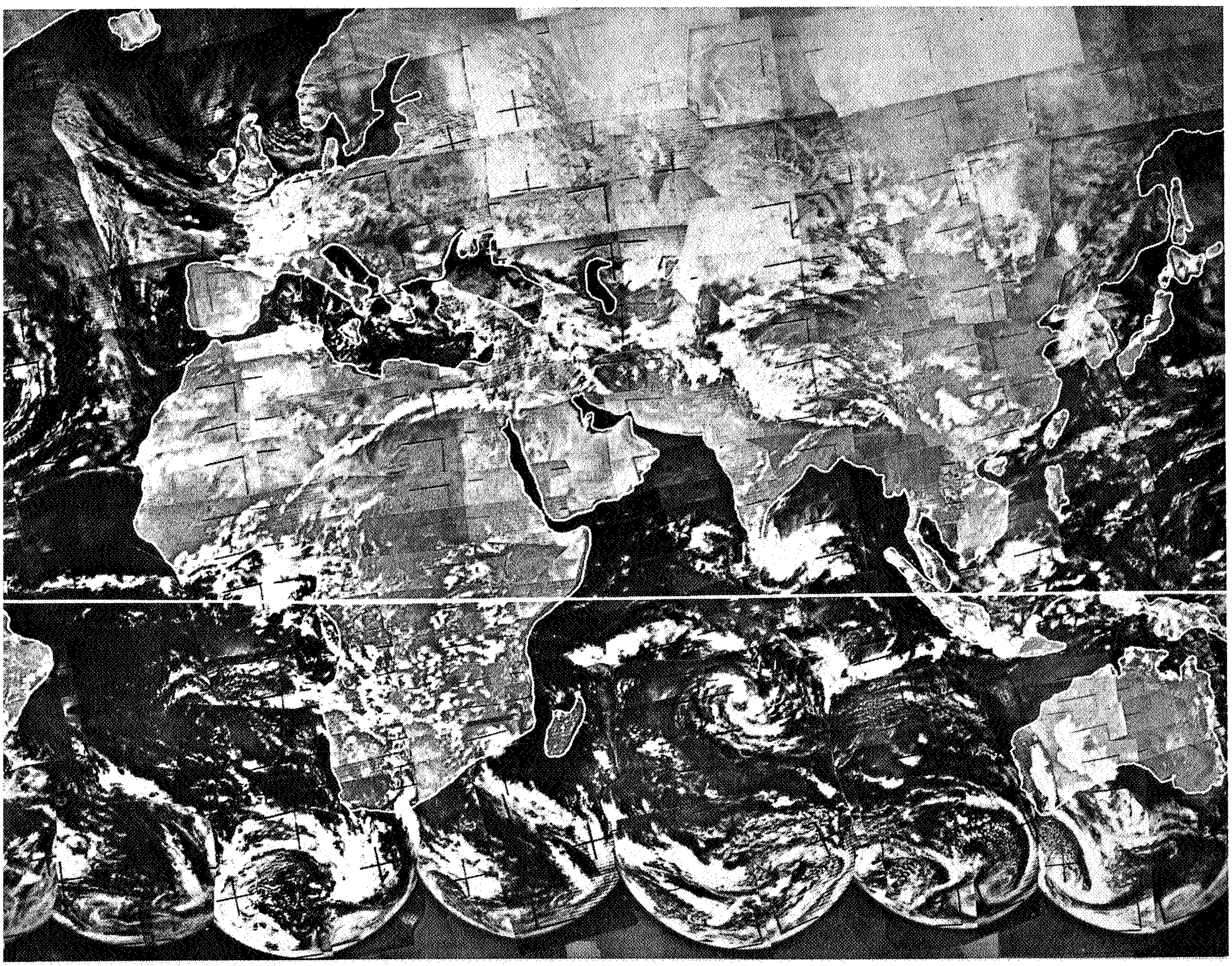


HE WORLD'S WEATHER



The World's Weather on February 13 as seen by TIROS IX Weather satellite. The photo is a composite of the series of pictures recorded during the day.

major contributions to science and knowledge was the discovery of the "pear-shaped" Earth.

With the satellite, scientists also were able to study and measure the "far out" density of the atmosphere, in a region some 465 miles above the Earth. It also provided extensive observation and measurements of variations in air density which are associated with solar activity and the first quantitative data on how solar radiation pressure effects a satellite's orbit.

When NASA phased out the 108-megacycle radio band used for scientific satellites during the IGY, the agency's tracking and data acquisition facilities were gradually converted to the internationally allocated 136-megacycle band. At the close of 1964, the station near Quito, Ecuador, was the only NASA station still monitoring on the 108-megacycle frequency.

Vanguard I's transmissions had steadily degraded over the years to the degree that it was expected that the signals would be acquired at Quito only under ideal conditions, such as when the satellite was in sunlight near perigee. These conditions prevailed during the later part of 1964; however, the signals were too weak for the Quito station to acquire them.

Vanguard's signals were acquired in May 1964, and although few engineers suspected it at the time, this proved to be the last time the satellite was heard. The Quito station continued its twice a week monitoring without success until Feb. 10, when it was directed to discontinue its efforts.

Engineers at the Goddard Space Flight Center which operates NASA's space tracking and data acquisition network did not rule out the remote possibility that the tiny satellite will regain its voice but, Vanguard I is never again expected to be of scientific use as a transmitting satellite.

FEBRUARY 14
An ad was placed in the Los Angeles Times recruiting for the Delta Program at Western Test Range.

FEBRUARY 14
The San Marco-A spacecraft stopped transmitting after several weeks of increasingly weak and intermittent transmission. STADAN was requested to suspend operations in support of this satellite.

MID FEBRUARY
The GSFC Data Operations Branch supported various GT-3 simulations.

MID FEBRUARY
Payload for the first Spin Stabilized Spacecraft in the Applications Technology Satellite series tentatively included the following experiments:

Technology:

Communications (6-4 gc)
Communications (VHF)
Nutation Sensor

Environmental Measurements:

1. Particle Telescope by BTL
2. Electron Spectrometer by University of Minnesota
3. Ion Detector by Rice University
4. Proton-Electron Spectrometer by TRW-STL
5. Magnetometer by UCLA
6. Omnidirectional Detector by Aerospace
7. Solar Cell Damage by GSFC
8. Thermal Coatings by GSFC

MID FEBRUARY
Operation of a near real-time data system began at the OSO Control Center satisfactorily. The 400 bit/second data from OSO B2 was received successfully in real-time.

FEBRUARY 15
The Bendix Field Engineering Corporation, Owings Mills, Md., was selected for a contract for the operation, maintenance and support services of the Manned Space Flight Network of tracking stations.

The cost-plus-award-fee contract was valued at approximately $36 million over two years. If annual options are exercised the contract might be extended for up to three years more. It would thus not only cover Gemini but would also include the Apollo program.

FEBRUARY 16
The Satellite Pegasus, Saturn SA-9 was launched from Cape Kennedy at 09:37 a.m. Preflight nominal values for the principal elements of the orbit and values for these elements obtained from an orbit based on early radar and Minitrack data were as follows:

	Preflight Nominal Values	*Values Based on Early radar and Minitrack Data*
Period (minutes)	97	97
Perigee height (st. miles)	309	308
Apogee height (st. miles)	464	462
Inclination (degrees)	32	32

Predictions were made as required for stations of the Stadan and Manned Space Flight Networks.

FEBRUARY 16
A contract was awarded to the Univac Division of Sperry Rand Corp., St. Paul, Minn., for digital data processors to be used in Project Apollo.

The fixed-price contract totaled $8,879,832 for 22 digital data processing systems to be installed at nine ground facilities and aboard three ships.

The contract also called for computer programming assistance to apply the characteristics of the equipment in modifying present computer programs or developing new ones for Project Apollo requirements.

One system was to be installed at the Manned Spacecraft Center, and one at the Goddard Space Flight Center, Greenbelt, Md., which operates the network of tracking and data acquisition stations supporting Apollo. Two systems will be installed at the stations at each of the following locations: Ascension Island; Bermuda; Carnarvon, Australia; Guam; Guaymas, Mexico; Hawaii, and Merritt Island, Fla.; and aboard three of the Apollo tracking ships.

FEBRUARY 17

Ranger 8 was launched by a Goddard launch team from Cape Kennedy. Lift-off occurred at 1705Z with all circuit status indicators green. Network performance during launch and midcourse maneuver was considered good. Extremely low geomagnetic activity contributed to better than average propagation conditions which continue to remain good at this time. GSFC was to participate in Ranger 8 mission through lunar impact February 20, 1965.

An interesting stereo effect was noted during the early phase of the flight when the spacecraft was visible simultaneously from Johannesburg, South Africa and Woomera Australia and the same analog T/M data was being received at both stations and transmitted via SCAMA to the SFOF at Pasadena.

FEBRUARY 17

NASA and the Department of Defense have agreed to establish a Delta launch vehicle capability at the Western Test Range near Lompoc, California.

In a Memorandum of Agreement, NASA and DOD will share costs of establishing the WTR Delta capability based on the estimated use of the vehicle by each agency.

The Goddard Space Flight Center, and the Space Systems Division, Air Force Systems Command were responsible for carrying out the agreement.

FEBRUARY 18

NASA awarded a $10,940,000 contract to Douglas Aircraft Co., Inc., Santa Monica, Calif., for mission integration and launch services of Delta launch vehicles at Cape Kennedy, Fla.

The cost-plus-fixed-fee contract covered the calendar year 1965. Douglas has been providing the services for Thor and Delta vehicles since 1959.

FEBRUARY 18

On Thursday, February 18 during Relay II revolution 2915, a group of Cub Scouts at the Fernwood Elementary School in Bethesda, Maryland spoke to another group at the American School in Tokyo, Japan via COMMOJ, the Relay II spacecraft and COMIBA.

FEBRUARY 19

Instrumentation for the nation's first Orbiting Astronomical Observatory was revised to keep the launch on schedule for late 1965 and to allow more time for developing a complex scientific experiment that has encountered delays, it was announced by NASA.

Inclusion of three X-ray and gamma ray telescopes on the first OAO was approved and the Smithsonian Astrophysical Observatory's Celescope experiment was rescheduled for the third OAO.

Unaffected by the change and proceeding on schedule for a 1965 launch is the University of Wisconsin's photometer telescope system to measure the energy distribution and emission intensities of stars.

The Celescope experiment is designed to map the stars and nebulae through observations in the ultra-violet region of the spectrum. Development problems have centered around the image tube used to detect specific bandwidths in the ultraviolet.

The three X-ray and gamma ray telescopes, already fabricated, contain experiments proposed by the Massachusetts Institute of Technology (William Kraushaar, principal investigator), the Lockheed Missiles and Space Division of Lockheed Aircraft Corp. (Philip Fisher, principal investigator) and the NASA Goddard Space Flight Center, (Kenneth Frost, principal investigator).

The MIT experiment is designed to survey the sky to detect high energy gamma rays that do not originate from Earth. The 37-pound instrument uses two detectors, a crystal scintillator and Cerenkov counter, to determine the diredtion of incident gamma rays.

The Lockheed experiment is designed to survey the night sky to seek new sources of low-energy (soft) X-rays and to study those recently discovered. Primary detection elements are two 75-pound arrays of high-gain gas proportional counters—gas filled chambers that count penetrating X-rays and measure their energy.

The 60-pound Goddard experiment will detect low-energy gamma rays using a thallium activated sodium iodide crystal and three photomultiplier tubes.

FEBRUARY 23

SYNCOM II was stopped at 72.5°E longitude. This was to be the final positioning of SYNCOM II because the on-board propulsion system fuel supply should be exhausted as a result of the stopping maneuver. The Department of Defense was to use SYNCOM II at this location.

FEBRUARY 24

A $2,740,000 contract was awarded to Collins Radio Co., Dallas (Tex.) Division, for Unified S-Band telemetry Systems for three 85-foot diameter antennas in support of Project Apollo.

THE KANSAS CITY STAR

FEBRUARY 20, 1965

A LONG FAREWELL TO AN ANCIENT SATELLITE

THERE was a day in the Space age when the sound of a satellite, signaling earth from so far away, was a source of awe and wonderment at the genius of man.

It was the "beep-beep" of Sputnik I, and that was a source, too, of a certain fear and uneasiness.

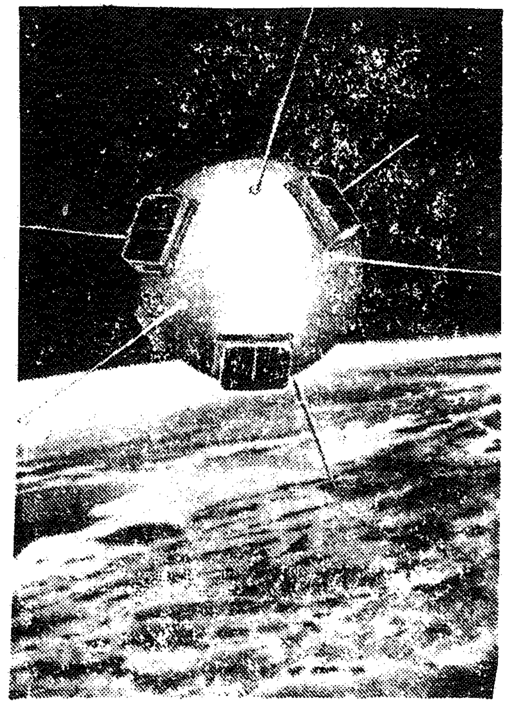
It was the voice of Explorer I, this nation's first contribution to the cosmos, and that was a source of reassurance.

And then, on March 17, 1958 after several months of failures, it was the voice of tiny Vanguard I. A few days ago Vanguard, after nearly seven years, went silent. Thus closed one of the significant chapters in space history.

In a sense Vanguard, although it weighed but 3¼ pounds, was proof that this nation's space program had finally found itself. To be sure, Nikita Khrushchev and his people scoffed at a "grapefruit" in orbit. No one has scoffed at the world of vital data provided by the grapefruit's radios. And perhaps it is only fair to note that Vanguard, as a fixture in the cosmos, doing the job it was assigned to do, continued to function after Khrushchev himself had gone out of orbit.

In fact, as a mute monument to a fantastic sort of pioneering, Vanguard still has some 194 years or so left, assuming the scientists are correct in their computations. It no longer serves a useful function. Rather, it is a piece of space junk, swinging tirelessly around the globe, each orbit a bit shorter than the previous and each bringing it nearer a fiery death. We trust that our counterparts of some two centuries hence will duly note its demise. In our times, we still write and speak of the prairie schooners and the wagon trains with a proper sort of nostalgia. The comparison is not entirely irrelevant:

There is a chance, of course, that Vanguard will be heard from again. Once, last year, it went suddenly silent, only to resume sending later on. This time, however, the Space agency has ordered its Quito, Ecuador, monitor—the last to be tuned in on Vanguard—to give up on that particular channel. So we will assume that this obituary is in order.



Still good for 194 silent years in orbit: An artist's conception of Vanguard I, far above the earth.

And an obituary in rather glowing terms it must be. From a research point of view, it can be said that this boy space traveler did a man's job. Because of information radioed back from space, the map-makers went back to their drawing boards, there to replot their charts of the earth. By tracking the beeping satellite in its path through the heavens, scientists were able to pinpoint misplaced areas on the earth with unparalleled accuracy. Vanguard resulted in a new calculation of this old globe's size and shape. Scientists still find Vanguard's data invaluable in their studies of the earth and its gravitational field.

It may be argued that in the great volume of knowledge acquired since the Space age began, this is not very much. Since, the Van Allen radiation belt has been discovered and probed. Pictures of clouds have been used to predict the weather. There have been photographs of the moon and even now Mariner 4 (and presumably its Soviet companion) speeds in the direction of Mars, to report back, if all goes well, on that planet. Man himself has traveled the pathways of space, in orbit about the earth. And now, we have our second set of sharp photographs of the moon's surface.

YET for all endeavors there has to be a beginning, and if Vanguard I was not precisely the point of departure, it was very close to it. Actually, the project's concept dates from 1955 when the space adventure was nothing more than a gleam in the Budget bureau's eyes. And let us note for the record that the project as a whole did not have a fantastic record: Three successes in 11 blast-offs.

Nevertheless, in the pre-Space age era of contemplation, scientists thought one out of six successes would be a solid accomplishment. But in the near-hysterical reaction to Sputnik I, too much was expected of the untried Vanguard.

Thus the first U. S. space triumph was the Army's Explorer I. Nevertheless there came with the Navy's first contribution, Vanguard I, a sense that the U. S. was on its way; that science—which had and still has the prime reason for existing in space—had discovered the key to its new laboratory.

On earth, as sophisticated as 20th century man had become, the stamina of Vanguard and its persistent voice combined to stagger the imagination. Its durability—another 194 years, remember—was (and is) a symbol that somehow man had crossed a new frontier, searching for information about the universe in which he lives, first with machines, later in person.

Vanguard I now has circled the earth more than 25,000 times and traveled millions of miles. One tiny satellite, launched originally as a test for the rocket vehicle, wrote many volumes of scientific history. Perhaps its great contribution was to remind man dramatically of his own genius and inventiveness. It is a reminder that mankind may need increasingly in this age of the machine.

Under the fixed-price type contract Collins will install the three systems at antennas to be built at Goldstone, Calif.; Canberra, Australia, and Madrid, Spain.

Unified S-Band telemetry is capable of combining in a single radio transmission the signals for tracking, command, voice communication with the astronauts, data on the condition of the spacecraft and information from its experiments. Instead of requiring separate antennas for each of these functions as was necessary for Project Mercury, the Unified S-Band System is used with a single antenna.

For long distance space communication, the 85-foot diameter parabolic antenna with its sensitive receiver and powerful transmitter makes possible contact with the astronauts on their way to the Moon, during their landing, and on their journey back to Earth.

The new contract is a follow-on to a NASA contract of July 10, 1964, under which Collins was to supply nine complete Unified S-Band Systems for 30-foot diameter antennas and various partial systems and other services.

LATE FEBRUARY

Launch Phase Simulator (Goddard Building No. 15) about 75% complete.

LATE FEBRUARY

The Orbiting Geophysical Observatory I, launched last September 4, received a new lease on life in late February when ground commands were used to administer "shock treatments" to a faulty inverter.

Had the inverter continued to malfunction, OGO's lifetime would have been shortened considerably because of the lack of electric power. The inverter supplies power for rotation of the solar panels to keep them at a proper angle to the Sun.

The remote control shock treatment, commanded from the ground, consisted of applying electrical charges of various voltages through the inverter. This "therapy" was successful and all OGO I's systems except the attitude control system were functioning normally.

MARCH 4

The NASA's Orbiting Solar Observatory II completed its first month in orbit at 11:36 a.m. EST after circling the Earth 419 times.

During its first month of operation, the 545-pound solar observatory has sent an average of seven miles of tape-recorded data daily to ground stations. These data are being processed and sent to experimenters from three universities and three government agencies.

One of OSO's eight scientific experiments was not functioning and part of another was returning only scrambled data when it was operating.

The ultraviolet scanning spectrometer provided by Harvard University was not working as planned despite efforts to correct irregularities in data transmission.

The spectroheliograph portion of the Naval Research Laboratory coronagraph experiment was being operated in the scanning mode of the spacecraft, but difficulties have been encountered in understanding the data.

Earlier problems experienced with data transmissions from the Goddard ultraviolet spectrometer experiment have been resolved and it was operating normally.

MARCH 4

The Mexican and U. S. governments agreed to extend to 1970 their agreement for operation of the tracking station at Guaymas, Mexico.

Extension of the agreement continued the former Project Mercury tracking station for NASA's Project Gemini two-men-in-orbit program and Project Apollo, manned moon-landing program.

The agreement, which established the station in 1960 for the Mercury program, was amplified in 1963 to include unmanned scientific satellites as well. The two governments also have agreed upon other areas of cooperation, particularly in meteorological sounding programs.

In support of Project Gemini, the Guaymas station provides dual capacity in tracking the Gemini spacecraft and the Agena rendezvous vehicle simultaneously. It is the first North American land station to establish voice communication with the Gemini astronauts after their orbit sweeps them past Australia across the Pacific Ocean toward the United States.

MARCH 5

The Early Bird prototype, first commercial communications satellite, arrived at Cape Kennedy.

MARCH 6

The Honolulu voice/data switcher was installed and became operational. The voice/data switcher will be used in conjunction with the GT-3 mission.

MARCH 9

During a readout at the Wallops CDA station, TIROS VII transmitted its 100,000th picture. This was the first time in TIROS history that the 100,000 picture mark was reached by a single spacecraft. The next runner-up was TIROS VIII with a current total of 68,219 pictures.

MARCH 10

How Goddard Space Flight Center Has Grown

March 16, 1961

Total Plant Value

Total Property – 552 Acres $15,300,000

Facilities Complete

Space Projects Building (Building # 1)
Research Projects Laboratory (Bldg. # 2)
Central Flight Control and Range Operations Laboratory (Bldg. # 3)
Central Power Plant and Service Shops (Bldg. # 4)

Facilities Under Construction
Instrument Construction and Installation Laboratory (Bldg. # 5)
Space Sciences Laboratory (Bldg. #6)

March 16, 1965
Total Plant Value
Total Property – 1175 Acres $151,800,000

Facilities Complete
Space Projects Building (Bldg. #1)
Research Projects Lab. (Bldg. #2)
Central Flight Control and Range Operations Lab. (Bldg. #3)
Central Power Plant and Service Shops (Bldg. #4)
Instrument Construction and Installation Lab. (Bldg. #5)
Space Sciences Lab. (Bldg. #6)
Payload Testing Facility (Bldg. #7)
Satellite Systems Lab. (Bldg. #8)
Gatehouse, Pump House, Water Tower
Environmental Testing Lab. (Bldg. #10)
Applied Sciences Lab. (Bldg. #11)
Tracking & Telemetry Lab. (Bldg. #12)
Spacecraft Operations Facility (Bldg. #14)
Development Operations Bldg. (Bldg. #16)
Multi-purpose Bldgs. (Bldgs. Nos. 17, 18, 19, & 20)
Anechoic Chamber
Antenna Control Facility
Antenna Test Facility
Bi-Propellant Facility
Gas Cylinder Storage Facility
Ground Plane Test Facility
East Gatehouse
Lawn Sprinkler System
Magnetic Test Facility
Optical Tracking Observatory

Facilities Presently Under Construction
Meteorological Systems Development Lab. (Bldg. #21)
Data Interpretation Lab. (Bldg. #23)
Launch Phase Simulator Facility (Bldg. #15)
Addition to Central Refrigeration and Heating Plant (Bldg. #24)

MARCH 11

Status of TIROS Photos:

Spacecraft	*VII*	*VIII*	*IX*
Orbit	9,302	6,446	564
Picture Total	100,034	68,219	18,951
Total usable	92,115	63,016	18,416
(%)	(92.1)	(92.3)	(97.1)
Nephanalyses	3,437	2,405	1,393
Storm Bulletins	554	651	363
IR orbits received	3,479	—	—
IR orbits digitized	2,455	—	—
IR orbits non-digitizable	920	—	—
IR orbits in process	104	—	—
Grand total of TIROS pictures	442,905		

MARCH 12

President Lyndon B. Johnson signed Public Law 89-5 (S.301) designating March 16, 1965 as a special day in honor of Dr. Robert H. Goddard.

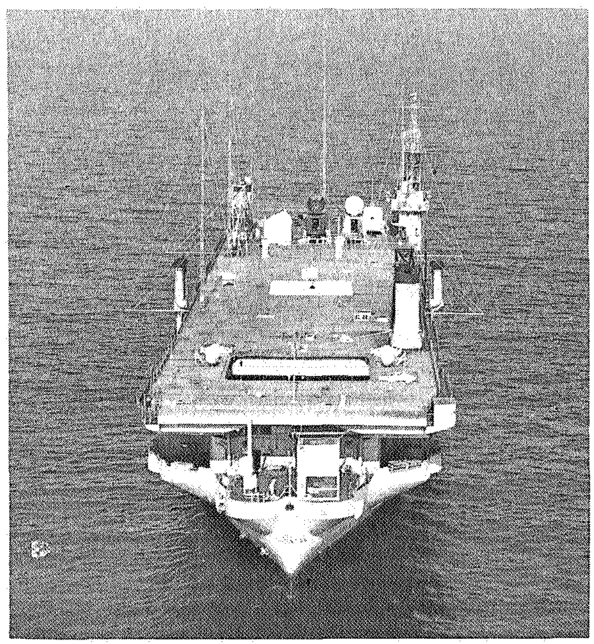
MARCH 12

Stages 1 and 2 of Delta-30 (Early Bird) were erected at Pad 17A. Checkout proceeding on schedule.

MID MARCH

NASA's floating launch platform, the USNS Croatan, completed the Balboa-to-Lima leg of its sea-going expedition across the Equator off the West Coast of South America.

The "sounding rocket ship" departed Balboa, Panama Canal Zone, March 6, and arrived at Lima, Peru, March 13. During the interval ten two-stage sounding rockets were launched from the deck of the ship, carrying upper atmosphere and ionosphere experiments for the University of Michigan, the University of New Hampshire, and NASA's Goddard Space Flight Center. Also three single-stage Arcas meteorological rockets, two of which carried experiments to measure ozone in the atmosphere, were sent aloft.



USNS Croaton

MARCH 16

A conference telephone call via RELAY II communications satellite was held in honor of the late Dr. Robert H. Goddard, whose pioneering space achievements have been recognized by Presidential proclamation.

The call was from Washington officials to Worcester, Mass., where Dr. Goddard's widow was attending Goddard Day at Worcester Polytechnic Institute.

Routing of the call was made through RELAY II, 4,200 miles above Hawaii.

The call was arranged by Vice President Hubert H. Humphrey, who is chairman of the National Aeronautics and Space Council, but a schedule conflict made it impossible for him to participate.

Mrs. Goddard heard Dr. Hugh L. Dryden, Deputy Administrator of the National Aeronautics and Space Administration, send greetings from Washington. He will introduce House Speaker John W. McCormack and Rep. George P. Miller, Chairman of the House Committee of Science and Astronautics. Other callers told of the impact of Dr. Goddard's invention on their areas of technology. Dr. Albert C. Hall, Deputy Director (Space), Office of Defense Research and Engineering, Department of Defense, represented the military.

Dr. Robert M. White, Chief, United States Weather Bureau; George Sampson, Director of Operations, Communications Satellite Corp.; and Dr. Harry J. Goett, Director, NASA's GSFC, named for the late Dr. Goddard, spoke on the conference line.

GODDARD SPACE FLIGHT CENTER

ANNOUNCEMENT

NO. 776

DATE 3/16/65

SUBJECT: Dr. R. H. Goddard's Anniversary

Thirty-nine years have passed since Dr. Robert H. Goddard successfully launched his first liquid-fuel rocket from an Auburn, Massachusetts farm. The event, comparable to Kitty Hawk in its significance, failed to arouse any public attention. To those of us who have become personally involved in the U. S. Space Program, the date of March 16, 1926, assumes ever increasing significance. Dr. Goddard's scientific curiosity, tenacity, and inventiveness gave birth to a new age. The staff of this Center takes pride in recognizing the contributions of this American pioneer whose name the Center bears in honor.

Harry J. Goett

HARRY J. GOETT
Director

MARCH 18

Ground breaking ceremonies were held for the antenna TIROS Operational Satellite Systems at Wallops Island, Virginia.

MARCH 18

Pre bid meeting held on March 9, 1965. Bid opening for Magnetic Tape Quality Control Center—Building No. 16.

MARCH 19

After a successful simulation, plans were announced to use SYNCOM II synchronous communications satellite to communicate between the GT-3 spacecraft and Cape Kennedy, Fla.

SYNCOM II will be used in the communications link as the astronauts pass over the Indian Ocean. The astronauts will be able to talk to the GT-3 flight director in the mission control center at Cape Kennedy and spacecraft telemetry will be sent at the same time.

Telemetry signals and voice messages will come from the manned spacecraft to a surface ship, the USNS Coastal Sentry, located in the Indian Ocean. The surface station, USNS Kingsport, which will then be lying a few miles away. From there the signals will be transmitted up to SYNCOM II, 22,300 miles above the Indian Ocean, down to a ground station at Clark Air Force Base, Republic of the Philippines, and by cable to a NASCOM (NASA Communications Network) station near Honolulu.

From Honolulu the transmission will go by cable to the U.S. and then by land line to the Goddard Space Flight Center, Greenbelt, Md. and on down to the flight director at Cape Kennedy.

Simultaneously, the same signals will be transmitted from the Coastal Sentry via high frequency radio to a NASCOM station near Perth, Australia. Cable will carry it to the NASCOM station at Honolulu. There, the better reception of the two transmissions will be selected and sent to the Cape. Return signals will be handled in the same manner. That is, messages from the U.S. will be sent to Honolulu, then via the satellite and the high frequency radio route.

In today's test the successful transmission was between the USNS Kingsport and the mission Control Center via SYNCOM II, Clark AFB, and Honolulu relay points.

The SYNCOM II, built for NASA by Hughes Aircraft Co., satellite moves in a figure eight pattern 33 degrees north and south of the Equator along the longitude of 66.59 degrees East. The Coastal Sentry is at 80 degrees E. longitude and 30 degrees S. lattitude.

Department of Defense ground crews are in charge of satellite communications aboard the Kingsport and at Clark Field. SYNCOM II was stopped by NASA at its present location and will be turned over the DOD for further experimental use at the end of March.

MARCH 19

President Lyndon B. Johnson has sent a message of congratulations to Australian Prime Minister, Sir Robert Menzies, on the occasion of the dedication of a new United States lunar and planetary spacecraft tracking station near Canberra, Australia.

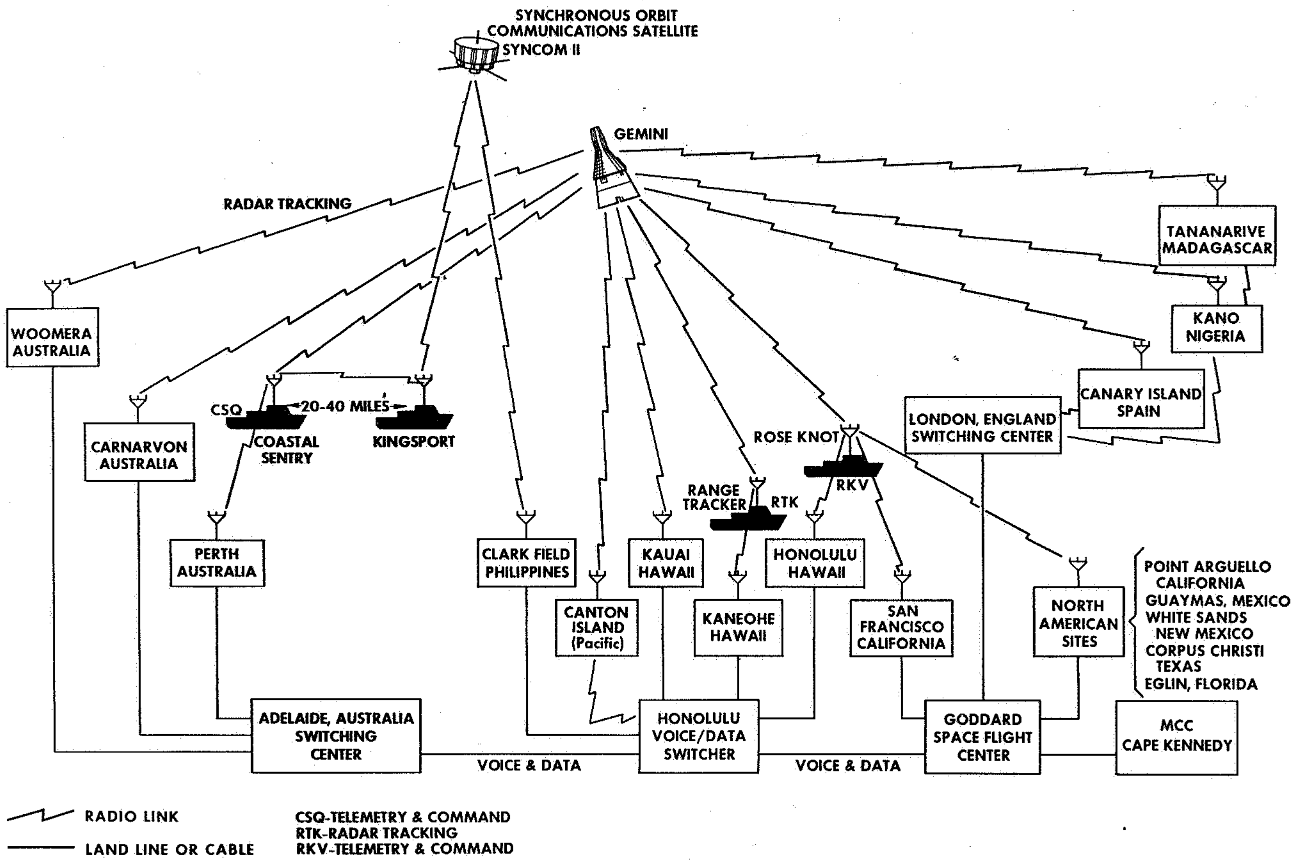
President Johnson called the opening of the Deep Space Network facility of the National Aeronautics and Space Administration "another step forward in the close cooperation between our two countries."

"The standard of performance at the tracking and data acquisition facilities already existing in Australia is excellent," the President wrote the Prime Minister. "I am confident that at the new space tracking facility at Tidbinbilla we will see the same high level of performance."

The new station is to be operated entirely by Australians, the President noted, as are the other NASA facilities in Australia.

The new facility in the Tidbinbilla Valley, 28 miles by road southwest of Canberra, was officially opened

NASCOM NETWORK SUPPORT FOR GT-3



at 11 a.m. Friday, Australian time, March 19, by Prime Minister Menzies. The ceremony will be attended by representatives of the United States Embassy, NASA, the Commonwealth of Australia and leaders of Australian science and industry.

The first assignment of the new facility is to track and communicate with the unmanned Mariner IV spacecraft on its scientific and photographic mission to the planet Mars. The Tidbinbilla station assumed this task when it became operational February 1, this year, and will continue Mariner support until the mission has been accomplished.

MARCH 26

The Goddard Launch Operations Division, formerly the Goddard Launch Operations Branch, Spacecraft Systems & Projects Division, was established in the Space Science & Satellite Applications Directorate. Mr. Robert H. Gray, Head of the former Branch, was named Chief of the new Division. For operational purposes Mr. Gray continued as Manager, Goddard Launch Operations; John J. Neilon, ETR, and Joseph B. Schwartz, WTR, continued as Associate Managers, Goddard Launch Operations.

The former GSFC Fabrication Division, Office of Technical Services is reorganized and redesignated as the "Experimental Fabrication and Engineering Division." Mr. Maurice Levinsohn continued as Chief of the Division.

MARCH 27

ARIEL II completed its first year of operation. Most systems continued to perform normally – but with the craft de-spun, very little useful scientific data was being obtained. The spacecraft performance continued to be monitored on a minimal data acquisition schedule.

MARCH 31

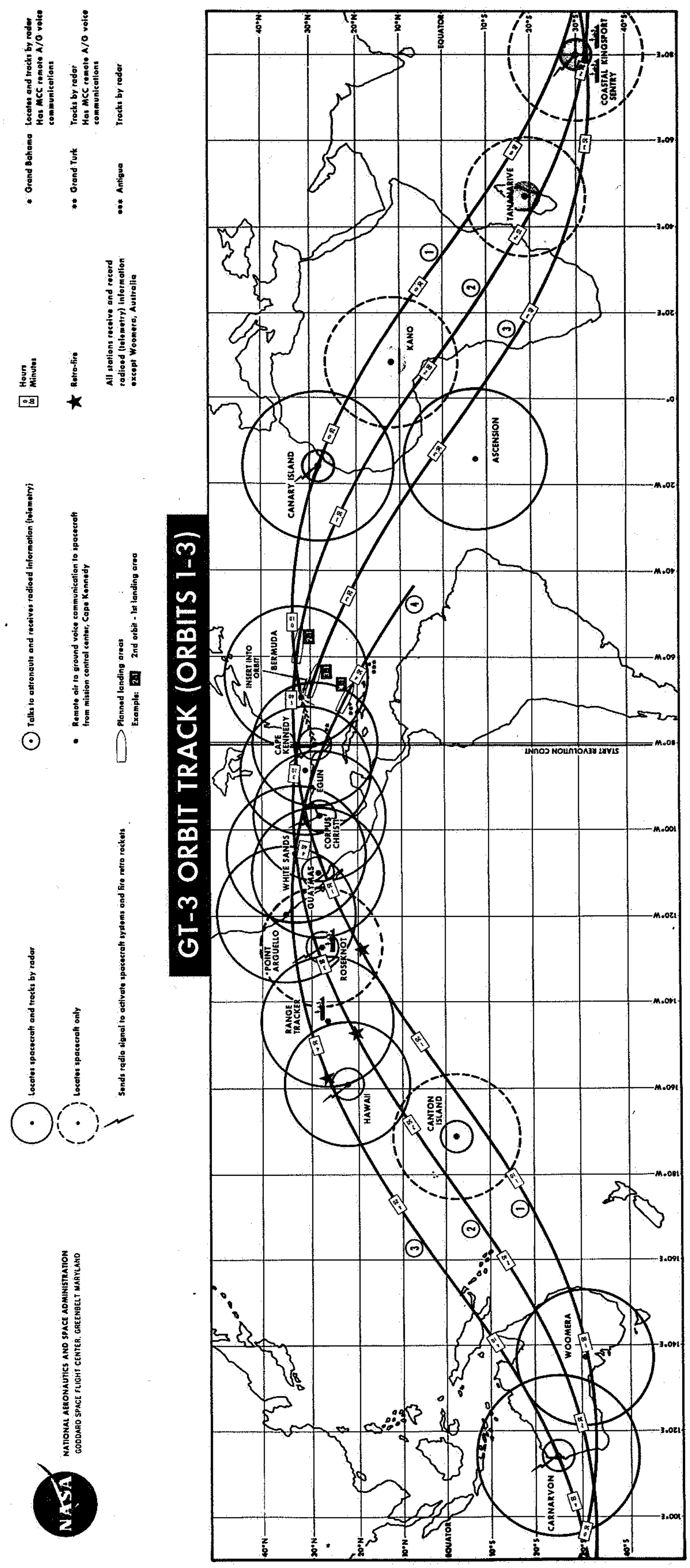
Launch Phase Simulator – Building No. 15 (Head Construction Co.) construction is 88% complete and on schedule. The lowbay area was accepted for beneficial occupancy on March 31, 1965, and completion of the remaining work is scheduled for May 15, 1965.

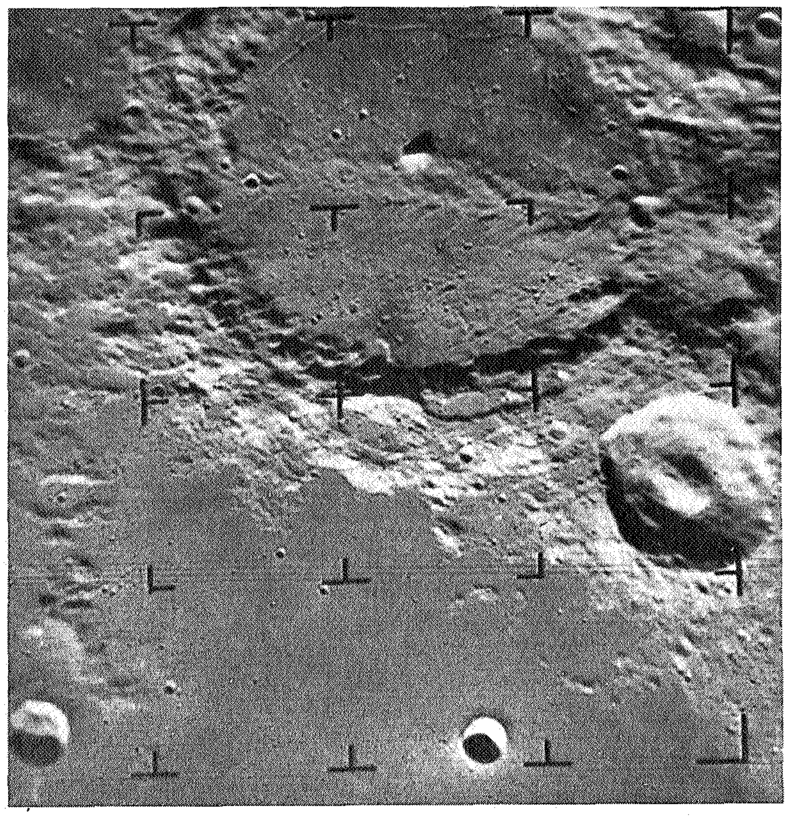
END OF MARCH

The Canberra DAF (Orral) antenna erection was virtually complete.

APRIL 1

Formal presentation of the TIROS I prototype to the Smithsonian Institution took place on the occasion of the 5th Anniversary of TIROS I.


GT-3 ORBIT TRACK (ORBITS 1-3)
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER, GREENBELT MARYLAND
CARNARVON
WOOMERA
HAWAII
CANTON ISLAND
RANGE TRACKER
ROSE KNOT
POINT ARGUELLO
WHITE SANDS
GUAYMAS
CORPUS CHRISTI
EGLIN
CAPE KENNEDY
BERMUDA
INSERT INTO ORBIT
CANARY ISLAND
ASCENSION
KANO
TANANARIVE
COASTAL SENTRY
START REVOLUTION COUNT
EQUATOR



Television picture taken by Ranges IX prior to impact on the moon on March 24, 1965 at 96 98 20 PST. The crater Alphonsus fills right half of the picture, Alpatragius is near lower left.

APRIL 9

One of the two cameras carried in the TIROS IX meteorological satellite launched January 22, 1965, was no longer taking useful pictures and failure was believed to be due to a malfunction of a diode caused by the high radiation encountered in the spacecraft's orbit which varies between 435 miles and 1605 miles above the Earth.

APRIL 9

It was announced that NASA was negotiating with the Grumman Aircraft Engineering Corp., Bethpage, N.Y., to convert the prototype Orbiting Astronomical Observatory (OAO) into a flight-ready spacecraft.

It was expected that the contract for conversion of the prototype would exceed $8 million. The prototype OAO was being used for environmental testing and systems checkout of two flight units, designated OAO A-1 and OAO B, being built by Grumman.

The converted prototype will be called OAO A-2. It will be scheduled as the third spacecraft for launch in the OAO program.

First launch of an OAO is slated for late this year or early next year from Cape Kennedy, Fla., using an Atlas-Agena rocket.

The OAO Program calls for launching 3,600-pound telescope observatories with one year life times into circular orbits 500 miles above the Earth where astronomy investigations can be conducted beyond the distorting influence of the Earth's atmosphere.

APRIL 9

It was announced that beginning with the Gemini/Titan-4 flight. The new Mission Control Center would be at the Manned Spacecraft Center, Houston.

Dr. George E. Mueller, Associate Administrator for Manned Space Flight, announced the change of primary flight control from the Mission Control Center at Cape Kennedy to the Mission Control Center of Houston.

MID APRIL

All maneuvers getting Early Bird communications satellite into its final orbit have been essentially completed. The apogee motor firing took place on 4/9 as well as reorientation of the spacecraft. On April 12, 13 and 14, a series of velocity adjustments was made and the spacecraft is on station and the drift has been nearly stopped. The declination of the spin axis is 85°. The preliminary orbital parameters are:

Apogee:	19,341.1 NM
Perigee:	19,336.2 NM
Eccentricity:	0.001
Inclination:	0.045°
Period:	23 hr 57 min 01 sec
Drift rate:	0.03/day W
Station:	27.6° W

MID APRIL
The OSO-II spacecraft has completed over 1040 orbits and all systems continued to function.

APRIL 15 - 16
The International Astronomical Union in cooperation with the Goddard Space Flight Center held a conference on the *Nature of the Surface of the moon.*

The conference, attended by some 300 scientists from throughout the world covered the following topics: Interpretation of Ranger Photographs; Crater Formation and Surface Structure; Physics and Chemistry of Lunar Surface.

APRIL 16
A contract was signed with Ball Brothers Research Corp., Boulder, Col., totalling $9,637,980 to build, integrate and test two Orbiting Solar Observatories.

Two OSO's built by Ball Brothers are now in orbit and a third is expected to be launched in the near future. The OSO program is the major solar physics effort of NASA's Office of Space Science and Applications.

The contract was awarded by the NASA Goddard Space Flight Center, Greenbelt, Md., which has technical direction of the program.

Experiments flown on the solar observatories are designed to advance understanding of the Sun's structure and behavior and the physical processes by which the Sun influences the near-Earth environment and interplanetary space.

APRIL 21
Dr. Normal Ness, a Goddard geophysicist, was among three American scientists honored by the American Geophysical Union for contributions to science. He received the John Adam Fleming award of the AGU. Dr. Ness was cited for research done with his experiments aboard Explorer 18.

APRIL 30
117 participants in the Eurospace Conference visited the Center.

MAY 2
Early Bird, the first Commercial Communications Satellite initiated transatlantic television programs. The U.S. and Europe's Eurovision conducted the initial transmissions under a pool arrangement.

MAY 4
Approximately 2400 Florida 4-H Club members in Manatee and Suwannee Counties volunteered to collect fireflies for the development of an instrument for detecting life in the upper reaches of the earth's atmosphere.

The project, dubbed "Fireflies for Research," was undertaken at the request of Goddard scientists who are developing the life detection instrument. Dr. Grace Lee Picciolo, was Goddard research scientist for the project.

MAY 6
The National Aeronautics and Space Administration and the Brazilian Space Commission agreed to cooperate in a scientific sounding rocket program.

The project, part of NASA's continuing program of cooperative space research, was a contribution to the International Cooperation Year, 1965.

Under the agreement, NASA provided and the Brazilian Space Commission (CNAE) will launch two sounding rockets from Natal, Brazil. CNAE will provide the launching range. The scientific payloads will be constructed by Brazilian technicians at Goddard Space Flight Center.

MAY 7
The final configuration of IMP C was agreed upon. The outstanding problem was the prime converter. It was decided to fly the "old" converter, serial 03, because of its excellent test history.

MAY 10
Dr. Henry Plotkin reported that another pass of Explorer XXVII was successfully tracked with 30-40% of the transmitted pulses returned. On May 5 the percentage was 80-90%.

MAY 10
The IMP C flight spacecraft was flown to Cape Kennedy, by a chartered MATS plane.

MAY 10
The spacecraft power subsystem of RELAY I recovered sufficiently to support the telemetry transmitters although the spacecraft remained in 100% sunlight.

MAY 11
A meeting was held to discuss the manning and training of the operator crews of the Apollo Aircraft fleet. It was decided that the USAF Air Training Command will provide training for the Air Force crews operating the electronics on the aircraft.

MAY 11
On-site work began on road interchange with Baltimore-Washington Parkway (Dewey Jordan, Inc.). The inbound ramp from the south and the access road were scheduled for completion by December 15, 1965. Remaining work by May 3, 1966.

MAY 12
NASA awarded a $15 mission contract to the Grumman Aircraft Engineering Corp., Bethpage, N.Y., to build an Orbiting Astronomical Observatory (OAO-C).

Grumman is prime contractor for the OAO Program. GSFC is responsible for project management.

Three other spacecraft being constructed are, OAO A-1, OAO B, OAO A-2.

The first OAO is scheduled for launch from Cape Kennedy, Fla., in winter of 1965-66 by an Atlas-Agena launch vehicle.

MID MAY

The Launch Phase Simulator building was nearing completion. Items still remaining were the steel decking for the equipment trench, simulator doors and painting of the simulator interior walls.

MID MAY

The Federal Communications Commission ruled that the Communications Satellite Corporation could control its ground stations (Andover, Maine) and circuits to the international telephone gateways (Andover to New York).

MAY 21

GSFC issued a Request for Proposals for design, development, construction and test of microwave radiometer for use in the Center's meteorological satellite programs. It will be a scanning type device to provide users with a map of the earth's temperature and will be used to measure the temperature of the earth in the microwave region.

MAY 24

ALOUETTE B spacecraft arrived at Goddard Space Flight Center for environmental testing.

MAY 25

The Saturn Pegasus B Satellite was launched from Cape Kennedy at about 03:35 a.m. EDT on Tuesday, May 25, 1965. Preflight nominal values for the principal elements of the orbit and values for these elements obtained from an orbit based upon early Minitrack data were:

	Preflight Nominal Values	*Values Based on Early Minitrack Data*
Period (minutes)	97	97
Perigee height (st. miles)	315	319
Apogee height (st. miles)	467	460
Inclination (degrees)	32	32

MAY 26

The OSO II observatory completed over 1660 orbits. All spacecraft systems continued to operate satisfactorily.

MAY 29

The Communications Satellite Corp. (COMSAT), filed with the Federal Communications Commission (FCC) a tariff of so-called "wholesale" charges to communications firms using Early Bird that will take effect June 27 unless the FCC moves to suspend or alter them.

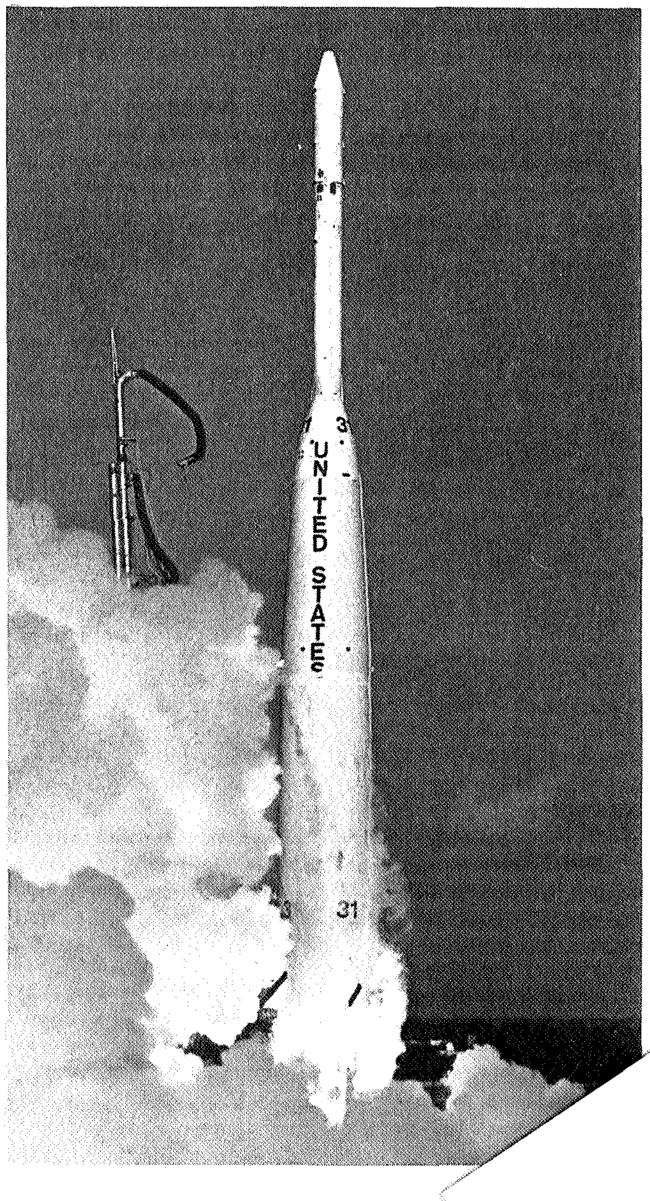
It proposed a monthly charge of $4,200 for a two-way voice channel that could be used 16-hours-a-day, seven days-a-week to transmit telephone calls, data, photographs or other signals.

Higher charges were asked for television channels. Rates ranging from $2,400 to $3,825 for the first 30-minutes of TV transmission and from $475 to $710 for each additional 15-minutes were proposed. That would cover one-way channels.

Two-way channels and color television transmission would cost an additional 50 percent under the tariff filed with the FCC.

MAY 29

The IMP C satellite was launched from Cape Kennedy at about 08:00 a.m. EDT. Preflight nominal values for the principal elements of the orbit and values for these elements obtained from an orbit based upon



The thirty-first Delta launch vehicle lifts
Kennedy on May 29 sending the IMP in

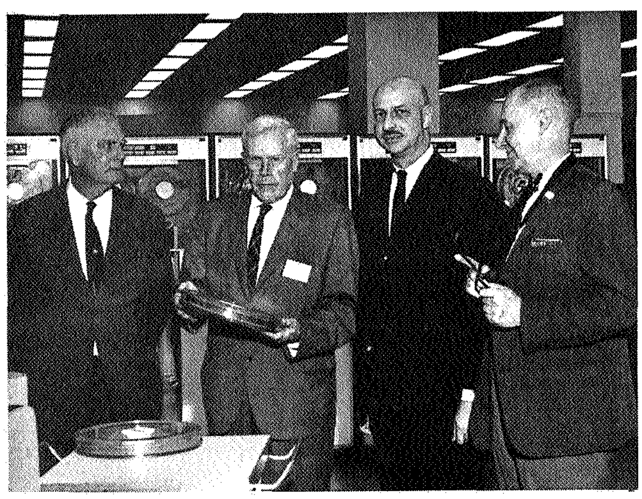
early Range and Range Rate and Minitrack data were as follows:

	Preflight Nominal Values	Values Based on Early Range and Range Rate and Minitrack Data
Period (minutes)	6,709	8,553
Perigee height (st. miles)	115	119
Apogee height (st. miles)	138,395	164,133
Inclination (degrees)	33	34

The first range and range rate data were obtained from Tananarive. The performance of this station was excellent. The range and range rate data provided by Tananarive were most valuable in connection with the early orbit determination.

MAY 29
Erection of the ROSMAN II 85' antenna was completed.

MAY 30
OSO-II passed through the path of a solar eclipse. It was not expected that the observatory saw more than 70 percent obscuration. During the eclipse orbits, the South American tracking stations (Quito, Lima, and Santiago) concentrated all of their facilities on acquiring OSO-II data. Each station made dual recordings of these passes using their redundant receiving systems. Special 5 kilowatt transmitters were utilized at Quito and Santiago to assure the transmission of playback command during these passes. The spacecraft was operated in the point mode with all wheel experiments and the NRL Chronograph pointed experiment on.



Historians Visit Goddard. Members of the NASA Historical Advisory Committee dropped by for an inspection of Goddard facilities May 21 on their first visit to a NASA center. From left are: Professor James Lea Cate of the University of Chicago; Dr. Alan T. Waterman, first Director of the National Science Foundation; Professor Melvin Kranzberg of Case Institute and Professor Wood Gray, Chairman, George Washington University.

MAY 31
GSFC facilities in College Park buildings were terminated.

EARLY JUNE
The first Radio Astronomy Explorer Design Review was held. The review was held early in the project, before detailed subsystem schematics were available therefore, it was orientated to project progress and concepts.

EARLY JUNE
The RELAY II spacecraft continued to operate satisfactorily and was in 76.5% sunlight. Both Japanese stations and the RELAY/Mojave Test Station continued to conduct spacecraft degradation experiments.

Command interference, which began about the time IMP C was launched, was experienced on five passes. The command frequency of both spacecraft was the same. Investigations were being made to see if there is correlation between commands to IMP C and interference on RELAY II. No serious effect was envisioned unless command patterns result in excessive exercising of the transponder on/time out circuitry.

The spacecraft operations as of June 2 for 3680 orbit revolutions were as follows: 1059 wideband experiments, 1061 narrowband experiments and 131 demonstrations. Transponder No. 1 has been operated for 232 hours and 57 minutes over a period of 428 operations and Transponder No. 2 has been operated for 213 hours and 18 minutes over a period of 374 operations.

EARLY JUNE
The OSO-II Observatory completed over 1780 orbits. All spacecraft systems continued to operate satisfactorily. The last pitch correction was made after 64 orbits. The pitch gas pressure was reading about 677 psi.

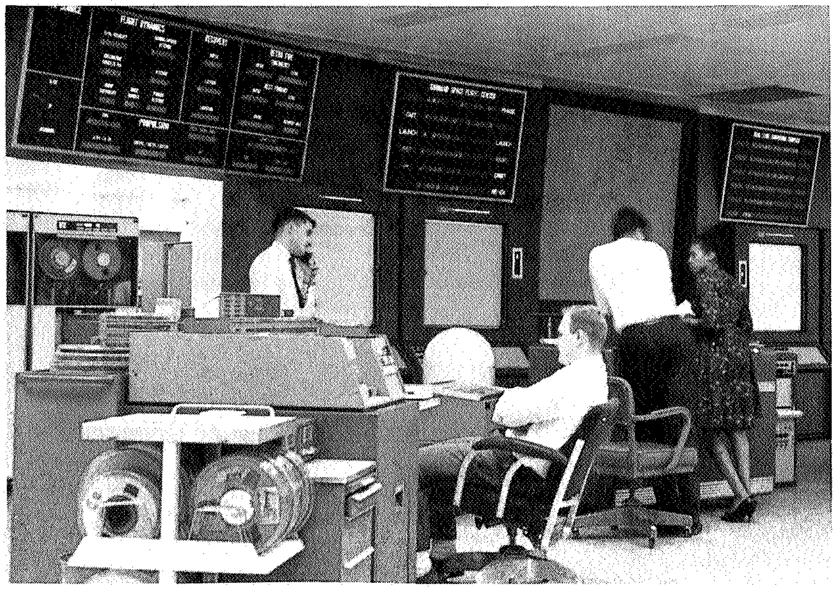
JUNE 3
Astronauts James McDivitt and Edward White were the 19th and 20th persons to rocket into space. They manned the GT-4 mission.

The 11 Russians who preceded them were Yuri Gagarin, Gherman Titov, Andrian Nikolayev, Pavel Popovich, Valery Bykovsky, Valentina Tereshkova, Vladimir Komarov, Boris Yegorov, Konstantin Feoktiskov, Pavel Belyayev and Alexei Leonov.

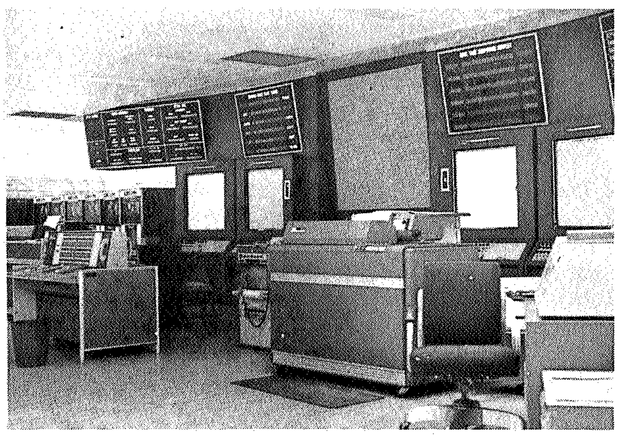
The seven previous American spacemen were Alan B. Shepard Jr., Virgil I. Grissom (twice), John H. Glenn Jr., Malcolm Scott Carpenter, Walter M. Schirra Jr., L. Gordon Cooper and John W. Young.

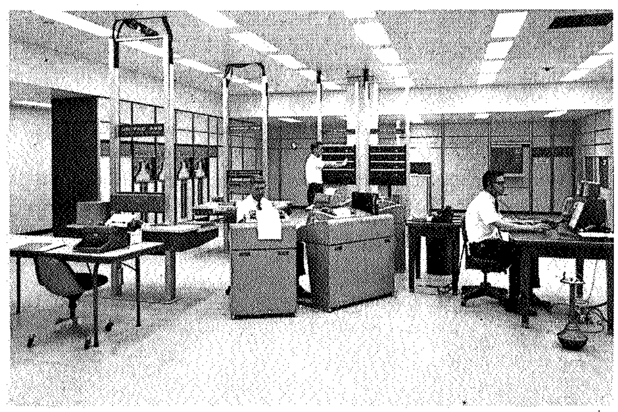
Here is a comparison of the Flights:

REALTIME COMPUTERS MAK



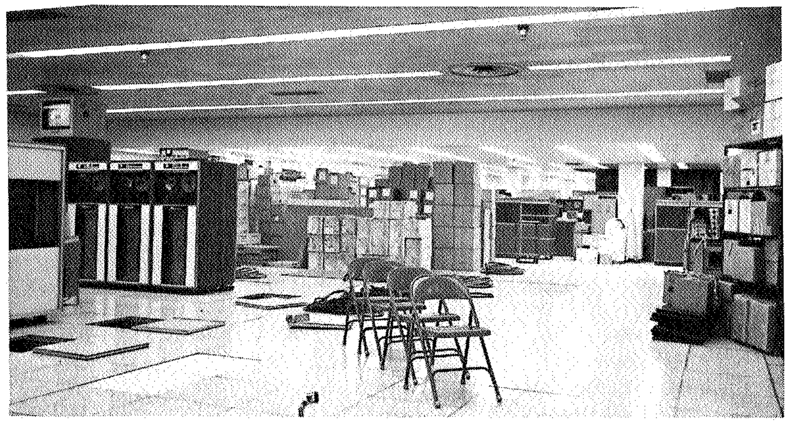
The Univac 490 Digital Message Switcher was transferred from its Building 3 location to the first floor of Building 14. The new 490 area provides greater personnel operating freedom plus expansion room for displays and peripheral equipment.



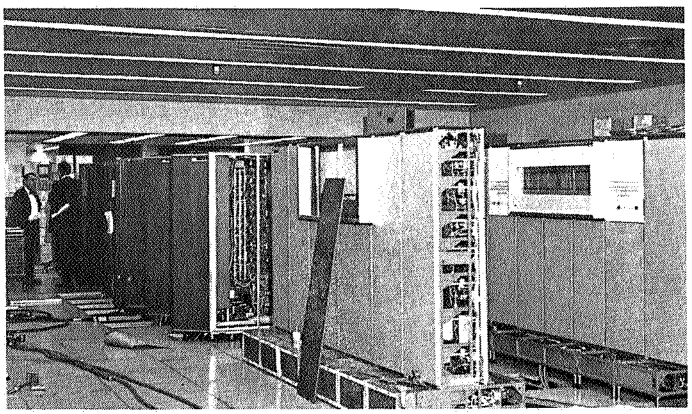


New location of the "C" computer in Building 14

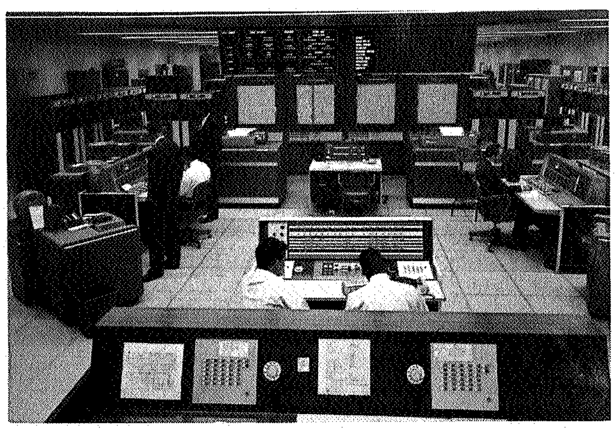
AST MOVE TO BUILDING 14



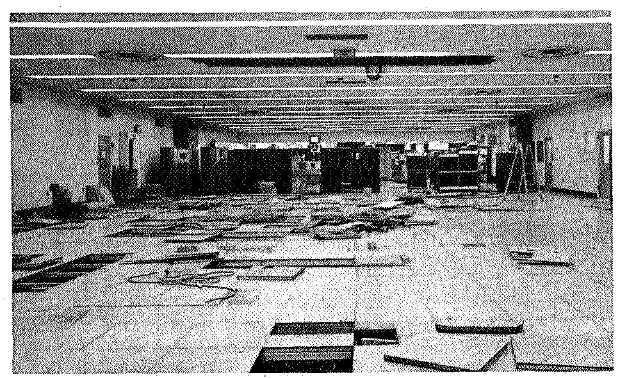
"C" Computer area prior to relocation



Moving "C" Computer memory units (far left)



Old computing location in Building 3 before move



Same view after removal

Portions of the half-million feet of interconnecting cabling required in the relocation of A, B, and C computers is seen on the false floor of Building 3.

Name	Date	Orbits	Altitude	Flight Time
Gagarin	April 12, 1961	1	110-187	1 hour 48 minutes
Shepard	May 5, 1961	(suborbit)	116	15 minutes
Grissom	July 21, 1961	(suborbit)	118	16 minutes
Titov	August 6, 1961	17	100-159	25 hours 18 minutes
Glenn	February 11, 1962	3	110-162	4 hours 56 minutes
Carpenter	May 24, 1962	3	99-167	4 hours 56 minutes
Nikolayev	August 11, 1962	64	114-156	94 hours 35 minutes
Popovich	August 12, 1962	48	112-158	70 hours 35 minutes
Schirra	October 3, 1962	6	100-176	9 hours 13 minutes
Cooper	May 15, 1963	22	100-166	34 hours 20 minutes
Bykovsky	June 14, 1963	81	107-146	119 hours 6 minutes
Tereshkova	June 16, 1963	48	113-144	70 hours 50 minutes
Komarov, Yegorov and Feoktistov	October 16, 1964	16	110-225	24 hours 17 minutes
Belyayev-Leonov	March 18, 1965	17	107-307	27 hours 2 minutes
Grissom-Young	March 23, 1965	3	100-139	4 hours 54 minutes

JUNE 3

The following organization and personnel changes were made in the Test and Evaluation Division, Office of Technical Services. John C. New and John H. Boeckel continued as Chief and Associate Chief, respectively; Fred Starbuck, former Head, Engineering Design Branch, was appointed Assistant Chief of Operations.

Additionally, the following offices were established and report to the Office of the Chief, Test and Evaluation Division: (1) Flight Program Office, formerly the Systems Evaluation Branch, with Mr. Harry D. Helfrich appointed as Head; (2) the Research and Technology Office with Mr. Dwight C. Kennard designated as Head; and (3) the Engineering Support Office with Mr. Dana S. Cope designated as Head.

JUNE 4

On the second day of GT-4, Astronauts McDivitt and White reported sighting on orbiting satellite at 21.08 GMT (5.08 p.m., EDT) at 30.1°N and 120.7°W. The North American Air Defense Command indicated that at the time of the sighting the following ten objects were in the vicinity of the spacecraft within 1000 Km.

Object	Spadat #	Time	Distance, Km.
Fragment	975	2056	439
Tank	932	2101	740
Fragment	514	2104.25	427
Omicron	646	2106.51	905
Omicron	477	2107.10	979
Fragment	726	2109.25	625
Fragment	874	2113	905
Omicron	124	2113	722
10 × 20 debris, Pegasus	1,385	2116	757
40-40 despin weight	167	2118	684

Pegasus "B" was reported to have been 2000 Km. away from the spacecraft in "a direction to be observed by the Astronauts," NORAD reported.

JUNE 10

It was announced that NASA would undertake a program to develop a more powerful Atlas space booster for future Agena and Centaur missions.

The program, designated the SLV-3X, will include the following basic changes to be made in the standard Atlas launch vehicle (SLV-3):

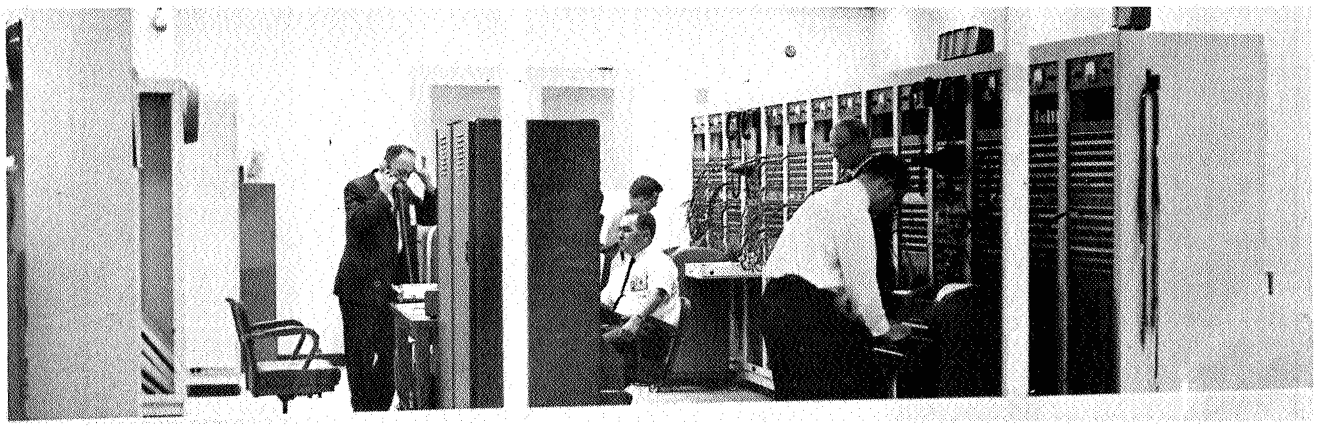
1. Propellant capacity will be increased by some 21,000 pounds by making the top of the vehicle cylindrical rather than a truncated cone. The legnth of the Atlas will not be changed but the increased tankage will enable the Atlas to carry 15,000 pounds more liquid oxygen and nearly 7,000 pounds more RP-1, a highly refined kerosene fuel.

2. Thrust of the three Atlas engines will be increased by use of an improved fuel injector and turbine. Use of a modified Saturn H-1 injector will increase the total thrust of the two booster engines from 330,000 pounds to 350,000 pounds. Use of an already-developed turbine will increase thrust of the sustainer engine from 57,000 to 65,000 pounds.

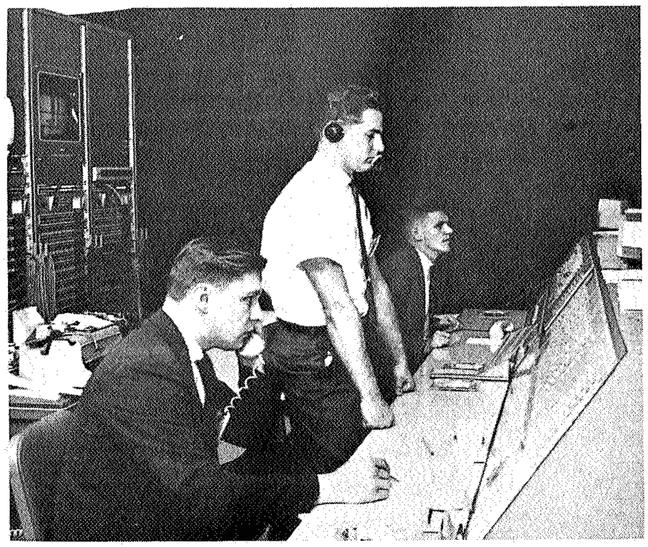
The Aeronautics and Astronautics Coordinating Board of NASA and the DOD has agreed that these modifications to the standard Atlas are consistent with the objectives of the National Launch Vehicle Program. The Atlas space booster had been successful in 32 out of its last 33 flights.

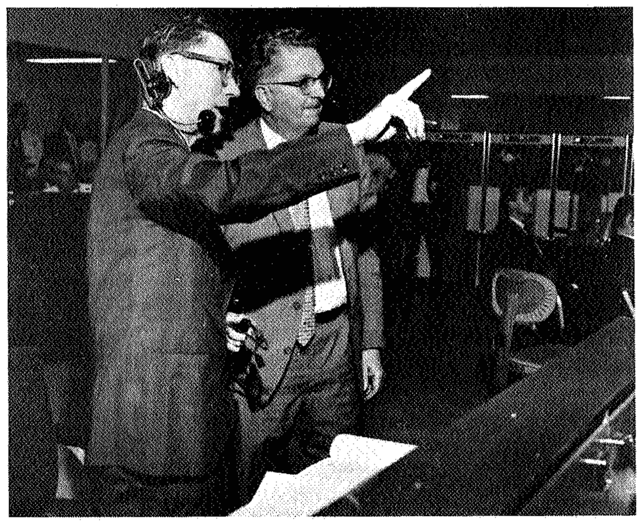
The modifications will use proven components to gain increased Atlas performance. Use of the uprated Atlas, for instance, will increase the Surveyor mission capability by 600 pounds. Similar payload increases can be expected for Lunar Orbiter, Orbiting Geophysical and Astronomical Observatories and the Applications Technology Satellite.

An extensive ground test program including full duration engine firings was planned to qualify the uprated vehicle for operational use.

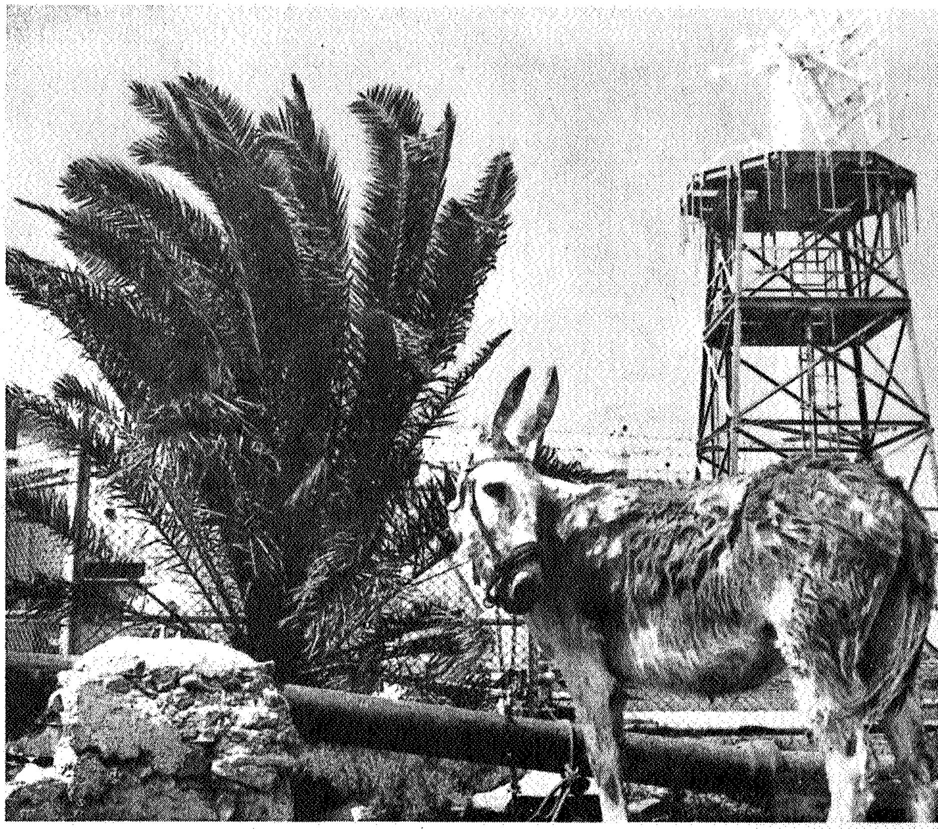


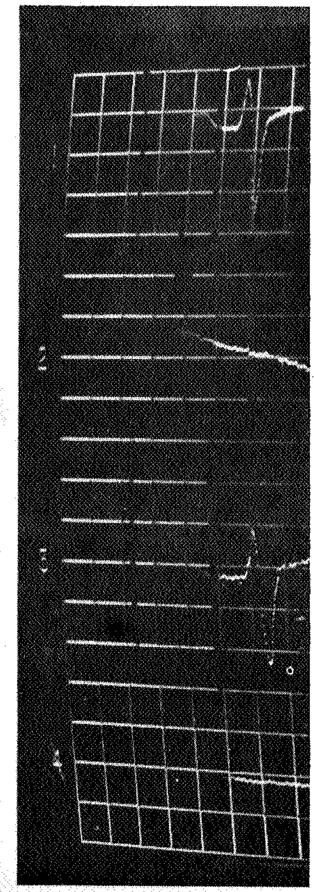
Director Harry J. Goett (right) with James Donegan.



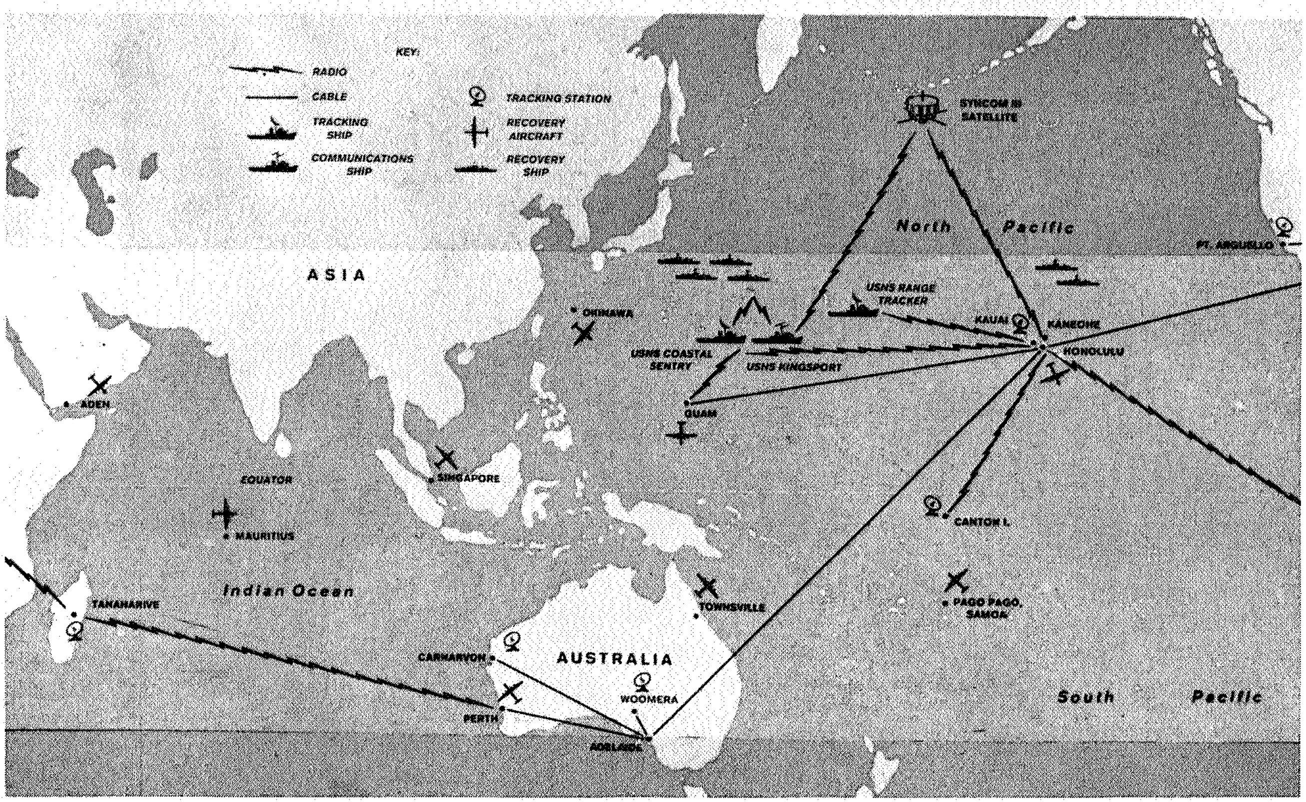


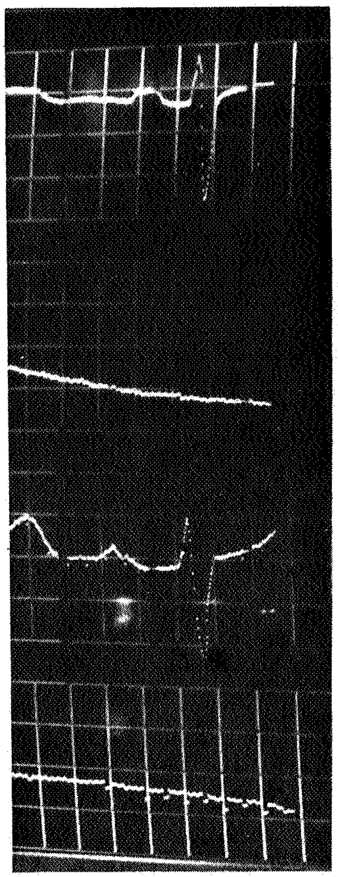
The Center Supports GT 4.





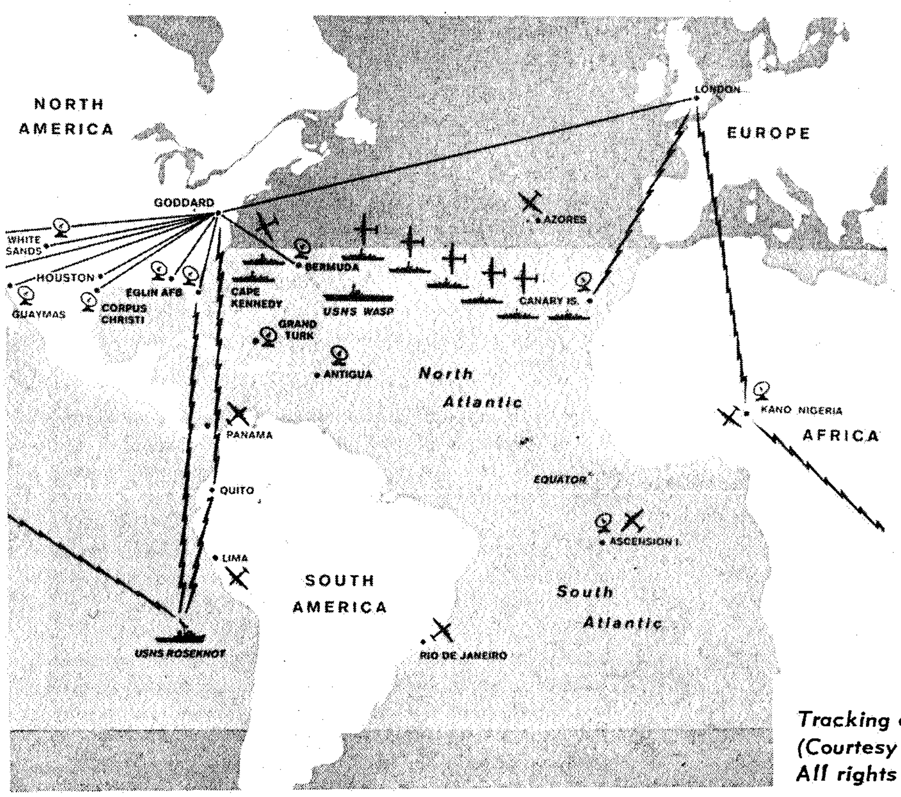
On Grand Canary Island in North Atlantic, a place of burros and tropical trees, a tracking antenna locks onto signals from the approaching spacecraft. The station talks with the Astronauts and receives data on the condition of the crew and capsule. The data is sent instantly to the Goddard computer center in the U.S. via London.





TRACKING ON AN ISLAND AND AROUND THE WORLD

Inside the Grand Canary station, Air Force Captain Bill Walter checks the medical condition of the Astronauts as they pass overhead. Signals from spacecraft are translated by computers and displayed on the console and scope (*left*), which shows heart and respiration rates of McDivitt in lines 1 and 2 and White in lines 3 and 4.



FAR-FLUNG FORCE IN CONSTANT TOUCH

This map shows the worldwide network of the tracking stations, planes and ships which kept vigil on the Astronauts. The light band shows areas over which Gemini 4 passed in its various orbits. At different times the craft came into range of 20 tracking stations spread from the Canary Islands (*see above*) to Tananarive. Data beamed from the spacecraft to the stations was relayed to the computer center at Goddard near Washington, D.C. There it was digested and fed to the Mission Control Center at Houston. If any single line of communications failed, stations could switch to back-up routes. The tracking ship in the western Pacific, the *Coastal Sentry*, could send data via nearby Guam or directly to Hawaii, or it could transmit through the communications ship *Kingsport*, which used the Syncom satellite to relay data to Hawaii. In case the spacecraft had to come down prematurely, six ships in the Pacific, 12 in the Atlantic and 43 land-based aircraft with rescue crews were on a constant alert.

Tracking on an Island and Around the World— (Courtesy LIFE Magazine (c) 1965 Time Inc.

JUNE 10 – 11

A meeting was held at the Goddard Center among organizations which had performed laser tracking experiments with NASA's Beacon Explorer satellites, Explorer 22 and 27. The organizations participating were:

Goddard Space Flight Center
DSIR, Radio Research Station, England
Service D'Aeronomie, CNRS, France
Air Force Cambridge Research Laboratory
General Electric Company
Bell Telephone Laboratories.

Explorer 22 was launched on October 4, 1964 and Explorer 27 on April 20, 1965.

The investigators presented results of tracking both of the Beacon Explorer satellites in which reflections from the target were received regularly. Over 260 reflections and range determinations could be obtained during a single pass, thus the difficulty of aiming with the necessary accuracy seemed to be coming under the control of new telescopes being developed for this purpose. The consistency of these returns also appeared to allay some of the fears as to how damaging the atmosphere would be for laser propagation. Both the French team and Goddard Space Flight Center have been analyzing the accuracy of range determinations obtained using laser tracking. These seem to be in agreement with previous calculations. An orbit for Explorer 22 derived by the French team from several laser reflections coincided very closely with the orbit for that same satellite determined by the Smithsonian Astrophysical Observatory using all the conventional tracking methods available to it. The Air Force representative described an experiment performed in Cambridge by which several photographs of the reflected laser light were obtained.

The English, General Electric and Goddard reported the reflected signal strength received from S-66 was in agreement with theory.

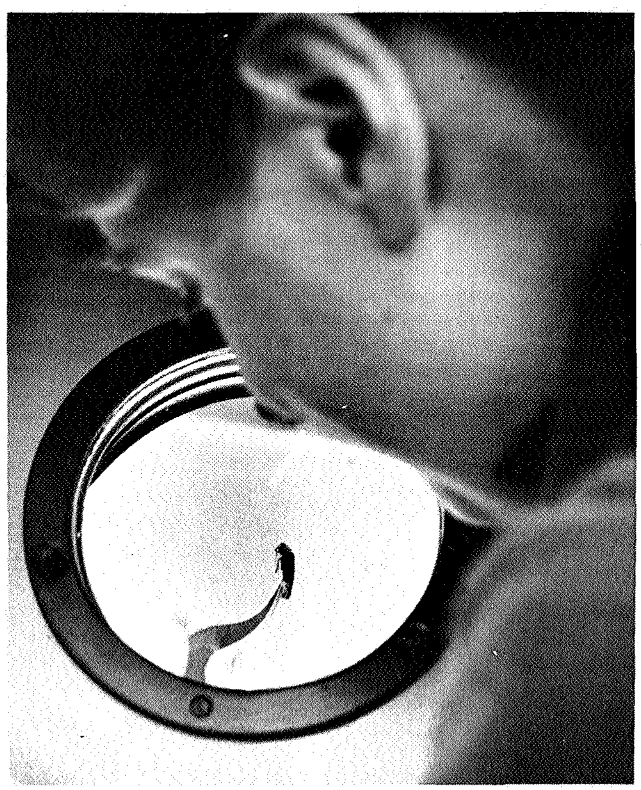
Dr. Henry Plotkin directs the Laser Research program at Goddard.

JUNE 14

A Washington D.C. commercial radio station provided a bonus experiment for a versatile sounding rocket payload.

Radio Station WTOP went on the air about a half hour earlier than usual to transmit a steady modulated tone for several minutes during the flight of the sounding rocket. The Nike Apache rocket was launched from NASA's Wallops Station, Wallops Island, Va., at 5:14 a.m. EDT, and the 55-pound instrumented payload rose to a peak altitude of 110 miles.

Scientists of the University of Illinois and the GCA Corp., Bedford, Mass., were interested in measuring the interaction (cross-modulation effects) of the WTOP signal on a signal of different frequency being transmitted from a Wallops ground transmitter as the payload and its radio receiver climbed into the ionosphere.



Dr. Grace Lee Picciolo, a GSFC life scientist examines a firefly. The tail lantern of this insect is being used along with those of many others in the development of a life detection instrument.

Cross-modulation occurs when a small portion of a radio wave of one frequency is impressed on a wave of different frequency. A delicate receiver can detect this and measure the amount impressed. The special WTOP transmission permitted scientists to get the maximum usefulness out of the electronics aboard the sounding rocket payload by performing an additional experiment.

The main purpose of the rocket flight was to study the lower portions of the ionosphere, the regions called D and E, as part of the United States participation of the International Quiet Sun Year.

The electron density of the lower ionosphere was measured by three techniques: differential absorption, Faraday rotation and a direct current probe. A novel feature was the receiver aboard the payload. It was designed to measure differential absorption by sending control signals to the ground to continuously increase the strength of the main Wallops transmitter signal as the rocket traveled upward. Also measured were absorption profiles of solar Lymanalpha radiation and a band of ultraviolet. Supporting instrumentation included magnetic and solar aspect sensors.

MID JUNE

The 22-nation European Post and Telecommunications Congress ended its 12-day meeting. A coordinating committee to deal rapidly with problems arising out of international radio and television communications by satellite.

The committee to handle satellite communications problems included representatives from West Germany, Belgium (with the Netherlands), the Scandinavian countries as a group, Spain (with Portugal), France (with Monaco), Italy, Britain (with Iceland) and Switzerland (with Austria).

A special working committee on satellite communications had agreed to the U.S. Communications Satellite Corporation's proposed telephone single circuit rental rate by satellite of $64,000 annually. Approval of this rate would continue until the end of 1965 when it would be subject to review.

The group did not consider that both telephone and TV circuits by the Early Bird satellite would be feasible before the end of 1965.

MID JUNE

The Japanese, Spanish and Mojave Ground Stations performed communications tests and the Scandinavian Station began a series of tracking tests all involving RELAY II.

JUNE 18

It was announced that NASA would negotiate with Lockheed Missiles & Space Co., Sunnyvale, Calif., for mission modifications on seven Agena-D second stages for future missions. Total cost of the modi-modification to be more than $13 million.

Five of the Agenas were planned for use with Atlas boosters to launch the Applications Technology Satellites. The other two, also to be boosted by Atlas launch vehicles, to be used for the third and fourth Orbiting Astronomical Observatories.

The Contracts under negotiation call for Lockheed to design, develop, and fabricate mission peculiar equipment and to match the Agenas with the Atlas boosters and the spacecraft.

NASA's Lewis Research Center, Cleveland, had management responsibility for Agena launch vehicles systems, payloads, and spacecraft launchings were the responsibility of the responsibility of the Goddard Space Flight Center.

JUNE 19

TIROS VII attained 2 years of operation with both cameras and the IR system providing useful information.

JUNE 21

Dr. Harry J. Goett, Goddard's Director announced to a staff meeting that the Center was planning a major reorganization. He announced that Dr. John W. Townsend, Jr., was to be named Associate Director for Research and Development with Mr. Eugene Wasielewski continuing in his capacity. Also announced was the establishment of the following new directorates: Space Science, Dr. George F. Pieper; Projects, Dr. John Townsend (acting); Technology, Daniel G. Mazur. The Tracking and Data Systems Directorate under John T. Mengel and the Office of Administration under Dr. Michael J. Vaccaro were not affected by these organizational changes.

JUNE 23

The International Business Machines Corp., Federal Systems Division, Bethesda, Md., was selected for negotiations leading to the procurement of a super speed computing complex to be located at Goddard Space Flight Center.

The initial procurement was to be about $8 million and with exercise of all contract options it was expected to come to about $18 million.

The proposed contract also called for an additional super speed system to be installed at the Goddard Institute for Space Studies in New York City.

Specifications called for the computer to have a data processing speed up to 40 times faster than computers previously installed at GSFC and the Goddard Institute. As such, the system would replace certain Goddard computers having specialized applications. It was to combine within one complex the operations for scientific engineering calculation, orbital computation, scientific data analysis, manned space flight mission support, and spacecraft experiment control.

JUNE 25

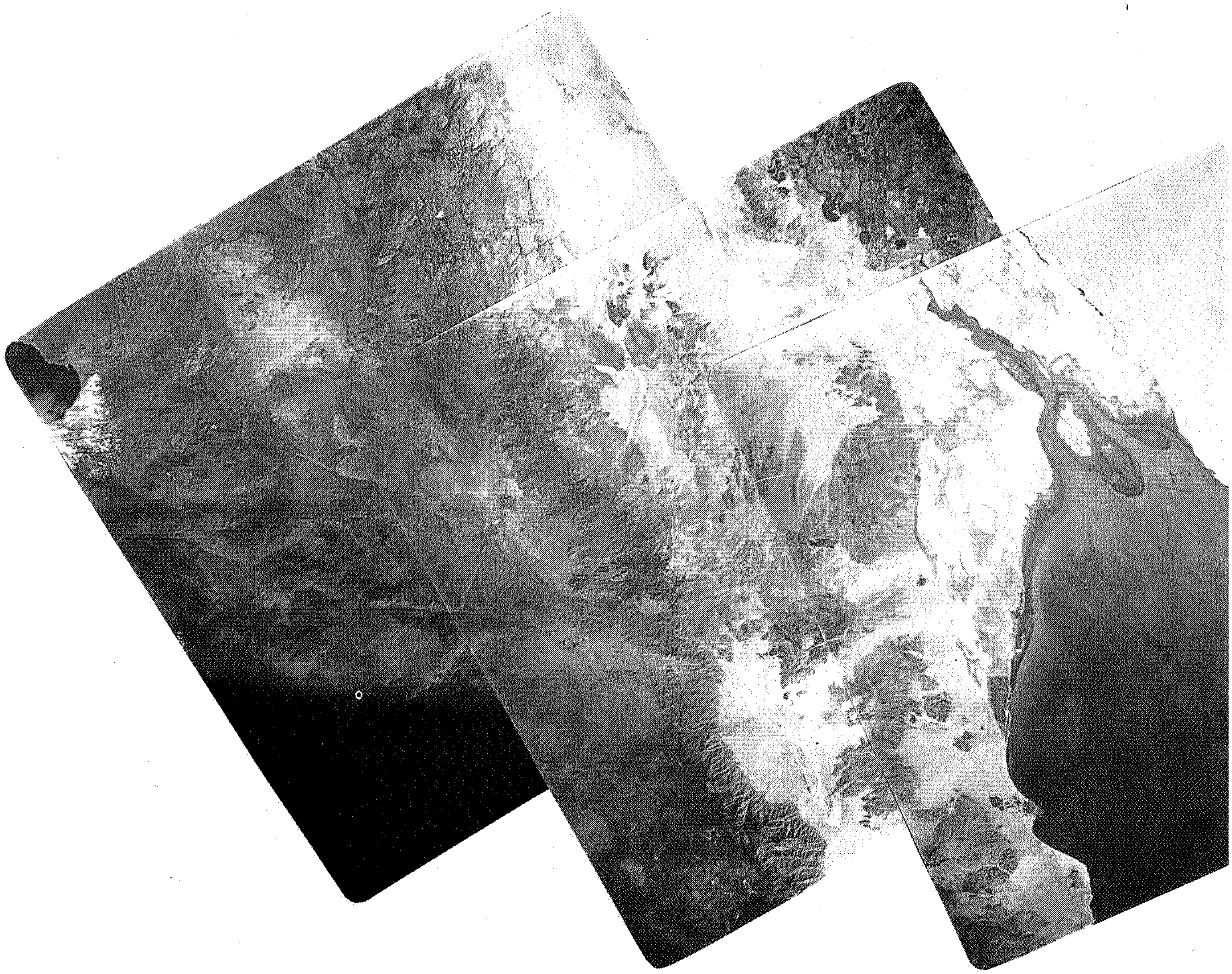
A Network Support Office was established in the Tracking & Data Systems Directorate. The new Office was to report to the Assistant Director for Tracking and Data Systems. Ralph L. Hicks was appointed Chief, Network Support Office.

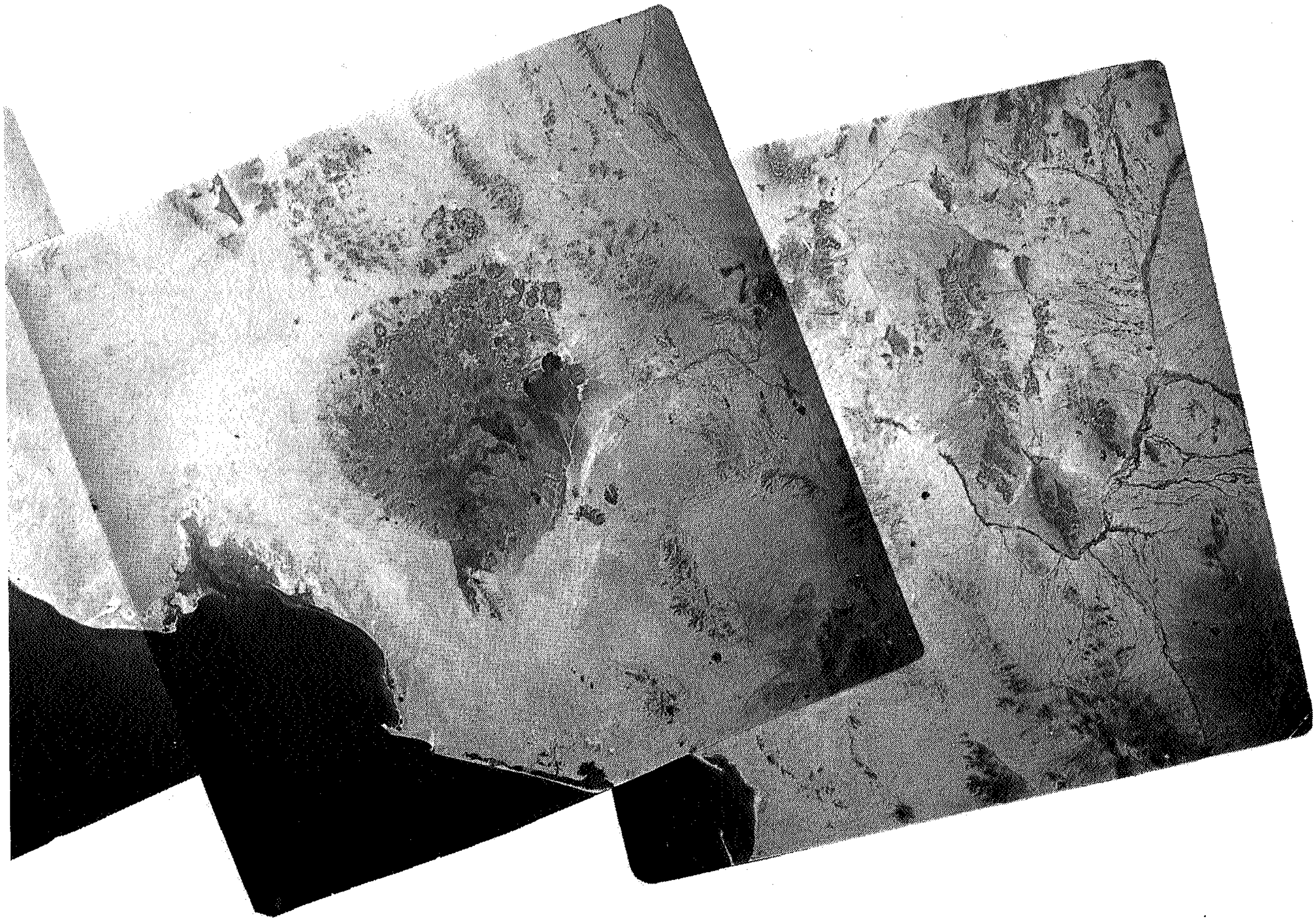
JUNE 25,

Prototype spacecraft integration started of Advanced IMP (D&E) started. Mission Profile and Real Time Computing System Description.

JUNE 30

After 44 days under vacuum and solar simulation, in the Center's test facilities the project Assess (spacecraft Ariel II backup) test portion came to a close. The spacecraft "flew" 83 simulated days of orbital life. It "saw" 445 sunrises, going into its mode 2 operation on each sunrise and received and executed 539 playbacks. 315 of these playbacks occurred before the cold portion of the orbit (35° aspect, 65% sun time) when the recording of data became sporadic and then failed. A similar (though less severe) malfunction was noted in orbit. These faults were not unexpected since the temperatures the spacecraft experienced in both orbit and test were below the tape recorder minimum design limits.





Fifteen Thousand Square mile mosaic of the first five of thirty nine photographs taken by Astronauts McDivitt and White. The sequence shows northern Mexico, Southern Arizona, New Mexico and West Texas. The estuary is the Colorado River emptying into the Gulf of California.

JUNE 30

Design of the NASA Space Science Data Center was proceeding on schedule with 50% complete drawings and specifications to be received for review.

JUNE 30

Status of Data from TIROS Satellites

	VII	*VIII*	*IX*
Orbit	10,994	8,094	1,942
Picture total	112,118	80,840	60,198
Total usable (%)	103,598	75,069	56,493
	(92.4)	(92.8)	(93.8)
Nephanalyses	3,632	2,625	4,812
Storm Bulletins	588	697	788
IR orbits received	3,949	—	—
IR orbits digitized	2,682	—	—
IR orbits non-digitizable	1,070	—	—
IR orbits in process	197	—	—
Grand Total of All TIROS Pictures	508,857		

Archival Status

TIROS I-VI – All usable pictures archived.
TIROS VII – All pictures up to orbit 10,263 (93%)
TIROS VIII – All pictures up to orbit 7,235 (90%)
TIROS IX – All pictures up to orbit 490 (25%)

EARLY JULY

The Early Bird Communications Satellite was in commercial service and performing satisfactorily.

JULY 2

Tiros X, the first operational weather satellite was launched from Cape Kennedy. Orbital elements were 467 st. miles perigee, 520 st. miles apogee, orbital period 100 minutes. Tiros X (OT-1) was one of three weather satellites purchased by the U.S. Weather Bureau. To date the Tiros weather satellite program consisted of the following milestones:

Tiros 1: Launched April 1, 1960. It proved that cloud cover information provided by a satellite was useful in describing atmospheric motions.

Tiros 2: Launched Nov. 23, 1960. This included infrared sensors which showed a relationship between temperatures provided by the satellite and cloud heights.

Tiros 3: Launched July 12, 1961. This provided excellent hurricane coverage in the summer of 1961. For example, in one 24-hour period it showed up five hurricanes and two typhoons.

Tiros 4: Launched Feb. 8, 1962. The Canadians cooperated in this project to provide ice reconnaissance of the St. Lawrence River during the late winter and early spring of 1962.

Tiros 5: Launched June 19, 1962. It was thrown into a higher than usual orbit to give pictures from the higher latitudes.

Tiros 6: Launched Sept. 18, 1962. This was the first partly operational Tiros satellite, rather than a just research and development project. Its purpose was to give continuity to the data obtained in the hurricane season of 1962.

It was used in Project Swift Strike, a United States Army cold-region maneuver. And it was called on in the Mercury flights of Astronauts Walter M. Schirra and L. Gordon Cooper to provide information on cloud-free areas where recovery could be made.

Tiros 7: Launched June 19, 1963. By extending the range of coverage it brought close the prospect of global coverage. It proved that it would be possible by two such satellites to cover the earth.

Tiros 8: Launched Dec. 21, 1963. This shot included the first use of the automatic picture transmission system.

Tiros 9: Launched Jan. 22, 1965. This satellite was flown in a cartwheel configuration, making it the first Tiros to provide pictures of the entire globe on a daily basis. It thus foreshadowed the TOS series of Tiros satellites to be initiated by the Weather Bureau in the fall of 1965.

JULY 7

The free world's most advanced magnetic facility for testing spacecraft became operational at the Goddard Center.

The new facility created the controlled magnetic environment necessary for testing and calibrating spacecraft instruments intended to measure the low magnetic fields in outer space.

The facility was also equipped to de-magnetize the spacecraft carrying the magnetic measuring instruments. The inherent magnetic field of such spacecraft often is stronger than the space magnetic field being measured by the airborne instruments.

Project manager for the facility is William G. Brown of Goddard's Test and Evaluation Division.

JULY 8

NASA completed transfer of control of Syncom II and Syncom III to the Department of Defense.

MID JULY

The Goddard Communications Technical Office was participating in the Mariner-Mars Encounter operations which commenced on July 14, at approximately 0932Z, with Johannesburg, South Africa acquisition of the spacecraft. Throughout a series of commands initiated from Johannesburg, communications remained excellent. Communications circuits were in operation during all critical acquisition and command periods.

The Center continued to participate in the Mariner mission during the picture transmission sequences estimated to last ten days.

JULY 15

NASA announced negotiations with Republic Aviation Corp., Farmingdale, L.I., New York, for Phase II development of the Advanced Orbiting Solar Observatory (AOSO).

A contract for approximately $60 million was to be signed by Goddard and Republic.

Phase II work on the observatory provided for Republic to furnish two flight spacecraft and a prototype. This included final development and design, checkout, experiment integration, and launch support for the 1250 pound AOSO. Work on the Phase I portion of the AOSO project was completed in July of 1965.

In addition to Republic Aviation, major subcontractors participating in the program include: Honeywell, Inc., Minneapolis; stabilization and control system, and Texas Instruments, Inc., Dallas, communication and data handling system.

JULY 19

Contract negotiations with Douglas Aircraft Corp., Santa Monica, California, for Delta space booster launch support service were announced. The contract was expected to be about 12 million dollars.

The new contract was to cover an anticipated 15 launchings from launch sites at Cape Kennedy and Western Test Range for a 12 month period beginning January 1, 1966. It was to provide for inspection and checkout as well as the actual launch of Delta's from Cape Kennedy and from NASA's new Delta LAUNCH FACILITY at Vandenberg Air Force Base in California.

The Douglas Aircraft Facility was prime contractor for NASA's Delta space system. The vehicle had launched more NASA satellites than any other booster and had a success ratio of 90% with 30 successful launches out of 32 attempts.

JULY 19

NASA and Federal German Ministry for Scientific Research (BMwF) announced the signing of a Memorandum of Understanding for cooperation in a program of space research on the Earth's radiation belts. The program contemplates the placing of a German scientific satellite in a polar orbit in 1968.

Primary objective of the program is a study of the Earth's inner radiation belt. Also to be studied are electrons in the outer radiation zone and solar proton events.

The first phase of the program consists of launchings of sounding rockets and balloon flights to test the instrumentation for the German experiments.

The BMwF experimenters include scientists from the Max-Planck Institute for Physics and Astrophysics (near Munich), the University of Kiel and the Max-Planck Institute for Aeronomy (near Göttingen).

The satellite will be designed and constructed in Germany and launched from the Western Test Range in California on a Scout vehicle provided by NASA.

No exchange of funds between the two organizations is contemplated. Results of the experiments will be made available to the world scientific community.

JULY 20

The systems testing of OAO Prototype was completed at Grumman Aircraft Corporation (contractor) and the spacecraft was shipped to GSFC. The prototype was to be used in connection with scheduled ground complex tests.

JULY 22

The National Aeronautics and Space Administration announced three organizational changes at Goddard Space Flight Center:

Dr. Harry J. Goett, Director of Goddard, will become Special Assistant to NASA Administrator James E. Webb, effective immediately.

Dr. John F. Clark, Director of Science in the Office of Space Science and Applications, will become Acting Director, Goddard Space Flight Center.

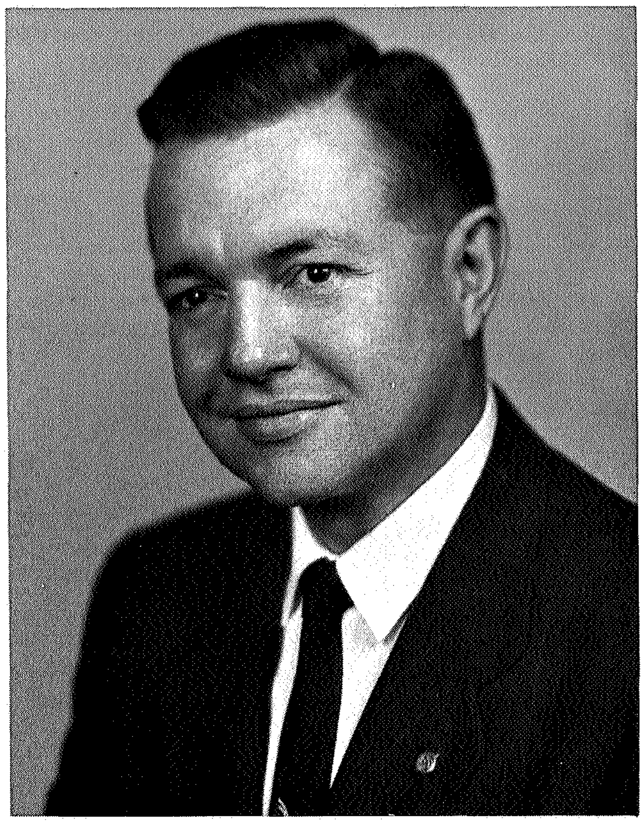
Dr. John W. Townsend, Jr., Assistant Director of GSFC's Office of Space Science and Satellite Applications, will become Deputy Director of Goddard. The position of Deputy Director is a new post at the Center. Eugene W. Wasielewski will continue as Associate Director.

Dr. Goett, who plans to retire from Civil Service next July, will assist the Administrator in carrying out a number of inter-agency and intra-agency scientific responsibilities and functions. He will represent the Administrator in discussions on scientific personnel before the Federal Council on Science and Technology.

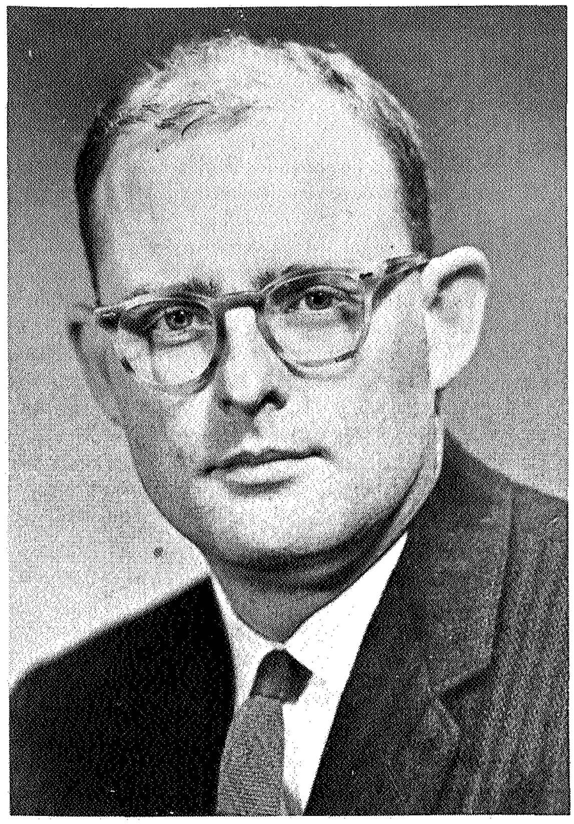
Dr. Goett was appointed Director of the Goddard Space Flight Center in September 1959, after a 25 year career in the field of aeronautical engineering and astronomical research. As Director, he held responsibility for all of Goddard's missions and objectives in the field of space flight and scientific and satellite programs and projects. These include: design and development of scientific, communications, and weather satellites; sounding rockets; and two world-wide tracking networks for manned and scientific space missions.

During Dr. Goett's tenure as Center Director, some 36 Goddard satellite projects carrying over 100 scientific experiments were successfully placed into orbit. These projects also included NASA's first international satellites.

Dr. Goett came to Goddard directly from Ames Research Center, Moffett Field, California, where he was Chief of the Full-Scale and Flight Research Division from 1948 to 1959. He has been associated with the technical and administrative supervision of research in aerodynamic and engineering problems encountered in flight ever since 1936 when he joined NASA's Langley Aeronautical Laboratory in Virginia as a project engineer.



Dr. John F. Clark
Acting Director



Dr. John W. Townsend
Deputy Director

Dr. Clark was NASA's Director of Geophysics and Astronomy Programs. He served consecutively as Chief, Ionospherics Physics Programs; Chief, Planetary Science Programs; and Chief, Geophysics Programs (Satellite and Sounding Rocket Programs).

From 1954 to 1958, Dr. Clark served as Head of the Atmospheric Electricity Branch in the Atmospheres and Astrophysics Division, Naval Research Laboratory.

Dr. Clark was born in Reading, Pennsylvania, on December 12, 1920. He received his BS Degree in Electrical Engineering (with honors) in 1942 from Lehigh University; his MS Degree in mathematics from George Washington University (1946) and his Ph.D. in physics from the University of Maryland in 1956.

JULY 24

Bermuda Radar transmission facilities to Cape Kennedy were completed. All engineering has been completed and orders were transmitted to give the IP Computers at Cape Kennedy access to the high speed Bermuda radar data.

JULY 26

Robert E. Bourdeau was appointed Acting Assistant Director for Projects.

JULY 27

The following announcement was issued by Dr. John F. Clark, Acting Director.

"Dr. Harry J. Goett built this Center from its original nucleus of some 200 persons into the present vigorous and effective organization of over 3700 employees. We have a distinguished record of thirty-seven successful major spacecraft launches in seven years to live up to. With this in mind, I hope to enlist the cooperation of each of you in working toward the common goal of maintaining and expanding Goddard's vital contributions to this Nation's space program. Dr. Townsend, our Deputy Director, Mr. Wasielewski, our Associate Director, and I need your full support.

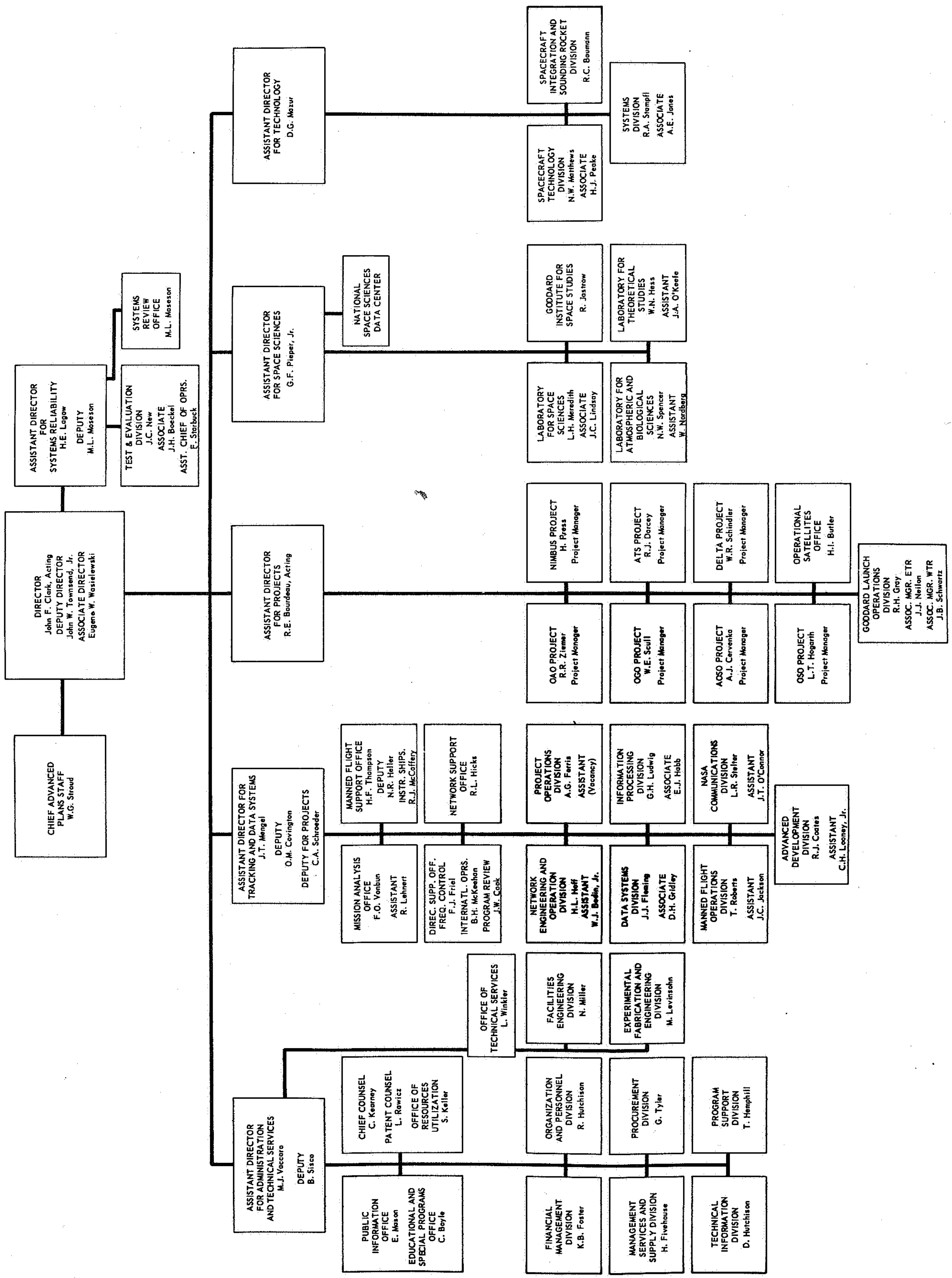
"In accordance with action of the Administrator on July 26, 1965, organization and personnel changes are immediately effected at the Goddard Space Flight Center.

DURING JULY

The Advanced Orbiting Solar Observatory received approval as a flight program.

LATE JULY

The archiving of Nimbus I AVCS and HRIR film data was completed. Work copy negatives and positives, of high quality, were on file to fill both AVCS and HRIR


DIRECTOR
John F. Clark, Acting
DEPUTY DIRECTOR
John W. Townsend, Jr.
ASSOCIATE DIRECTOR
Eugene W. Wasielewski
CHIEF ADVANCED PLANS STAFF
W.G. Stroud
ASSISTANT DIRECTOR FOR SYSTEMS RELIABILITY
H.E. Lagow
DEPUTY
M.L. Moseson
SYSTEMS REVIEW OFFICE
M.L. Moseson
TEST & EVALUATION DIVISION
J.C. New
ASSOCIATE
J.H. Boeckel
ASST. CHIEF OF OPRS.
F. Starbuck
ASSISTANT DIRECTOR FOR TECHNOLOGY
D.G. Mazur
SPACECRAFT INTEGRATION AND SOUNDING ROCKET DIVISION
R.C. Baumann
SPACECRAFT TECHNOLOGY DIVISION
N.W. Matthews
ASSOCIATE
H.J. Peake
SYSTEMS DIVISION
R.A. Stampfl
ASSOCIATE
A.E. Jones
ASSISTANT DIRECTOR FOR SPACE SCIENCES
G.F. Pieper, Jr.
NATIONAL SPACE SCIENCES DATA CENTER
GODDARD INSTITUTE FOR SPACE STUDIES
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LABORATORY FOR THEORETICAL STUDIES
W.N. Hess
ASSISTANT
J.A. O'Keefe
LABORATORY FOR SPACE SCIENCES
L.H. Meredith
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J.C. Lindsay
LABORATORY FOR ATMOSPHERIC AND BIOLOGICAL SCIENCES
N.W. Spencer
ASSISTANT
W. Nordberg
ASSISTANT DIRECTOR FOR PROJECTS
R.E. Bourdeau, Acting
NIMBUS PROJECT
H. Press
Project Manager
ATS PROJECT
R.J. Darcey
Project Manager
DELTA PROJECT
W.R. Schindler
Project Manager
OPERATIONAL SATELLITES OFFICE
H.I. Butler
GODDARD LAUNCH OPERATIONS DIVISION
R.H. Gray
ASSOC. MGR. ETR
J.J. Neilon
ASSOC. MGR. WTR
J.B. Schwartz
OAO PROJECT
R.R. Zimmer
Project Manager
OGO PROJECT
W.E. Scull
Project Manager
AOSO PROJECT
A.J. Cervenka
Project Manager
OSO PROJECT
L.T. Hogarth
Project Manager
ASSISTANT DIRECTOR FOR TRACKING AND DATA SYSTEMS
J.T. Mengel
DEPUTY
O.M. Covington
DEPUTY FOR PROJECTS
C.A. Schroeder
MANNED FLIGHT SUPPORT OFFICE
H.F. Thompson
DEPUTY
N.R. Heller
INSTR. SHIPS.
R.J. McCaffery
NETWORK SUPPORT OFFICE
R.L. Hicks
PROJECT OPERATIONS DIVISION
A.G. Ferris
ASSISTANT
(Vacancy)
INFORMATION PROCESSING DIVISION
G.H. Ludwig
ASSOCIATE
E.J. Habib
NASA COMMUNICATIONS DIVISION
L.R. Stelter
ASSISTANT
J.T. O'Connor
ADVANCED DEVELOPMENT DIVISION
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ASSISTANT
C.H. Looney, Jr.
MISSION ANALYSIS OFFICE
F.O. Vonbun
ASSISTANT
R. Lehnert
DIREC. SUPP. OFF.
FREQ. CONTROL
F.J. Friel
INTERNATL. OPRS.
B.H. McKeehan
PROGRAM REVIEW
J.W. Cook
NETWORK ENGINEERING AND OPERATION DIVISION
H.L. Hoff
ASSISTANT
W.J. Bodin, Jr.
DATA SYSTEMS DIVISION
J.J. Fleming
ASSOCIATE
D.H. Gridley
MANNED FLIGHT OPERATIONS DIVISION
T. Roberts
ASSISTANT
J.C. Jackson
ASSISTANT DIRECTOR FOR ADMINISTRATION AND TECHNICAL SERVICES
M.J. Vaccaro
DEPUTY
B. Sisco
OFFICE OF TECHNICAL SERVICES
L. Winkler
FACILITIES ENGINEERING DIVISION
N. Miller
EXPERIMENTAL FABRICATION AND ENGINEERING DIVISION
M. Levinsohn
CHIEF COUNSEL
C. Kearney
PATENT COUNSEL
L. Rowicz
OFFICE OF RESOURCES UTILIZATION
S. Keller
ORGANIZATION AND PERSONNEL DIVISION
R. Hutchison
PROCUREMENT DIVISION
G. Tyler
PROGRAM SUPPORT DIVISION
T. Hemphill
PUBLIC INFORMATION OFFICE
E. Mason
EDUCATIONAL AND SPECIAL PROGRAMS OFFICE
C. Boyle
FINANCIAL MANAGEMENT DIVISION
K.B. Foster
MANAGEMENT SERVICES AND SUPPLY DIVISION
H. Fivehouse
TECHNICAL INFORMATION DIVISION
D. Hutchison

data requests. Over 239 requests from various Government agencies, academis institutions, foreign users and commercial/industrial concerns have been filled since October 1964.

DURING JULY

Good quality data was being received regularly from TIROS X. Quality data was being received from TIROS VII and VIII, however, these spacecraft were being programmed only on an average of once per day. Remote pictures from TIROS IX, camera system 2, exhibited RF interference to the extent that the pictures were in the most part unusable. Direct mode pictures was normal.

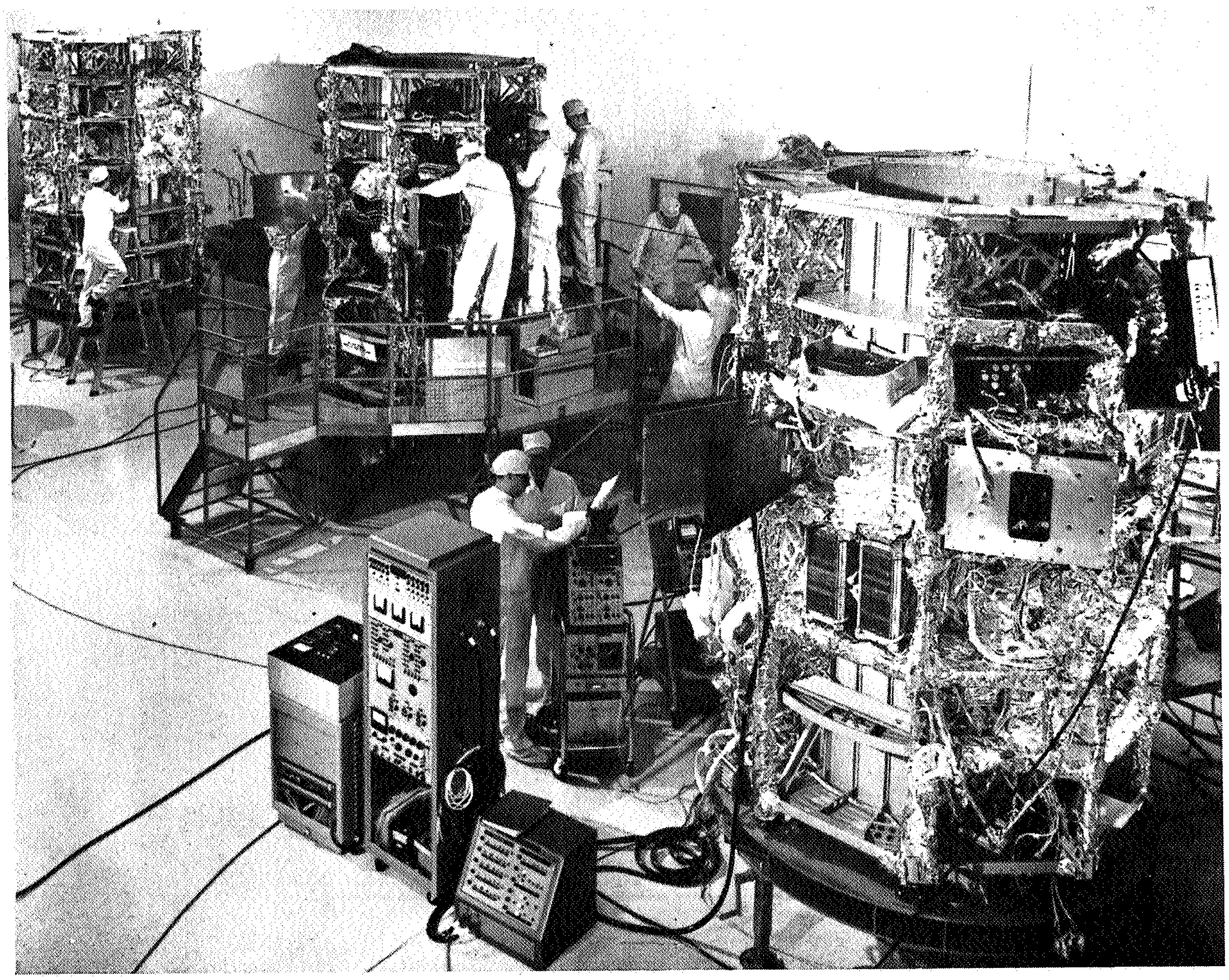
DURING JULY

The second phase of the Remote Operations Experiments (ROE) to transmit pictures from Wallops and Fairbanks to NWSC was in process. All pictures received at both sites were transmitted in near-realtime.

JULY 29

TIROS Spacecraft Status:

1. TIROS VII—The spacecraft was interrogated on two orbits per day during this report period. Five readouts of direct pictures and seven command telemetry readouts were recorded. All spacecraft systems functioned normally. The spacecraft has been in orbit for 769 active days.
2. TIROS VII—was interrogated on two orbits per day for power consumption purposes. The spacecraft was in 100% sun time. All spacecraft systems functioning normally. The spacecraft has been in orbit 584 active days.
3. TIROS IX—On July 25, 1965, after approximately 186 days in orbit, noisy pictures were transmitted. It appeared that one of the onboard tape recorders was malfunctioning.
4. TIROS X—As of July 24 TIROS X assumed top priority and was being interrogated 11 orbits per



The Orbiting Astronomical Observatory under Construction day. This spacecraft has been in orbit for approximately 25 days and has transmitted 1814 usable pictures.

JULY 30

The Pegasus C Saturn Satellite was launched from Cape Kennedy at about 9:00 a.m., E.D.T. Preflight nominal values for the principal elements of the orbit and valued for these elements based upon early Minitrack data were as follows:

	Preflight Nominal Values	*Values Based on Early Minitrack Data*
Period (min.)	95	95
Perigee height (st. mi.)	330	323
Apogee height (st. mi.)	330	337
Inclination (deg.)	29	29

LATE JULY

Pictures from 38 orbits of TIROS spacecraft were transmitted to NWSC. Although the remote operational experiment was not complete as an experiment, the analysis of pictures was being performed at NWSC in a manner as planned for the operational system.

EARLY AUGUST

Construction of Unified S-Band facilities at Carnarvon, Australia was proceeding on schedule. The completion date of the 30' antenna foundation was advanced to September 15, 1965.

EARLY AUGUST

A contract was awarded for construction of the Apollo 85-foot antenna foundation at Goldstone, California.

EARLY AUGUST

A go-ahead was received for construction of major STADAN site facilities on Madagascar.

AUGUST 2

Plans were announced for the installation of tracking facilities at Corpus Christi, Texas to support Apollo missions.

The equipment will include the Unified S-Band system to combine in a single two-way transmission all types of communications with the three Apollo astronauts. Seven different kinds of communications will be conducted simultaneously for Apollo—two more than required for Mercury.

AUGUST 3

Relay spacecraft operations for 4141 orbit revolutions were as follows: 1151 wideband experiments, 1148 narrowband experiments and 135 demonstrations. Transponder No. 1 had been operated for 250 hours and 17 minutes over a period of 468 operations and Transponder No. 2 had operated for 227 hours and 2 minutes over a period of 395 transmissions.

The STADAN recorded 1700 minutes of radiation experiment data.

AUGUST 3

The Orbiting Solar Observatory II completed its design objectives by operating successfully in orbit for 6 months. Life expectancy was now predicted as mid or late November 1965, based on the pitch gas supply. All wheel experiments and the spacecraft continued to operate satisfactorily. The observatory completed over 2800 orbits.

AUGUST 3

NASA announced that Brazil would join U.S. and Argentina space scientists in studying hemispheric weather patterns by launching meteorological sounding rockets from Brazil.

AUGUST 5

Explorer XXVI (EPE-D), launched December 21, 1964, successfully completed 721 orbits and transmitted to the STADAN network more than 5200 hours of data on trapped particles and the earth's magnetic field. GSFC processed and shipped 552 orbits of data (approximately 4140 hours) to the experimenters for their analysis.

AUGUST 10

The Apparatus Division of Texas Instruments, Inc., in Dallas, Texas, was selected for contract negotiations expected to exceed 1 million dollars for development of a weather-measuring device to be carried in the Nimbus B weather satellite.

The experimental sensor, called IRIS for Infra-Red Interferometer Spectrometer, will be designed to collect information on the atmosphere's vertical temperature and water vapor distribution on a world-wide basis. Other tasks which the IRIS can accomplish from the orbiting Nimbus include the measurement of ozone distribution, surface temperatures, and cloud height estimates. Nimbus B was scheduled for launching by an Atlas-Agena D rocket in 1967

The ultimate goal of the 15-pound IRIS is to collect sufficient information on the atmosphere's profile to allow meteorologists to accurately give advance weather forecasts of two weeks and more.

AUGUST 11

Posts for three additional Assistant Directors and a Chief of Advanced Plans Staff, were announced:

Herman E. LaGow, Assistant Director for Systems Reliability; Deputy, Merland L. Moseson;

Daniel G. Mazur, Assistant Director for Technology;

Dr. George F. Pieper, Jr., Assistant Director for Space Sciences;

Robert E. Bourdeau, Acting Assistant Director for Projects;

William G. Stroud, Chief, Advanced Plans Statt.

Dr. Michael J. Vaccaro and John T. Mengel continued as Assistant Directors. Dr. Vaccaro's post was expanded to include Technical Services as well as Administration.

Goddard's Top Management (from left to right): Robert E. Bourdeau, Assistant Director for Projects; Herman E. LaGow, Assistant Director for Systems Reliability; John T. Mengel, Assistant Director, Tracking and Data Systems; Eugene W. Wasielewski, Associate Director, Dr. John F. Clark, Acting Director, Dr. John W. Townsend, Jr., Deputy Director, Dr. Michael J. Vaccaro, Assistant Director, Administration and Technical Services; William G. Stroud, Advanced Plans; Daniel G. Mazur, Assistant Director for Technology and Dr. George F. Pieper, Assistant Director for Space Sciences.

Mr. Mengel's position as Assistant Director for Tracking and Data Systems remained unchanged although offices under him have been strengthened and realigned. Mr. O. M. Covington continued as his Deputy, and Mr. Clarence A. Schroeder was named Deputy for Projects.

The changes were designed to meet the increasing demands of advanced space programs by strengthening lines of authority and responsibility at the center which, in the last seven years, successfully launched 37 major spacecraft.

AUGUST 11

The GSFC Data Operations Branch provided computing support for the Centaur AC-6 mission. Liftoff occurred at 14:31:06 GMT. For that liftoff time the launch azimuth was 94.539 degrees. The Atlas launch was nominal and the Centaur burn was successful.

AUGUST 11

Four companies were selected to provide feasibility studies for experiments in new applications satellite technology. The resultant contracts will represent the first phase of work on experiments and may lead to additional study and/or hardware contract to fly on a series of Applications Technology Satellites.

The companies and experiments selected were as follows:

The Control Data Corporation, Minneapolis, Minnesota, for approximately $45,000 to examine a technique for determining a satellite's orbit by using only spacecraft observations. This was essentially a self contained navigation system.

The Philco Corporation, Western Development Division, Palo Alto, California, for approximately $50,000 to study a device capable of determining the attitude of a spin stabilized spacecraft from star measurements.

The Bell Aerospace Corporation, Buffalo, New York for about $47,000 to study an electrostatic accelerometer which could provide needed information about the relative motion of a gravity gradient stabilized spacecraft.

The Electro Optical Systems, Inc., of Pasadena, California, for approximately $37,000 to develop a reflectometer experiment designed to measure the degradation of the optical characteristics of materials in space.

AUGUST 16
Key elements of the Goddard Center were renamed as follows:

Systems Reliability Directorate;
Administration and Technical Services Directorate;
Tracking and Data Systems Directorate;
Projects Directorate;
Space Sciences Directorate;
Technology Directorate.

AUGUST 19
A total of 2238 files of OSOII data have been shipped to the experimenters.

AUGUST 20
Mariner IV spacecraft which took the first close photos of Mars, July 14, was still transmitting engineering and scientific data as it continued its long, 570-day orbit around the sun. It was operating properly and the signals were strong.

At 10:30 p.m. EDT the spacecraft was 163,162,460 miles from Earth. On its 265th day of travel from the launch site at Cape Kennedy, Fla. it covered about 365,000,000 miles. It was 8,622,011 miles from Mars.

Mariner IV's speed relative to Earth is 77,331 mph; relative to the Sun, 48,323 mph.

AUGUST 25
An attempted launching of the OSO-C observatory using Delta 33, was made from ETR at 15:17:00.14 GMT. Preliminary indications were that the third stage achieved less than the required velocity to inject the observatory into orbit. Possible difficulty was believed to be due to a delay from the igniter of about ½ second when it was designed for 6 second initiation. Spin-up was reported at about 75 rpm. It was reported that arms extention and a certain amount of de-spin were observed. The spacecraft was not located by NORAD after the launch phase. The spacecraft was assumed to have impacted in the South Atlantic.

AUGUST 25
Explorer XX has met its design goal after one year's operation.

AUGUST 25
NASA contracted with Douglas Aircraft Co., Santa Monica, Calif., for 15 improved Delta launch vehicle upper stages and associated equipment. The fixed price, incentive fee contract was $16,200,000.

Work was to be performed at the Douglas Missile and Space System Division at Santa Monica. The improved Deltas have larger fuel tanks which extend the burning time to 400 seconds from 160 seconds for the standard Delta.

Technical direction of the Delta program is charged to the Goddard Space Flight Center.

AUGUST 25
Dr. Siegfried J. Bauer was named Acting Head of the Planetary Ionospheres Branch, Laboratory for Space Sciences Directorate. Dr. Bauer replaced Robert E. Bourdeau, who has been named Acting Assistant Director for Projects.

AUGUST 26
Good quality video data continued to be available from the two camera systems of TIROS VII, one camera system of TIROS VIII, and one camera system of TIROS X.

AUGUST 27
Solar simulation test of Alouette B was satisfactorily completed at Goddard and the spacecraft was returned to Canada.

LATE AUGUST
Gemini V Mission: August 21, 1965 through August 28, 1965.

During the countdown and mission phases the Center provided computing support 24 hours a day during the entire Gemini V mission.

The general areas of computing support were the following:

1. CADFISS testing to determine the manned flight network readiness to support.
2. Second stage booster track, orbital computation and impact point prediction.
3. Processing of tracking on the Radar Evaluation Pod (REP) from NORAD and transmittal of position and velocity vectors to MSC.
4. Generation of skin track acquisition data on the spacecraft for the network radars.
5. Generation of acquisition information and transmittal to NORAD and SAO on the spacecraft, booster and REP.
6. Evaluation of the quality of the radar tracking data received during the mission.
7. Support of the MSC realtime computing system by providing checks on such parameters as time to fire retros, apogee, perigee, etc., and providing other information requested by the Flight Dynamics Officer, Retrofire Controller and Network controller of MSC.
8. Support of miscellaneous requirements by NASA Headquarters, Langley, and the Navy for acquisition type information.
9. Drive appropriate displays at NASA Headquarters and MCC at Cape Kennedy.

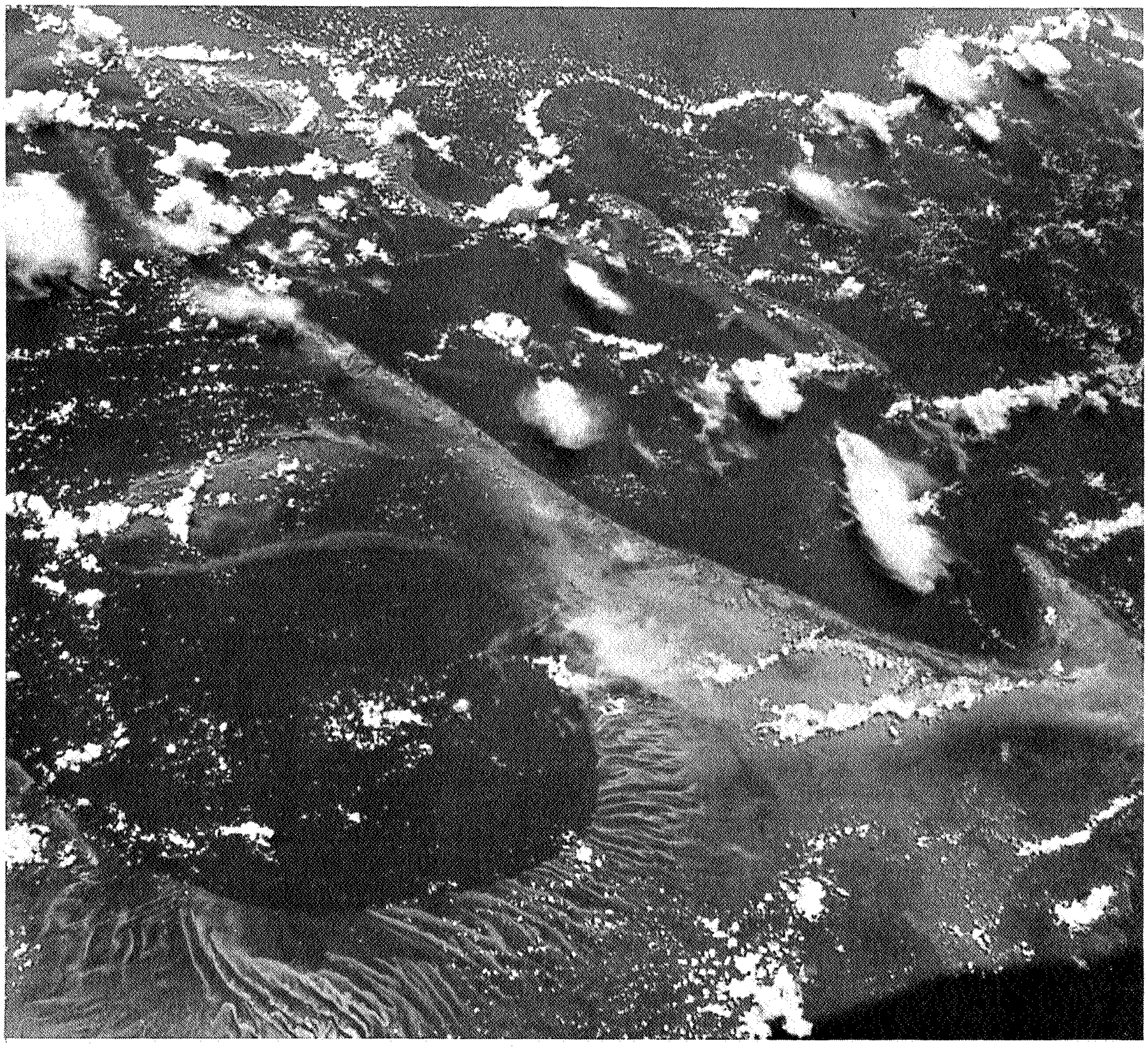
During renetry of the spacecraft Goddard passed to MSC time to fire retros and passed on guidance parameters computed by interrupting the White Sands tracking data on direction from the Flight Dynamics Officer; further passed in realtime the landing footprint to Flight Dynamics Officer computed on the basis of White Sands and Eglin tracking data during reentry; finally computed an Impact Point and informed MSC the trajectory flown by Gemini V during reentry as reflected by the tracking data was a ballistic or zero life trajectory.

AUGUST 30

Negotiations with Ball Brothers Research Corp., Boulder, Colo., for procurement of three additional Orbiting Solar Observatory spacecraft were announced. The contract was expected to be in excess of $12 million.

The three spacecraft will bring to eight the number of satellites contracted for in the OSO series. Ball Brothers is prime contractor.

Two OSO spacecraft have been orbited successfully from Cape Kennedy, Fla. The OSO I, weighing 458 pounds, was launched March 7, 1962, and transmitted data for over a year. The 545-pound OSO II launched February 3, this year, was still operating and returning useful data. A third OSO was launched August 25, but due to an apparent premature ignition of the launch vehicle's third stage the spacecraft failed to achieve orbit.



The Grand Bahama Bank Southeast of Andres Island as seen from orbiting Gemini V spacecraft.

AUGUST 31

Status of Data from Active TIROS Satellite as of August 31

	VII	VIII	IX	X
Orbit	11,893	8,981	2,672	868
Picture Total	114,084	84,769	66,580	18,136
Total Usable	105,225	78,820	61,691	16,467
(%)	(93.0)	(93.0)	(92.7)	(90.8)
Nephanalyses	3,634	2,676	5,304	1,037
Storm Bulletins	595	739	891	311

Grand Total of ALL TIROS Pictures 539,270

Archival Status of TIROS Photos

TIROS I-VI	All usable pictures archived
TIROS VII	All pictures up to orbit 10,833 (95%)
TIROS VIII	All pictures up to orbit 8,317 (97%)
TIROS IX	All pictures up to orbit 560 (24%)

LATE AUGUST

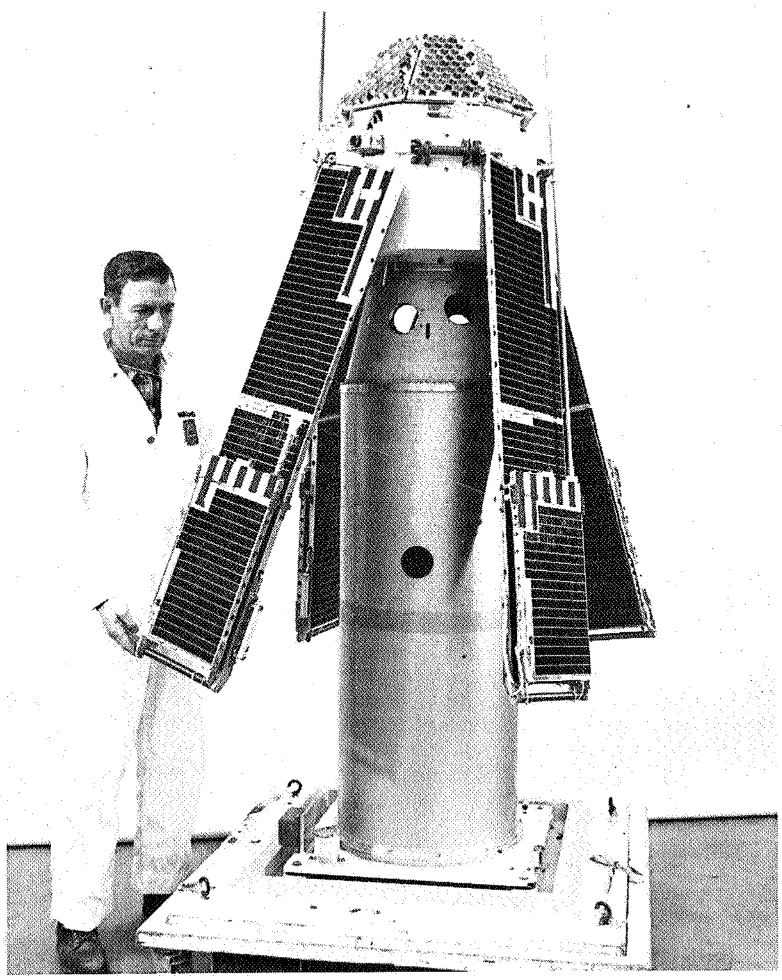
TIROS was supporting the Gemini V mission ascertaining weather conditions along the flight path and possible capsule recovery areas. One direct picture over Florida from TIROS IX was taken eight minutes before Gemini-5 liftoff on August 21, 1965.

LATE AUGUST

Procurement action for the operation of a Nimbus Data Utilization Center (NDUC) for the Nimbus C flight was initiated.

LATE AUGUST

All pictures received from all TIROS operating satellites (VII: 2 cameras; VII: 1 camera; IX: direct readouts only; X: camera 1 and directs from camera 2) were being transmitted in near realtime from Wallops and Gilmore sites to NWSC. The coverage provided by the wheel mode (TIROS IX) and also by TIROS X together with the near realtime transmission of all data to NWSC has established satellite data as a regular input to the daily world-wide weather analysis.



Beacon Explorer-C under test at Goddard

LATE AUGUST
Typical Tracking Operations

The following is a summary of STADAN operations for the week ending August 30.

Tracking passes scheduled	2,493
Tracking data messages	2,000
Telemetry passes scheduled	1,347
Minutes of telemetry data recorded	45,098
Satellites interrogated average daily	35

EARLY SEPTEMBER
The Douglas Aircraft Co. was authorized the following operational support tasks:

Determine the feasibility of modifying one of the existing vehicle service towers at Complex 17 at the Eastern Test Range to accommodate the long tank first stage "Improved Delta" as well as various other Delta vehicle configurations.

Modify, refurbish and provide special test equipment for Western Test Range Complex 75-1 and associated areas to serve the "Improved Delta."

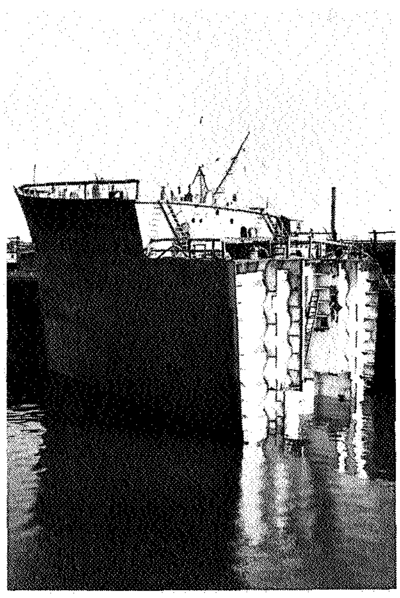
EARLY SEPTEMBER
Construction was expected to begin on the Jupiter Monitoring System at Carnarvon, Australia after the GT-5 mission.

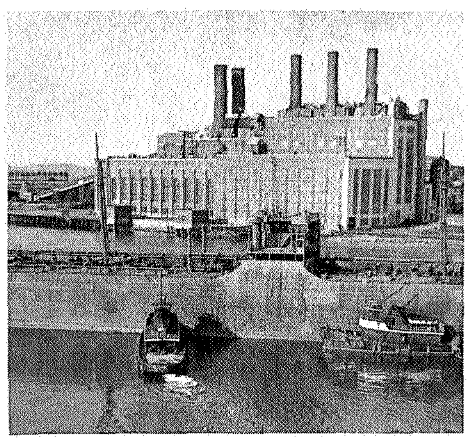
SEPTEMBER 7
Members of the House Space Committee agreed on a memorial to Dr. Robert Hutchings Goddard, at Clark University, Worester, Mass.

SEPTEMBER 9
Float-out of the "Vanguard" Apollo tracking ship at the Quincy, Massachusetts, shipyard of the Electric Boat Division of General Dynamics Corporation. The joining of the bow and stern to the midbody of T-AGM-20 was begun on September 11, 1965.

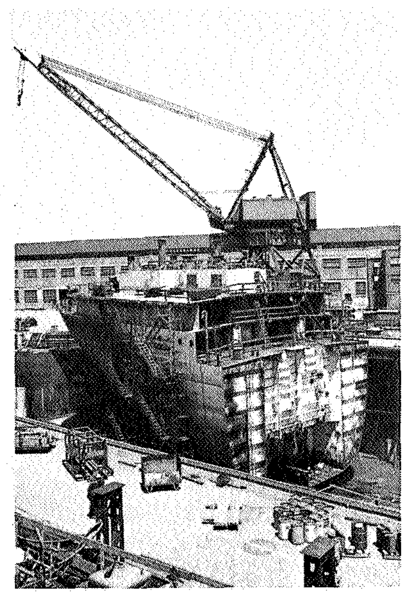
SEPTEMBER 9
Status of construction for Apollo Tracking Stations:

1. *Bermuda–FPQ-6:* Contract for construction awarded to Vanguard Construction Company for $391,739.
2. *Ascension:* Joint Beneficial Occupancy of JPL portion of facility scheduled for October 6-7.
3. *Antigua:* Joint Air Force, Navy KSC and GSFC pre-design conference held at ETR on September 8-9.
4. *Corpus Christi:* Pre-Bidders Conference held with prospective contractors at Corpus Christi September 2. Final hearing on rezoning of Rodd Field held in Corpus Christi September 10-11.
5. *Guayma, Mexico:* Construction bid opening scheduled for September 17th at Guaymas.
6. *Madrid:* Award of construction contract awaiting resolution of land acquisition Bids opened June 25th.
7. *Canary Island:* A&E Selection Board met in New York, and recommendation forwarded to OICC, Madrid, for action.
8. *Canberra, Australia:* Review of design complete and comments forwarded to GSFC representative in Australia. Contractor on site for site grading and other site preparation.
9. *Goldstone:* Phase I–Antenna Foundation contract awarded with completion date for November. Phase II–Design complete and forwarded to Procurement





Ships get ready for Apollo Space role. First time an instrumentation ship has ever been constructed this way: Center section cut out to be replaced by bigger midbody.



Division in July. Award of contract must be made by September 15th to maintain schedule.

10. *Guam:* Operation Rm. accepted for Beneficial Occupancy. Land lease for communication cable to be resolved by OTDA.

SEPTEMBER 15

A group of French Engineers were at the Center in connection with the testing of the FR-I satellite prototype which had been shipped to the Test and Evaluation facilities.

SEPTEMBER 18

The first cooperative sounding rocket experiment sponsored by NASA and the Netherlands Organization for the Advancement of Pure Research (ZWO) was successfully conducted.

The launching at Coronie, Surinam (Dutch Guiana), was one of four to be conducted under a memorandum of understanding signed in June 1964.

Object of the experiment was to measure winds in the equatorial upper atmosphere by releasing a cloud of sodium vapor that is illuminated by the Sun. Photographs of the cloud from several ground points permitted observers to measure wind directions and speed.

Personnel from Goddard Space Flight Center, Greenbelt, Md., and the Wallops Station, Va., attended the Surinam launching.

SEPTEMBER 17

The Orbiting Geophysical Observatory I spacecraft completed its first year of operation in space. Officially classified a failure when a major objective—three axis stabilization—was not achieved, the 1200-pound scientific satellite was brought through its first year by controllers at the Goddard Center, in one of the unusual "success" stories of the space age.

Launched September 4, 1964, from Cape Kennedy, Fla. into a highly elliptical orbit, two of the 13 boom-like appendages designed to unfold in sequence did not deploy as planned. One of these booms apparently obscured a sensor which was to enable the satellite to lock on the Earth's horizon for the planned Earth stabilized orientation. OGO I began to spin at about five revolutions per minute.

Faced with a crippled spacecraft, a team of OGO experts under the direction of Wilfred E. Scull, OGO Project Manager and Dr. George H. Ludwig, Project Scientist, developed a contingency operations plan to get as much useful information as possible out of their satellite.

By a series of ground commands the OGO I solar panels were turned into a favorable Sun angle. Then began the problem of working out a program to make the scientific data being transmitted meaningful to the experimenters.

During its first year in space, OGO's solar panels were turned 11 different times to follow the Sun as Earth traveled around the Sun. The latest "slewing maneuver" occurred August 28. It was successfully completed after 402 separate commands were issued by the OGO Control Center in a period of two and one half hours. In all, during its first year OGO I obeyed 19,657 ground commands.

Although some of its scientific usefulness was degraded when the Earth-Sun-stabilized orientation was not achieved, 16 scientific papers had been presented by experimenters on findings of their instruments aboard OGO.

SEPTEMBER 23

NASA announced plans to negotiate a contract with Bendix Field Engineering Corp., Owings Mills, Md., for operations and maintenance support for portions of the Space Tracking and Data Acquisition Network (STADAN) facilities over a two-year period, from Oct. 1, 1965, through Sept. 30, 1967. The support required was a follow-on to services previously being performed by Bendix Corp.

The contract called for operations and maintenance service on a 24-hour seven-day week basis for facilities and stations of the STADAN system at Blossom Point, Md.; East Grand Forks, Minn.; Fort Myers, Fla.; Goldstone, Calif.; Lima, Peru; Santiago, Chile; Quito, Ecuador; and Tananarive, Malagasy Republic. Total cost for the two-year services was estimated at about $25 million.

SEPTEMBER 24

The OSO-II operated successfully in orbit for 8 months and has completed over 3600 orbits.

Due to the near depletion of the pitch gas supply, a series of Terminal Operations were started. The satellite was being maintained at a low spin rate.

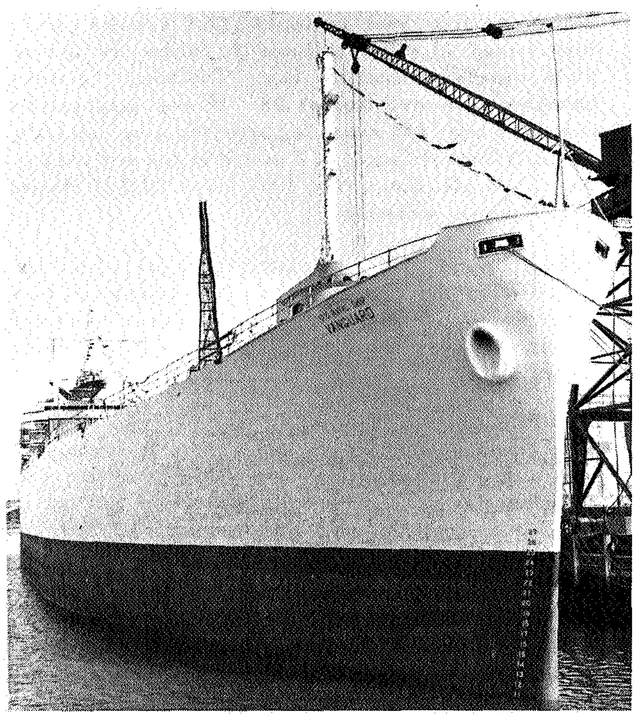
SEPTEMBER 26

Dr. John C. Lindsay, Associate Chief, Laboratory for Space Sciences died. He was Project Scientist for the Orbiting Solar Observatory. A John C. Lindsay Memorial Fund was established at Guilford College, North Carolina in his memory.

SEPTEMBER 26

Relay II Communications Satellite ended its demonstration career by providing a communications link in opening a textile exposition on the boardwalk at Atlantic City, N.J.

Senator B. Everett Jordan of North Carolina spoke via the satellite from Exposition Hall in opening the week-long International Exposition of the American Textile Machinery Association. Senator Jordan's voice was carried by land line to NASA's ground station in California Mojave Desert, up to and through Relay II, down to the station and back to Atlantic City by land line.



USNS Vanguard tracking ship

At the time of Senator Jordan's address, 8:20 p.m., EDT, the satellite was about 4000 miles over the Pacific Ocean about 1600 miles west of Panama, moving eastward at 12,000 miles per hour.

Relay II, launched on Jan. 21, 1964, has been used in thousands of tests and experiments and in some 40 public communications demonstrations. Many of these involved transatlantic and transpacific television news transmissions, such as the opening of the Winter Olympic games last year in Austria, the first television transmission from Japan, the opening of the New York World's Fair, and television coverage of the national political campaigns and election in 1964.

Relay II was in excellent condition. Relay I's transponders have not been useable since February 1965, however, it still intermittently responds to commands. It thus cannot be used for experiments.

NASA's Mojave station, which was the only United States ground station equipped to send and receive via Relay, ceased operations September 30, 1964. The station was to be remodeled for use in NASA's Applications Technology Satellite program.

The Mojave station retained command and telemetry capability, however, as did the station at Blossom Point, Md. Therefore, Japanese and European ground stations continued to work with Relay to observe how long the satellite remained operable. In addition, radiation experiments carried by Relay II were to be conducted on a regular basis to provide additional information on the Earth's radiation belt.

SEPTEMBER 29

A contract for expansion of facilities at the Tananarive, Madagascar station was signed totalling about $726,000.

SEPTEMBER 30

IMP-B (Explorer XXI) resumed intermittent operation. During the period from 8 to 30 September, approximately 2200 minutes of data were recorded. The average "on-time" between recycle periods was 43 minutes with the maximum continuous "on-time" being 150 minutes. All spacecraft systems appeared to be operating normally with the exception of the battery supply.

LATE SEPTEMBER

Edmund Habib was placed in charge of advanced planning for the Information Processing Division, T&DS.

LATE SEPTEMBER

The decision was made to again upgrade the communications system at the Madagascar STADAN Facility for the GT-6 Mission. Three rhombic antennas, a 40 KW transmitter, and the necessary cabling were to be shipped. Land at the site has been cleared and the antenna tower located. This effort was on schedule and the upgraded system was to be operational in time to support the GT-6 Mission.

LATE SEPTEMBER

The second phase of the Early Bird communications system tests was underway. These tests involved the evaluation of customer reaction to 300 telephone calls each via satellite on sub-cable circuits (600 total) to the United Kingdom, 250 each via satellite and cable (500 total) to France, and an equal number to Germany under similar circumstances. These interviews to be completed in late October. The final results should be available during November. Thus, any action the future of the Early Bird system by the Interim Committee may not take place until December 1965.

LATE SEPTEMBER

The OSO-II spacecraft completed over 3550 orbits. Due to the depletion of the pitch gas supply, a series of terminal operations was September 24. Operations included (1) spin down to 15 rpm for 15 orbits; (2) pitch down to -4 degrees; (3) spin up to 25 rpm; (4) turn on of the Harvard experiment for two orbits; (5) raster mode operation for two orbits; and (6) a switch from Transmitter No. 2 supply is depleted which was expected to be about October 8, 1965.

A total of 2410 files of production data have been shipped to the experimenters.

LATE SEPTEMBER

Nimbus I: The U.S. Geological Survey acknowledged several cartographic changes to be incorporated in the Antarctic plastic relief model resulting from Nimbus I data. U.S.G.S. requested all AVCS land area photography, in the form of dodged negatives on 250-foot spools.

SEPTEMBER

All picture data received from all operating satellites (TIROS VII 2 cameras, TIROS VIII 1 camera, TIROS X, camera I, and direct from camera 2) continued to be transmitted in near realtime from the Wallops and Gilmore stations to NWSC. The coverage provided by the operating TIROS satellites, together with the near realtime transmission of all data to NWSC, has established satellite data as a regular input to the daily world-wide weather analysis.

EARLY OCTOBER

The erection of the 85-foot TIROS Operational Satellite antenna on Wallops Island was progressing on schedule.

OCTOBER 1

The Mariner IV spacecraft, in its 300th day of flight, received a command, concluding—possible only temporarily—NASA's longest and most complex deep space mission.

Since launch November 28, 1964, Mariner IV has transmitted to Earth nearly 50 million engineering and scientific measurements on the environment of interplanetary space and in the vicinity of Mars.

It flew past Mars last July 14, 1965, at an altitude of 6118 miles, recording the first close-up pictures of the planet's surface.

After October 1, when the ground command switched the spacecraft's transmitter from the high-gain directional antenna to the omni-directional antenna, telemetry from Mariner IV would cease.

Project officials at J.P.L. said the spacecraft was to continue transmitting and may renew its radio link with Earth in 1967.

OCTOBER 1

Consolidation of unmanned launch activities at both the Eastern and Western Test Ranges under the John F. Kennedy Space Center, was announced. Robert Gray, formerly Chief of GSFC's Launch Operations at Cape Kennedy, was named Assistant KSC Director for Unmanned Launch Operations.

At the Western Test Range, Lompac, California, the part of the Goddard team permanently assigned to that and the NASA Pacific Launch Operations Office which logistically supported it also was placed under KSC and supervised by Gray.

With the consolidation, KSC was assigned the following unmanned missions: lunar and planetary missions for the Jet Propulsion Laboratory; scientific, meteorological and communications satellite missions for Goddard; Atlas-Centaur and Atlas- and Thor-Agena flights for the Lewis Research Center; lunar missions for Langley; and interplanetary and scientific satellite missions for the Ames Research Center. These missions will be launched by the new unmanned launch directorate.

The transfer of staff and functions included 107 Civil Service personnel of the Goddard launch operations team at Cape Kennedy and 22 more members of the team from the Pacific Launch Operations Office moving under KSC. These 129 Civil Service personnel were responsible for a combined government-industry operation involving more than 1600 industrial contractor personnel at the Eastern and Western Test Ranges.

Goddard Launch Operations compiled an impressive record of 47 successes out of 55 launched assigned to it.

Originally a 20-man unit called the Vanguard Operations Group, the team was transferred from the Naval Research Laboratory to NASA when it was founded in October 1958. Its first launch for NASA was on February 17, 1959—the Vanguard II satellite to study cloud cover.

The Goddard Team had launched more than half of all NASA satellites. Rangers, Mariners, Tiros, Echos, Explorers, Nimbus, Relays, and Syncoms were among the payloads launched by this group. Also launched by Goddard were the world's first privately owned satellite, the American Telephone and Telegraph Co.'s Telstar, and the world's first commercial satellite, the Communication Satellite Corp.'s "Early Bird."

Launch vehicles fired by the Goddard team included the Delta which achieved successes in 30 out of 33 lift-offs. The three-stage Delta had 22 straight orbital successes and in 1963 Goddard's Delta launch team received NASA's Group Achievement Award.

Atlas-Agena launches made possible the longest flights in space history. Mariner IV photographed Mars in July after 312-million-mile flight. Mariner II flew near Venus in 1962 and three Ranger spacecraft made close-up photographs of the Moon.

OCTOBER 5

Administrator James Webb presented NASA's Exceptional Scientific Achievement award to Dr. Leslie H. Meredith; and Dr. William Nordberg, GSFC scientists.

OCTOBER 8

Astronaut James McDivitt and Dr. Paul Lowman, Jr., meeting at Goddard discussed the results of the terrain photography experiments from Gemini IV spacecraft.

OCTOBER 8

Representatives of the U.S. National Aeronautics and Space Administration and the U.S.S.R. Soviet Academy of Sciences reached two satisfactory understandings in discussion on space cooperation in New York.

The first understanding reaffirmed the existing agreement for the exchange of weather satellite data between Washington and Moscow. It was understood by representatives of both sides that satellite data was expected to be available on a continuing basis from both sides within a few months. Meanwhile, the daily and useful exchange of conventional weather data was to continue.

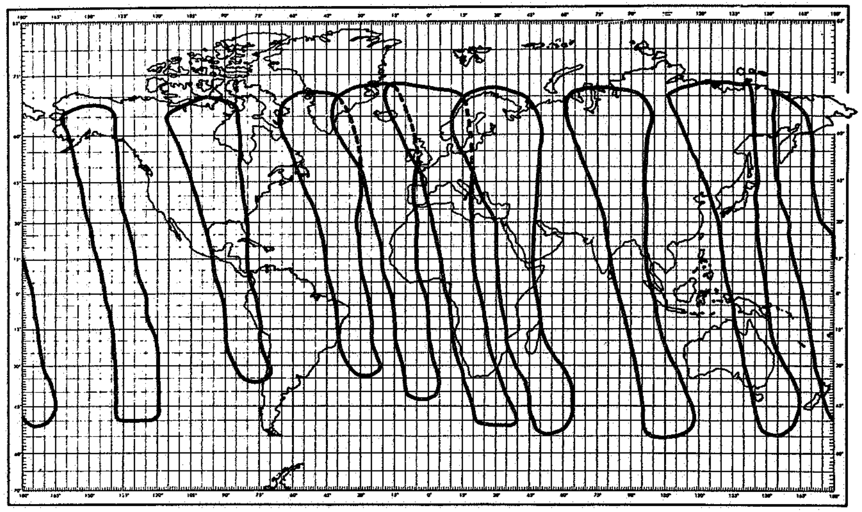


FIG. 1 – TIROS X TWO CAMERA COVERAGE

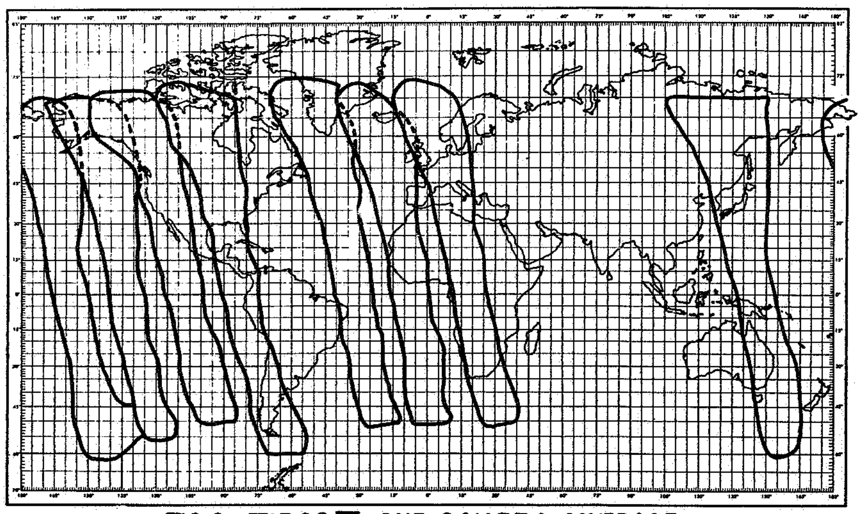


FIG. 2 – TIROS X ONE CAMERA COVERAGE

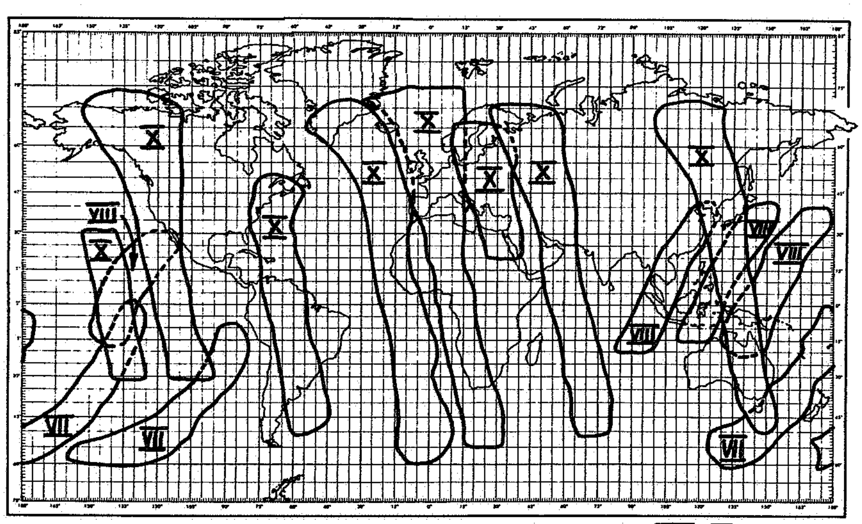
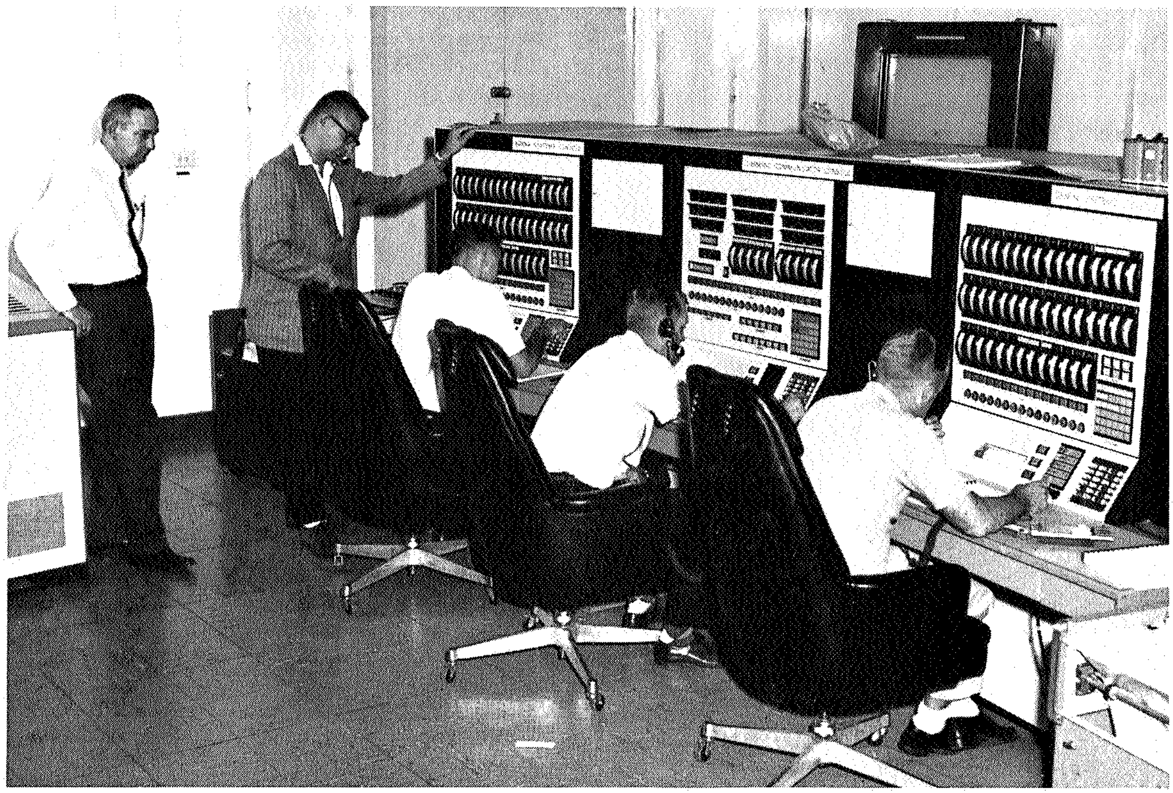
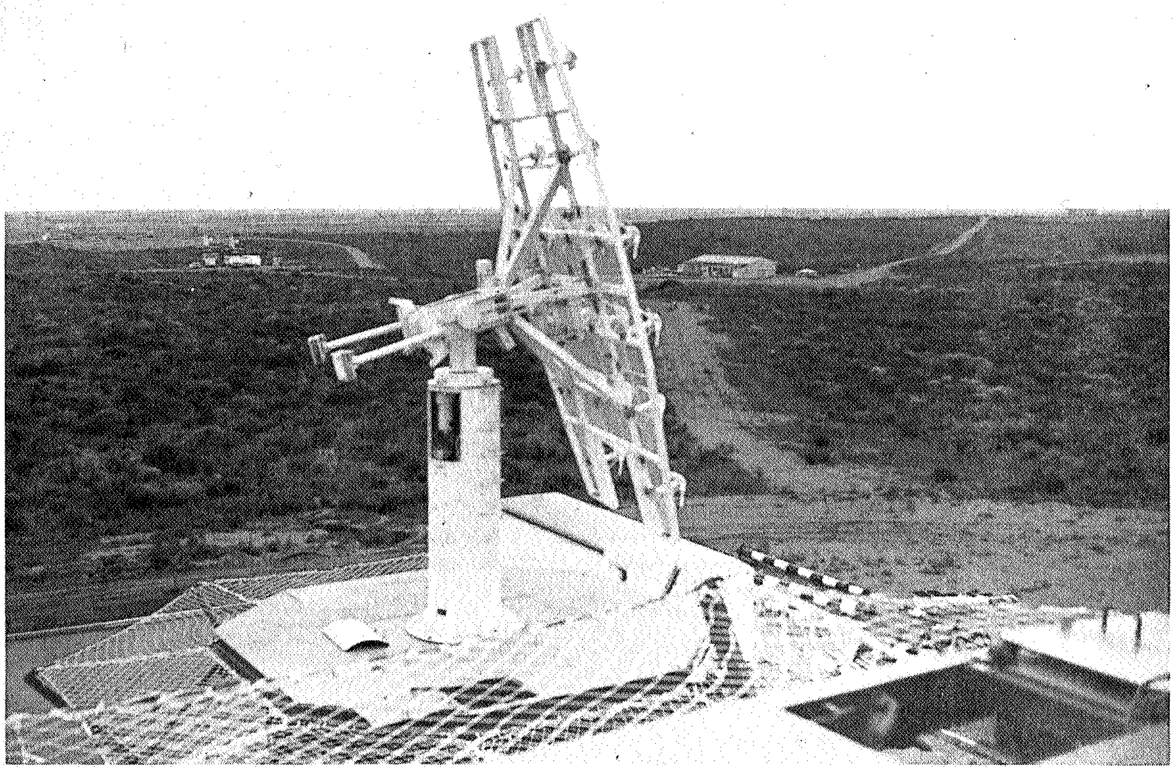


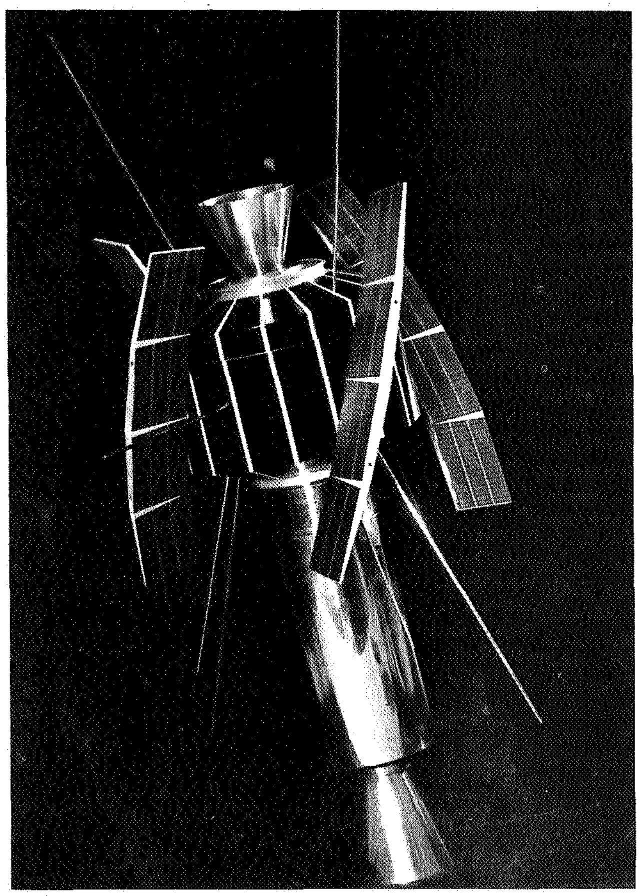
FIG. 3 – CURRENT COVERAGE – TIROS VII, VIII, X

TIROS looks at the world





Tracking Station at Carnarvon, Australia



Model of Radio Astronomy Satellite

The second step was a new agreement for the preparation and publication of a joint review of research in space biology and medicine in the two countries. This agreement provided for a joint Editorial Board and for full cooperation by both sides in the preparation of materials available in the two countries, the selection of authors, and the publication of their work, probably in two or more volumes. The agreement was to go into effect automatically in the absence of objection from either side within two months.

OCTOBER 8

NASA asked the Communications Satellite Corporation to provide communications satellite services in support of tracking and data acquisition needs for Project Apollo. The facilities are to be in operation by the fall of 1966.

OCTOBER 9

Allen M. Ludington, Deputy Chief of the Procurement Division died.

OCTOBER 13

The Telecomputing Services, Inc., of Panama City, California, was selected for negotiations leading to a two-year contract for computer operations and data processing services at the Goddard Space Flight Center.

When negotiations were completed, the cost-plus-award-fee contract was expected to exceed $4 million. An option in the contract for an additional year would increase the cost by $2 million.

The contractor was to be responsible for broad scale computer operations and programming in various Goddard divisions and laboratories. Emphasis of the procurement lies in the Information Data Processing Division and Data Systems Division in which the heaviest traffic of scientific satellite data and manned space flight support computing was centered.

OCTOBER 14

At 06.11.55 a.m. PDT OGO-C was launched. The Thrust Augmented Thor injected the satellite into an elliptical orbit significantly higher than nominal, with an apogee of 850 n.mi., a perigee of 231 n.mi. and an orbital period of 105.1 minutes.

The TAT experienced soft-shutoff as a result of LOX depletion and the Agena velocity meter initiated cutoff of the Agena engine to terminate the ascent phase.

MID OCTOBER

The OSO-II had completed over 3870 orbits. Predictions were that the observatory would continue to function into the month of November and would have a life span of 9 months or more. All spacecraft systems except the back-up tape recorder continued to perform normally.

MID OCTOBER

The equipment installation was proceeding rapidly on the first Apollo Insertion/Injection Ship, the Vanguard at Quincy, Mass.

MID OCTOBER

Headquarters approval was received for the construction of additional facilities at the STADAN tracking station, Fairbanks, Alaska to support scientific and application satellite programs. Approval was also given for the construction of Apollo S-Band equipment at Antigua, West Indies, and the construction of manned space flight network wing to be added to the Deep Space Tracking Facility at Madrid, Spain and Canberra, Australia.

OCTOBER 18

The first meeting of the committee appointed to negotiate a contract between NASA and COMSAT Corp. for communications satellite services in support of the Apollo project.

OCTOBER 19

The quick reaction capability of the sounding rocket project was utilized to cover sounding rocket observations of Wallops Island and one from the White Sands Missile Range. The first was on ultraviolet experiment (4.142 NA) launched at 2000Z from Wallops Island, Va. The second comet observing rocket was 4.146 DS launched at 2035Z from White Sands.

OCTOBER 21

The last Ikeya-Seki comet observing Aerobee 4.164 UA was launched from Wallops Island, Va. at 1600Z. The experiment scanned the comet head and tail twice. Data was also obtained of the sun's corona. Reportedly this shot was the best of three sounding rocket experiments to observe the Ikeya-Seki comet.

OCTOBER 22

Dr. P. H. Fang a Goddard researcher discovered that silicon solar cells damaged by electron radiation could be completely recovered any number of times when subjected to high temperatures for a period of time.

Dr. Fang, a physicist in the Thermal Systems Branch of the Spacecraft Technology Division, presented his results at a Photovoltaic Specialists Conference.

As a typical example of his laboratory results, Dr. Fang cited the case of an N-on-P (negative-on-positive) silicon solar cell which exhibited about 11 percent efficiency in converting sunlight directly into useful electrical voltage. The efficiency of this cell was reduced to about eight percent when it was bombarded by electrons of a two millivolt energy level.

Dr. Fang was able to recover the full efficiency of this cell by heating it to a temperature of 390 degrees Centigrade for about 15 minutes. This same cell was recovered similarly after several successive exposures to electron radiation.

LATE OCTOBER

Following completion of pre-launch activities, OGO-C was launched at 06:11:55 hours PDT on October 14, 1965, from Pad 75-1-1 of Western Test Range; it has been officially designated as 1965 81A (OGO-II). After injection of OGO-II into an elliptical orbit, significantly higher than nominal because of anomaly (absence of guidance during powered ascent) in the Western Electric (WECO) Vehicle Guidance System, the supply of argon gas in the Attitude Control Subsystem (ACS), sized to provide stabilizing torques for OGO-II for a full year, was being used at a much higher rate than anticipated. The supply of argon gas became exhausted within ten days during which OGO-II was operated in both ACS Mode 2C (sun-acquisition, ½ deg/sec rotation about the ptich (Y) axis) and Mode 3, (earth stabilized, normal operating mode) in an effort to conserve gas. Scientific data were obtained satisfactorily in both modes. Seventy percent of the experiments were operable in Mode 2C.

Following the loss of argon gas, OGO-II, operating in Mode 3 eventually was unable to maintain lock on the sun, which resulted in a condition of under voltage on October 24 (experiments automatically turned off). The available power in OGO-II improved in the period between the evening of October 24 and October 29 so that experiments were turned on during Revolution 211 on October 29 and operated with the observatory in commanded Mode 3 until the evening of October 30.

Comet Ikeya-Seki on November 2, 1965

OCTOBER 31

Status of Data from Active TIROS Satellites

	VII	VIII	IX	X
Orbit	12,789	9,865	3,408	1,741
Picture Total	118,214	90,891	67,295	36,930
Total Usable	108,843	84,298	61,922	34,103
(%)	(92.1)	(92.7)	(92.0)	(92.3)
Nephanalyses	3,650	2,745	5,304	2,647
Storm Bulletins	610	769	891	633
Grand Total of all TIROS Pictures	569,031			

Archival Status

TIROS I-VI	All usable pictures archived
TIROS VII	All pictures up to orbit 11,327 (89%)
TIROS VIII	All pictures up to orbit 8,571 (87%)
TIROS IX	All pictures up to orbit 627 (19%)

NOVEMBER 1

The OSO-II Observatory was placed in a stowed operational mode. It operated successfully for 9 months and completed over 4100 orbits. Terminal operations were completed early in October due to the pending depletion of pitch and spin gas supplies. At the request of the University of Minnesota, the spin rate was maintained at about 8 RPM from completion of terminal operation until November 1. At that time, a final pitch correction was made and the observatory spun up to normal spin rate (30 RPM). When the spacecraft was placed in stow mode, all spacecraft systems were performing normally except the back-up tape recorder.

EARLY NOVEMBER

The Orroral STADAN Station, Canberra, Australia became operational. The 85-foot antenna system was scheduled to support space flight missions including those previously supported from the Woomera Station. Telemetry acquisition at Woomera was discontinued as of November 1, 1965.

EARLY NOVEMBER

The Unified S-Band pedestal installation was completed at Carnarvon, Australia. The alignment of the antenna was scheduled to begin November 8. The first shipment of electronics arrived on site on November 5, 1965.

At Guam, the Unified S-Band system installation had been completed, system installation had been completed, and system tests were being performed by the contractor. Official acceptance tests were scheduled to begin the first week of January 1966.

NOVEMBER 6

The GEOS satellite was launched using the DSV-3E Improved Delta launch vehicle for the first time. The 15 second delay squib used on the GEOS mission and scheduled for use on all subsequent missions using the X-258 motor was fully qualified prior to the GEOS launch.

Public Law 89-320
89th Congress, H. J. Res. 597
November 3, 1965

Joint Resolution

79 STAT. 1186

Providing for the erection of a memorial to the late Doctor Robert H. Goddard, the father of rocketry.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the National Aeronautics and Space Administration shall erect in the Commonwealth of Massachusetts an appropriate memorial to the late Doctor Robert H. Goddard, former professor of physics at Clark University in Worcester, Massachusetts, and the father of rocketry. Doctor Robert H. Goddard Memorial.

The memorial shall comprise a sculpture in bronze or other enduring metal and shall symbolize the scientist's role as the pioneer of the space age. It shall be located on the Clark University campus in Worcester, Massachusetts, on a site donated by the Clark trustees adjacent to the Robert Hutchings Goddard Library. The National Aeronautics and Space Administration shall request the advice and comment of the Commission of Fine Arts and consult with Clark University trustees with respect to the design and setting of the memorial.

The memorial shall give appropriate recognition to the pioneering efforts of the late Doctor Goddard in his country's achievements in rocketry and supersonic flight.

SEC. 2. There are authorized to be appropriated such sums as may be necessary, not to exceed $150,000, to carry out the purposes of this joint resolution. Appropriation.

Approved November 3, 1965, 10:15 p.m.

NOVEMBER 8

Dr. Harry J. Goett, former director of NASA's Goddard Space Flight Center, began his new duties as director of advanced technology for plans and programs at the Western Development Laboratory of Philco Corp., Palo Alto, California. Dr. Goett had been a special assistant to NASA Administrator James Webb prior to accepting the new post.

The position was a new one, and was part of a staff reorganization at WDL aimed at "penetrating new areas of future space activities." The Philco division involved in such projects as NASA's Mission Control Center, in which it was systems integrator, and DOD's communications satellite program, for which it was the prime contractor. Dr. Goett's office will have complete responsibility for marketing, engineering and technical planning.

NOVEMBER 9

During the Northeastern power failure all NASCOM Network circuits through New York City were lost except one voice circuit to London which was made good using emergency facilities of IT&T. Area affected by this circuit loss were: Newfoundland, Bermuda, Canary Island, Europe, South Africa and South America. Contact with all except Bermuda and South America was established within 40 minutes by using the Goddard to London back-up route through Australia. Service to Bermuda, Newfoundland and the South American stations were not restored until November 10, 1965.

NOVEMBER 10

The Zenith Radio Corporation, Chicago, Illinois, was selected for contract negotiations to develop and construct a prototype vidicon camera system to be integrated with an X-ray telescope for Advanced Orbiting

Solar Observatory (AOSO) spacecraft. The contract was estimated to be in excess of $500,000.

The prototype vidicon system to be developed by Zenith will be designed to convert X-ray telescope experiment findings into visible pictures which would be transmitted by the AOSO to ground stations.

NOVEMBER 15
First laser reflections from GEOS-1 were detected at 3:48 a.m. Returns were detected both by photographing signal display on an oscilloscope and by using the signal pulses to stop a digital range counter.

NOVEMBER 15
A cooperative agreement was signed under which Brazilian-United States would continue its sounding rocket project to obtain meteorological information. The project provided for cooperation in obtaining wind, temperature and other meteorological information between 40 and 100 kilometers by rocket soundings using the acoustic grenade technique. The experiments were to be conducted from the Brazilian launch range at Natal.

MID NOVEMBER
GSFC equipment and personnel to conduct the GT-7/MSC-4 Laser Experiment were en route to Ascension Island.

NOVEMBER 17
It was announced that a tracking and telemetry station to support Application Technology Satellites would be established at Toowoomba in eastern Australia near Brisbane. The station will support the ATS satellite program. Multiple experimental and scientific payloads aboard these spacecraft will serve for satellite communications and television transmission, meteorological studies including pictures of the Earth's cloud cover, navigational studies and other studies of radio propagation and gravity gradient.

NOVEMBER 18
The IQSY (International Quiet Sun Year) Satellite was launched from Wallops Island on Thursday, at about 11:48 p.m., E.C.T. Preflight nominal values for the principal elements of the orbit and values for these elements obtained from an orbit based upon early Minitrack data are as follows:

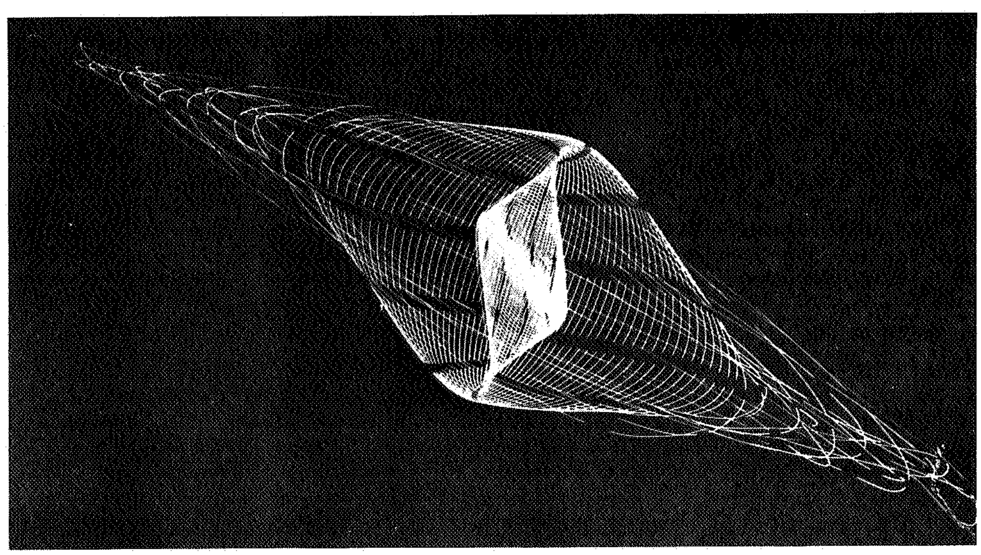
	Preflight Nominal Values	*Values Based on Early Minitrack Data*
Period (min.)	102	101
Perigee height (st. mi.)	437	441
Apogee height (st. mi.)	633	549
Inclination (deg.)	60	60

NOVEMBER 18
Laser tracking flashes from Explorer XXIX (Geos A) were recorded at Goddard and also at Blossom Point; Rosman, N.C., Edinburg, Texas; the Coast and Geodetic Survey station at Beltsville, Maryland; and the Smithsonian Astrophysical Observatory station at Organ Pass, New Mexico. These flashes were the first from the spacecraft since it was oriented properly.

NOVEMBER 24
The 85-foot antenna system no. 2 at Rosman, North Carolina was accepted.

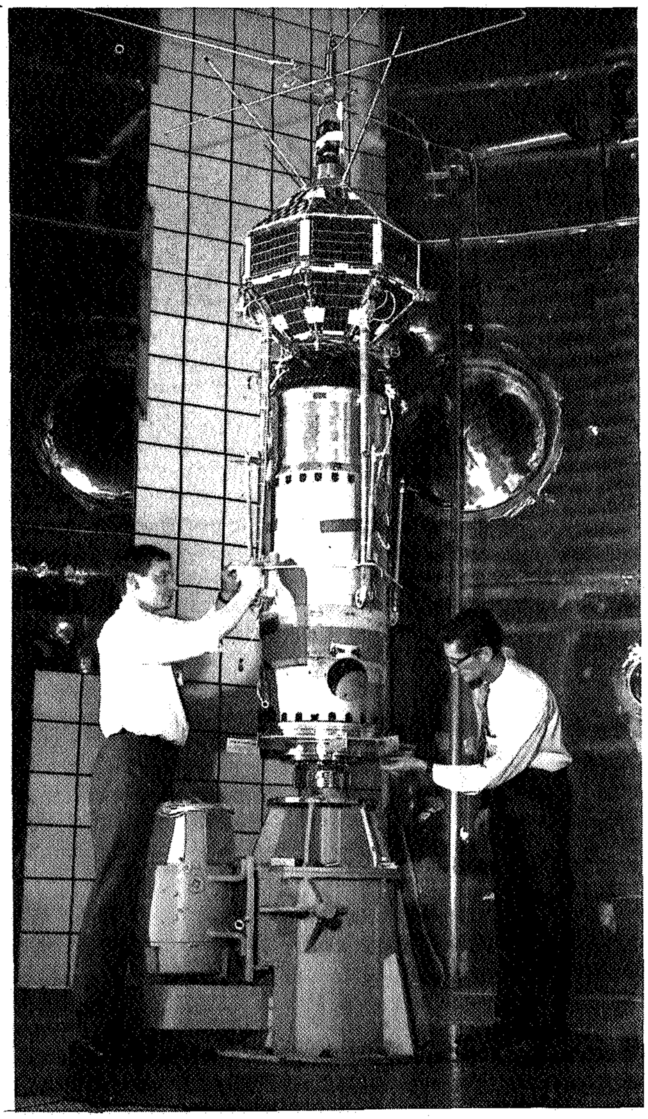
NOVEMBER 28
The ISIS-X satellites, Alouette II and Explorer XXXI, DME-A, were launched from the Western Test Range at 11:48 p.m., EST. Preliminary values of position and velocity vectors at injection based on radar tracking data were furnished by the Manned Flight Operations

Boom Deployment Test of REA Antenna



Division. Principal elements of the orbits were as follows:

	Preflight Nominal Values	*Values Based on Alouette II*	*Early Minitrack Data for Explorer XXXI, DME-A*
Period (min.)	121.4	121.4	121.4
Perigee height (km.)	500	501	501
Apogee height (km.)	3000	2983	2984
Inclination (deg.)	80	80	80



France's FR-1 spacecraft is prepared for testing in the Dynamic Test Chamber at Goddard. The FR-1 is designed to study propagation of very low frequency waves as well as irregularities in the distribution of the ionosphere.

NOVEMBER 30

A group of amateur astronomers working on a lunar research project reported to have observed unusual color glows on the Moon and made photographs of the phenomenon.

The group told NASA it saw the color in the crater Aristarchus during a four-hour period before daylight Nov. 15 through a 16-inch telescope at Port Tobacco, Maryland.

The observation was a culmination of a 16-month vigil by members of a "Moon-Blink" team from Annapolis, Md. The team made two previous confirmed sightings, including one in the crater Alphonsus last year, but they were much shorter and were not photographed.

The team, operating under a NASA contract, developed the instrument from an idea conceived by Dr. James B. Edson, technical assistant to the Associate Administrator for Advanced Research and Technology.

The contract was handled through the Goddard Center.

LATE NOVEMBER

A paper by Ness and Behannon entitled "Magnetic Storms in the Earth's Magnetic Tail" showed that there were correlations between magnetic field changes observed in the tail of the magnetosphere and changes observed on the surface of the earth. Compressions of the tail and the drawing out of additional lines of force into the tail were mechanisms that might help explain this phenomena.

LATE NOVEMBER

The installation of the Nimbus ground station in ULASKA was completed, except for the MRIR bit synchronizer and the PCM teletype output device. Limited checkout of the equipment had been completed and installation personnel were returning to Goddard.

LATE NOVEMBER

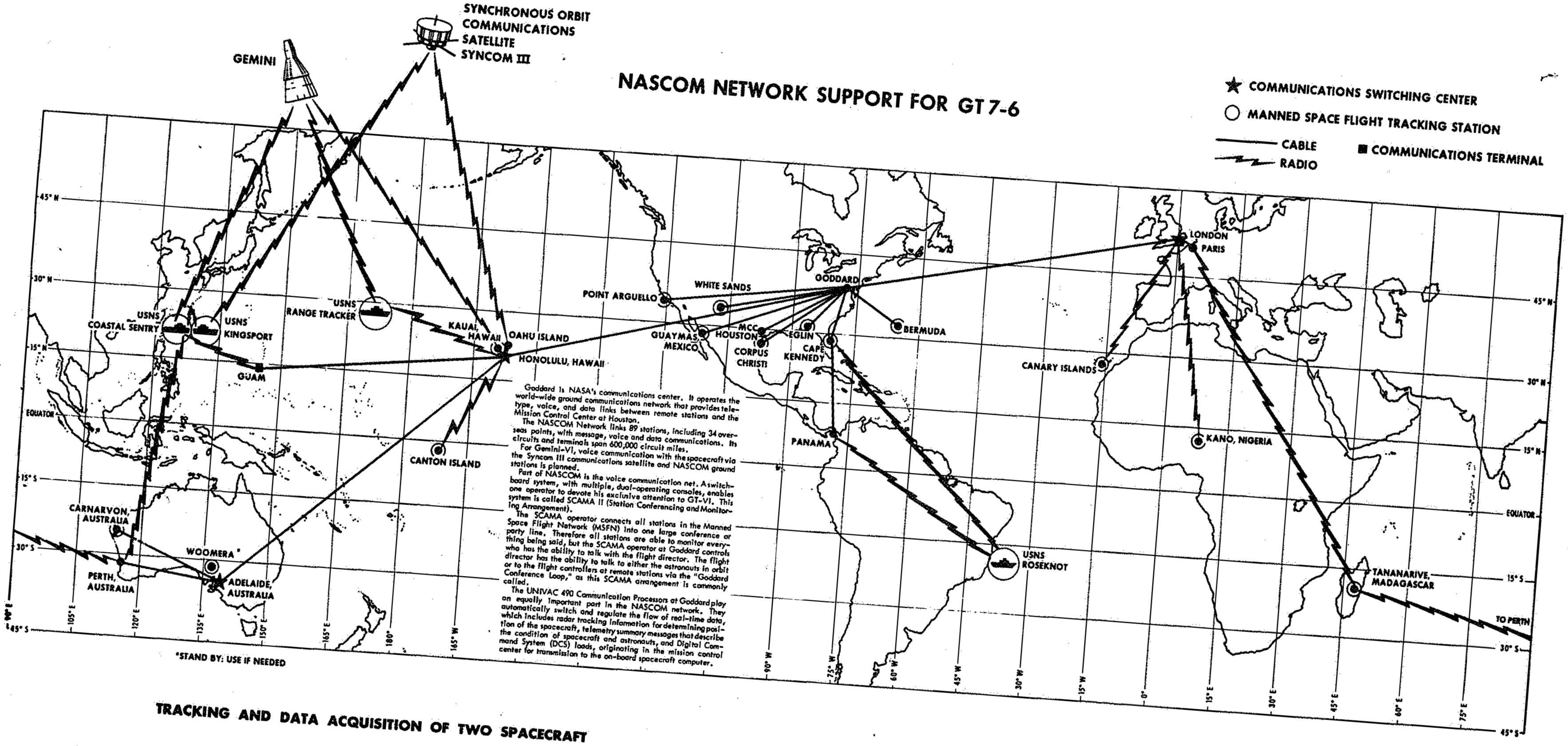
Three instruments to be used on the current GT 7/6 flights were designed by the Astrophysics Branch and built by the Experimental Fabrication and Engineering Division:

Spectrograph attached to a Hasselblad 500C flight camera with a sighting device.
An adaptable lens which converts the camera lens into a monocular with an aluminated reticule.
Optical filter adapters.

EARLY DECEMBER

Detector equipment for GT 7/MSC-4 Laser Communication Experiment was installed on the telespectrograph at Ascension Island, and checked out. Weather prevented fly-by tests of radar slaving accuracy, but ground tests showed system performing satisfactorily. The argon ion laser to be used as a pointing beacon for the astronaut was operated. Laser passes tentatively assigned to Ascension to occur during orbits 46, 62, 91, and 164. Alternate passes were in orbits 120, 135, and 193.

NASCOM NETWORK SUPPORT FOR GT 7-6



Goddard is NASA's communications center. It operates the world-wide ground communications network that provides tele-type, voice, and data links between remote stations and the Mission Control Center at Houston.

The NASCOM Network links 89 stations, including 34 over-seas points, with message, voice and data communications. Its circuits and terminals span 600,000 circuit miles.

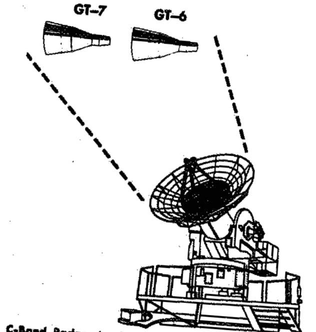
For Gemini-VI, voice communication with the spacecraft via the Syncom III communications satellite and NASCOM ground stations is planned.

Part of NASCOM is the voice communication net. A switch-board system, with multiple, dual-operating consoles, enables one operator to devote his exclusive attention to GT-VI. This system is called SCAMA II (Station Conferencing and Monitor-ing Arrangement).

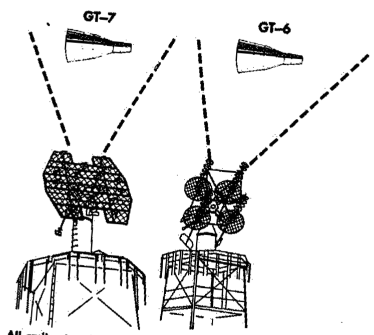
The SCAMA operator connects all stations in the Manned Space Flight Network (MSFN) into one large conference or party line. Therefore all stations are able to monitor every-thing being said, but the SCAMA operator at Goddard controls who has the ability to talk with the flight director. The flight director has the ability to talk to either the astronauts in orbit or to the flight controllers at remote stations via the "Goddard Conference Loop," as this SCAMA arrangement is commonly called.

The UNIVAC 490 Communication Processors at Goddard play an equally important part in the NASCOM network. They automatically switch and regulate the flow of real-time data, which includes radar tracking information for determining posi-tion of the spacecraft, telemetry summary messages that describe the condition of spacecraft and astronauts, and Digital Com-mand System (DCS) loads, originating in the mission control center for transmission to the on-board spacecraft computer.

TRACKING AND DATA ACQUISITION OF TWO SPACECRAFT



C-Band Radar pinpoints each spacecraft and detects differ-ence from variations in beacon signals.

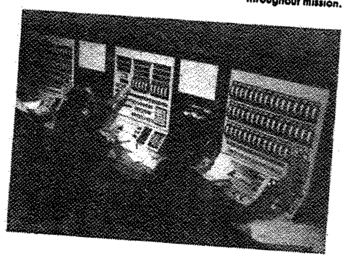


All radio signals bearing information about men and capsule enter the PCM telemetry antenna. GT–7 data is directed to Gemini Systems Monitor Console; GT–6 data to Agena Systems Monitor Console.

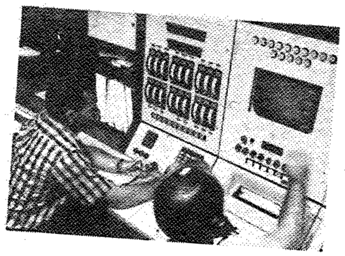
AGENA SYSTEMS CONSOLE
GT–6 spacecraft data will be dis-played on Agena Systems Monitor Console.

COMMAND COMMUNICATOR CONSOLE
Presents composite status of spacecraft systems and has ground command controls for trigger-ing on-board sys-tems events.

GEMINI SYSTEMS CONSOLE
GT–7 spacecraft data is displayed on Gemini Systems Monitor Console throughout mission.



AEROMEDICAL MONITOR CONSOLE. Full biomedical presenta-tions will be displayed at key ground station Aeromedical Consoles during the GT 7 portion of the mission. For the GT7–6 rendezvous segment, composite data on the four astronauts will be presented at the console with the remainder going to Sanborn recorders and Cardiotac (meters) counters located next to the console.



GT7-6 Instrumentation

EARLY DECEMBER

TIROS X and VII supported the Gemini mission.

DECEMBER 2

Dr. Hugh Latimer Dryden, 67, Deputy Administrator died of cancer. He held that position since the establishment of NASA.

DECEMBER 4

Launch of the GT 7/6 mission (GT 7 liftoff 14.30 EST) was according to the GSFC Data Operations Branch, "the most perfectly executed and nominal launch witnessed." Inserted into an 87/177 n.mi. orbit the astronauts then performed a station keeping series of maneuvers to fly formation on the booster. Goddard simultaneously tracked the booster and the spacecraft and indicated the separation distance between the two vehicles to be a few miles for over 2 revolutions. A maneuver was then performed raising perigee of the spacecraft to 120 n.mi. which changed its period, and caused the booster to phase out ahead of the spacecraft

The Titan II booster tracked by Goddard reentered 13:30Z on December 7 in the 42nd revolution. A new phenomena was observed. The booster on entering the atmosphere breaks up as visually observed by the MILA site during GT-4. One fragment of the booster developed lift and skipped out of the atmosphere across the NORAD radar site at Trinidad where it was tracked and reentered in the Atlantic Ocean. The main portion of the booster reentered in the South Pacific.

DECEMBER 6

The French VLF satellite FR-I was launched from the Western Test Range at about 4:05 p.m., EST. Preflight nominal values and the principal elements of the orbit were as follows:

	Preflight Nominal Values	*Values Based on Early Minitrack Data*
Period (min.)	100	100
Perigee height (km.)	735	744
Apogee height (km.)	740	773
Inclination (deg.)	76	76

DECEMBER 14

The further development effort on the Advanced Orbiting Solar Observatory (AOSO) was cancelled.

Development of AOSO was begun in November 1963. A contract was negotiated with Republic Aviation Corporation, Farmingdale, N.Y., which subsequently merged with Fairchild Hiller Corporation, to develop a 1450-pound satellite capable of accurately pointing 250 pounds of instruments at the sun. Scientific instruments were being developed to study a broad range of solar radiation emitted from specific locations on the solar disc.

The spacecraft cancellation was ordered because of budgetary considerations. Through Fiscal Year 1966, $39,000,000 had been budgeted for AOSO program. Some of the $24.9 million appropriated in Fiscal Year 1966, however, were expected to be recoverable.

MID DECEMBER

The Experiment Engineering Branch was the first to occupy Building 21.

MID DECEMBER

From December 4 to December 18 the Center provided computing support for the GT-7/6 mission. The areas of support for which Goddard was responsible performed without incident. The network was Green. The two sets of remote site computer programs (40.8 kilobit, 2 kilobit, and low speed TTY) for GT-7 and GT-6 performed flawlessly. CADFISS ran smoothly preflight and postflight. The GT-7 and GT-6 second stage boosters were successfully tracked to splash. Skin track pointing data on both spacecrafts and boosters was transmitted to the Network. All the computer updates to the spacecraft prior to reentry were checked by Goddard including the times to fire retros for the spacecrafts. The reentry and impact point computations performed by Goddard were fed directly to MSC for backup.

In summary GT-7/6 a new mission conceived in November and executed in December requiring a considerable Goddard effort to tailor the network to support two manned vehicles simultaneously in a rendezvous exercise, was successfully supported by Goddard in all required areas.

DECEMBER 15

At 8:26 a.m., GT 6 was launched at Cape Kennedy. At 2:27 p.m., EST, 185 miles above the Pacific Ocean, two orbiting Gemini spacecraft drew within 10 feet of one another for the start of a six-hour "formation" flight. Man's first rendezvous in space had been accomplished. The entire GT 7/6 mission was supported by GSFC's NASCOM and the Center-managed Manned Space Flight Tracking Network.

The tracking station at Hawaii radioed that they were standing by in case the astronauts wanted to consult with the ground.

"There just seems to be a lot of traffic up here, that's all," Astronaut Walter M. Schirra said.

For Astronauts Frank Borman and Jim Lovell, the "visit" must have been a blessed relief. For 11 days, the two astronauts had been drifting through space in their tiny capsule, able to move no more than a few inches off their seats.

There was unfeigned exhilaration in Borman's voice when—as Gemini 6 inched in to within six feet of his spacecraft—he radioed the message: "We have company tonight."

After six hours of close formation flight, during which all four astronauts took turns maneuvering near and around the other craft Gemini 6 pulled away a few miles, and the astronauts settled down for a night's sleep.

DECEMBER 16

Brazil successfully launched the first sounding rocket from its Natal Range. The launching was conducted by the Brazilian Space Activities Commission (CNAE).

Instrumentation for the rocket payload and the telemetry ground support equipment was constructed by Brazilian technicians of the Goddard Space Flight Center.

DECEMBER 16

While Astronauts Frank Borman, Jr., and Jim Lovell looked on in their GT 7 spacecraft Astronaut Walter M. Schirra fired the GT 6 retrograde rockets and dropped swiftly away from Gemini 7 to begin reentry. At 10:29 a.m., Gemini 6 splashed down into the Atlantic, 12 miles from the carrier Wasp, the prime recovery ship. It was over for Schirra and Stafford. Borman and Lovell still had three more days to go.

DECEMBER 18

Gemini 7 followed Walter M. Schirra and Thomas Stafford's blazing reentry through the earth's atmosphere to splash down on schedule at 9:05 a.m.

The journey of 5,149,400 miles ended 7.6 miles from the carrier Wasp. Astronauts Frank Borman and Jim Lovell—dirty, exhausted, bearded and beaming—were taken aboard the recovery ship by helicopter. After 14 days of weightless confinement in the equivalent of the front seat of a Volkswagen, the two astronauts walked steadily through the welcoming crowd to the ship's sick bay to begin days of verbal and medical debriefing.

DECEMBER 19

Robert E. Bourdeau, former Head, Planetary Ionospheres Branch, Laboratory for Space Sciences, Space Sciences Directorate was appointed Assistant Director for Projects. Concurrent with Mr. Bourdeau's appointment, Dr. Siegfried J. Bauer was appointed Head, Planetary Ionospheres Branch. Dr. Bauer continued to serve as Acting Head of the Upper Ionosphere Section.

DECEMBER 30

NASA Administrator James E. Webb presented the NASA Exceptional Service Medal to John T. Mengel, Goddard's Assistant Director for Tracking and Data Systems, in ceremonies held at the Manned Spacecraft Center, Houston.

The citation read in part: ". . . for his outstanding contributions to the mastery of space flight as demonstrated by the development and operation of worldwide networks for tracking, data acquisition and communications in support of NASA space programs, manned and unmanned, scientific and applied, and for leadership in the development of the basic operational concepts that have resulted in efficient program support by these facilities as recently evidenced in the Gemini VI and VII rendezvous space flights."

END OF DECEMBER

The Tiros Project Review

Completed 2½ years of useful operation of TIROS VII including IR and Electron Temperature. Both IR and ET data were no longer required after 2 years operation.

Completed 2 years of useful operation of TIROS VIII.

Improved daily world-wide coverage from 30% to 90%. In January 1965 TIROS VII and VIII yielded an average total of 225 pictures per day for approximately 30% earth coverage. With launch of TIROS IX an average of 480 pictures per day yielded approximately 90% earth coverage.

Completed study of a TIROS satellite in a highly eccentric orbit, simulating synchronous altitude.

Completed study and project development plan of a TIROS satellite containing HRIR for nighttime coverage.

Launched TIROS IX—first wheel spacecraft.

Established and demonstrated centralized telemetry data processing for TIROS including attitude determination.

Terminated use of PMR CDA station without loss of system effectiveness and at considerable savings.

Modified TIROS OT-1 for sun-synchronous orbit.

Launch TIROS X into near perfect sun-synchronous orbit.

Established and demonstrated system to relay all TIROS picture data to GSFC and subsequently to NESC. This resulted in halving the time from receipt of picture and analyses to dissemination to real time users. Also it established TIROS data as a regular and required input to the daily global weather analysis.

Administrater James E. Webb (right) presents NASA's Exceptional Service Medal to John T. Mengel, Goddard's assistant Director for Tracking and Data Systems.

In summary, TIROS has evolved a system which was being used operationally and was prepared to launch OT-3 to fulfill data requirements until initiation of the TOS system.

TIROS LAUNCHINGS AND PERFORMANCE
(Active Spacecraft)

TIROS	*Launch Date*	*Useful TV Life*	*Useful IR Life*	*Total Pictures*	*Sensors*	*Special Accomplishment*
VII	6/19/63	925 days as of 12/31/65	730 days as of 6/19/65	118,214	Two wide angle TV, two IR systems, 1 ETP	Hurricane coverage special IR study for Horizon Sensors
VIII	12/21/63	791 days as of 12/31/65	—	90,891 CAM-1 APT 4074	Wide angle TV and APT	Hurricane coverage direct picture readout operations
IX	1/22/65	343 days as of 12/31/65	—	67,295	Two wide angle TV	Wheel mode successful; daily world-wide coverage accomplished; QUOMAC and Horizon-sensing camera trigger successful
X	7/2/65	182 days as of 12/31/65	—	36,930	Two wide angle TV	Hurricane coverage sun-sync. orbit

Status of data from active TIROS satellites:

	VII	*VIII*	*IX*	*X*
Orbit	13,693	10,748	4,144	2,611
Picture Total	122,328	101,300	67,930	54,832
Total Usable	112,689	93,804	62,533	50,937
(%)	(92.1)	(92.6)	(92.1)	(92.9)
Nephanalyses	3,683	2,825	5,306	4,229
Storm Bulletins	630	794	891	752
Grand Total of all TIROS Pictures	602,091			

Archival Status:

TIROS I-VI – All usable pictures archived
TIROS VII All pictures up to orbit 11,921 (87%)
TIROS VIII All pictures up to orbit 8,996 (84%)
TIROS IX All pictures up to orbit 1,254 (30%)

END OF DECEMBER
During the year members of the Goddard Staff received the following recognitions:

NASA HONORARY AWARDS

Exceptional Scientific Achievement

Dr. Leslie M. Meredith, Chief, Laboratory for Space Sciences, for assembling and directing an outstanding group of space scientists who have significantly advanced our Nation's knowledge and understanding of the space environment. For originating mission concepts and specific payloads on Explorer and Observatory spacecraft.

Dr. William Nordberg, Assistant Chief, Laboratory for Atmospheric and Biological Sciences, for the development of a highly intricate infrared imaging system which has contributed greatly to man's knowledge of the earth's surface and atmospheric surroundings thereby enhancing the interpretation of meteorological and geodetic phenomena.

Group Achievement Award

The Syncom Group, for outstanding teamwork and group effort in the planning and execution of the Syncom Program which has significantly advanced the position of the United States as the leading nation in the field of satellite communications. Alfred J. Babecki, Richard M. Buckingham, Robert G. Chaplick, Joseph P. Corrigan, Robert J. Darcey, Richard A. DeMarco, Don V. Fordyce, George H. Harris, Richard T. Hibbard, Alton E. Jones, Paul Karpiscak, George G. Kronmiller, John Larson, Kenneth R. Mercy, Howard A. Miller, Ann M. Provoncha, Dr. Joseph W. Siry, Harry E. Tetirick, Carl A. Wagner, Forest H. Wainscott, John B. Zegalia.

PRESIDENTIAL CITATIONS FOR ECONOMY ACHIEVEMENTS

The OGO Experiment Qualifications Group

Theodore C. Goldsmith, Willard E. Jackson, Frank T. Jones, Donald A. Krueger, James W. Kunst, Earl R. Moyer, Richard P. Puffenberger, James H. Shisler, Calvin F. Showalter, Aubrey T. Smith, Jan M. Turkiewicz, John H. Wolsh.

Individual Employee Achievement

Herman S. Kaufman, Facilities Engineering Division; Lawrence R. Shipp, Facilities Engineering Division; James A. Sterhardt, Spacecraft Integration and Sounding Rocket Division.

Arthur S. Flemming Award

Dr. Robert Jastrow, Director, Goddard Institute for Space Studies, for continuous research concerning various aspects of nuclear theory and in particular the concept that there exists a very short repulsive force between nucleons inside the attractive forces that holds nuclear matter together. This concept is generally referred to as the "Jastrow hardcorepotential" and represents an essential step forward in the understanding of nuclear-nucleon interaction.

John Adam Fleming Award

Dr. Norman F. Ness, Laboratory for Space Sciences, for his experiments aboard Explorers 18 and 21 which increased our knowledge and fundamental understanding of the geomagnetic field, the interplanetary magnetic field and the interaction of the solar wind with the earth and the moon.

Best Technical Paper

Dr. Raymond C. Waddel, Consultant, Spacecraft Technology Division, Paper titled: "Radiation Damage to Solar Cells on Relay I and Relay II."

Awards for Patentable Inventions

Otto E. Berg and W. Merle Alexander, Micro-Particle Impact Sensing Appartus; Vincent J. DiLosa and Charles R. Laughlin, Diversity-Locked Combining System; Harold Shapiro and William F. Hardgrove, Omni-Directional Anisotropic Molecular Trap; Joseph G. Haynos, Interconnection of Solar Cells; John N. Libby and Harry D. Moore, Reversible Ring Counter; Victor R. Simas; Optimum Pre-Detection Diversity Combining System; Frank A. Volpe and Benjamin G. Zimmerman, Sun Tracker.

Invention Award

A. Guy Eubanks and Ronald E. Hunkeler, Spacecraft Technology Division, Foamed-in-place Ceramic Refractory Insulating Material.

NASA Group Achievement Award

The Goddard Launch Operations Division, for outstanding achievement and significant contributions to mankind's understanding and use of space by conducting the world's most successful launch operation program for orbiting unmanned spacecraft.

The Sounding Rocket Group, for exceptional technical achievement in creating, expanding, and operating the NASA sounding rocket program; for developing the program on an international basis in close cooperation with many foreign nations thereby supporting the world's scientific community, fostering international goodwill, and emphasizing the role of the United States as a champion of the peaceful use of space.

APPENDIX A

GODDARD SPACE FLIGHT CENTER AUTHORED STUDIES

TECHNICAL NOTES

JANUARY

D-2588 Cane, "Quadrature Formulae for the Ω and Φ

D-2614 Bernier, R., Hoffman, R., Timmins, A., and Powers, E., "Solar Simulation Testing of an Earth Satellite at Goddard Space Flight Center."

FEBRUARY

D-2612 Maeda, K., "Diffusion of Auroral Electrons in the Atmosphere."

D-2627 Smith, G. D., "Flyback Voltage Regulator."

MARCH

D-2682 Spafford, M., Wiack, A., and Woodman, "The Rocket Interferometer Tracking (RIT) System."

D-2692 Musen, P., "On the General Perturbations of the Position Vectors of a Planetary System."

D-2646 Ludwig, G. H., "The Orbiting Geophysical Observatories."

APRIL

D-2732 Lehnert, R., Rosenbaum, B., "Plasma Effect on Apollo Re-Entry Communication."

D-2752 Korvin, W., Steckel, J., "A Vertical Test Range for Antenna Radiation Measurements."

MAY

D-2667 Bissell, E., "A Standard Telemetry Package for Nike-Apache Vehicles."

D-2756 Nagy, J., "Flight Vibration Data from the Scout X-258 Rocket Motor."

D-2758 Rogers, L., Hepler, D., "Constant Amplitude Variable Phase Filters."

D-2759 Wagner, C., "Determination of the Ellipticity of the Earth's Equator from Observations on the Drift of the Syncom II Satellite."

D-2766 Stark, K., White, A., "Survey of Continuous Loop Recorders Developed for and Flown on Meteorological Satellites."

D-2790 Obayashi, T., "Corpuscular Streams Related to Solar M-Regions."

D-2791 Talwar, S., "Hydromagnetic Stability."

D-2819 Studer, P., "Development of a Sealed Brushless DC Motor."

JUNE

D-2534 Bandeen, W. Halev, M., Strange, I., "A Radiation Climatology in the Visible and Infrared from the TIROS *Meteorological Satellites*."

D-2822 Ferris-Prabhu, A., "PADE Approximant Calculation of the Singularity in the Magnetic Susceptibility of an Ising Square Lattice."

D-2826 Fitz, J., "Solid State, Sequential Camera Trigger Circuits."

D-2851 Allison, L., "The Interpretation of TIROS Radiation Data for Practical Use in Synoptic Weather Analysis."

D-2852 Carpenter, L., "Computation of General Planetary Perturbations, Part II, A Comparison of Components."

JULY

D-2789 Obayashi, T., "Magnetosphere and Its Boundary."

D-2798 COSPAR, "Goddard Space Flight Center Contributions to the COSPAR Meeting, May, 1964."

D-2825 Thornwall, J., "Analog to Digital Converter for the S-57 Ion-Chamber Experiment."

D-2874 Stassinopoulos, E., "A Computer Program to Calculate Artificial Radiation Belt Decay Factors."

D-2888 Priester, W., Rosenberg, J., "Extragalactic Radio Sources."

D-2911 Henry, V., McDonald, M., "Television Tests with the Syncom II Synchronous Communications Satellite."

D-2918 Mahoney, M., Quann, J., "Visual Presentation of the Motion and Orientation of an Orbiting Spacecraft (OGO).

D-2952 Creveling, J., "Signal-to-Noise Ratios in Magnetic Recording."

AUGUST

D-2880 Vonbun, F., "Apollo Entry Tracking: A Shipborne Unified S-Band Interferometer System."

D-2893 Granick, N., Stern, J., "Material Damping of Alumini m by a Resonant-Dwell Technique."

D-2917 Tomboulian, D., "The Determination of Absolute Photon Fluxes and Applications to Calibration Procedures in the 100A and 300A Range."

D-2940 Conrath, B., "A Survey of the Methods Developed for the Inversion of the Radiative Transfer Problem for Planetary Atmospheres."

D-2963 Looney, C., Carlson, D., "Coverage Diagrams for X-Y and Elevation-Over-Azimuth Antenna Mounts."

D-2964 McIlwraith, N., Lind, D., "The Pressure Profile of a Rocket Payload after Nose-Cone Ejection."

SEPTEMBER

D-2919 Kobren, L., "Effects of Electron Radiation on TV Lens Components."

D-2939 Langebartel, R. G., "Two-Center Problem Orbits as Intermediate Orbits for the Restricted Three-Body Problem."

D-2992 Liwshitz, M., Singer, S., "Thermal Escape of Neutral Hydrogen and Its Distribution in the Earth's Thermosphere."

D-3000 Morakis, J., "Bandwidth Optimization in Frequency Shift Keying."

D-3001 Turkiewicz, J., Fueschsel, C., Martin, R., Piazza, F., Krueger, V., "Electronic Integration of the UK-1 International Ionosphere Satellite."

OCTOBER

D-2984 Goldstein, J., Adler, I., "Absorption Tables for Electron Probe Microanalysis."

D-3002 Bahiman, H., "Membrane Analysis of Pressurized Thin Spheroid Shells Composed of Flat Gores, and Application to Echo II."

D-3008 Bauernschub, J., "Mechanism for Spacecraft Optical Instrumentation."

D-3009 Theon, J., Nordberg, W., "On the Determination of Pressure and Density Profiles from Temperature Profiles in the Atmosphere."

D-3020 Harrison, E. R., "Equation of State of Matter at Supernuclear Density."

D-3033 Shapiro, H., "A Mass Spectrometric Analysis of DC 704 Diffusion-Pump Oil Fragmentation."

D-3050 Rabinovich, H., "Partial Wave Calculation of the Diatomic Molecule $(HeH)^{++}$

D-3052 Talwar, S. P., "Two-Stream Instability in Gravitating Plasmas with Magnetic Field and Rotation."

NOVEMBER

D-2842 Karras, T. J., "Equivalent Noise Bandwidth Analysis from Transfer Functions."

DECEMBER

D-3051 Talwar, S. P., "Volume and Surface Instability in Sliding Plasmas."

D-3084 Musen, P., "On the Numerical Theory of Satellites with Highly Inclined Orbits."

D-3108 Serlemitsos, P., "An Investigation of the Intensities and Charge Composition of Low Energy Electrons at Balloon Altitudes."

TECHNICAL REPORTS

APRIL

R-215 Samuelson, R. E., "Radiative Transfer in a Cloudy Atmosphere."

R-217 Langebartel, R., "Liouville's Equation and the n-Body Problem."

R-266 Busse, J., Leffler, M., "Compendium of Aerobee Sounding Rocket Launchings from 1959 through 1963."

SPECIAL PUBLICATIONS

SP-74 Thekaekara, M., "A Survey of the Literature on the Solar Constant and the Spectral Distribution of Solar Radiant Flux."

SP-80 "IEEE-NASA Symposium on Short-Term Frequency Stability."

SP-87 "Proceedings of the Apollo Unified S-Band Technical Conference."

SP-89 "Observations from the Nimbus I Meteorological Satellite."

APPENDIX B

THE GODDARD MISSION AND CAREERS FOR YOUNG SCIENTISTS AND ENGINEERS

Discussed By

Dr. John F. Clark
Acting Director, Goddard Space Flight Center

The Goddard Space Flight Center is the first U. S. Laboratory devoted entirely to the investigation and exploration of space. The Center is responsible for the complete development of experiments in basic and applied science on orbiting spacecraft and sounding rockets. Our work includes astronomical, geophysical, weather and communications satellites which orbit in that region of space between the earth and the moon known as cislunar space. We also manage the Delta launch vehicle, a world-wide communications network, and two world-wide Tracking and Data Acquisition networks serving manned and unmanned spaceflight missions.

By virtue of its extremely wide variety of activities and responsibilities, Goddard is one of the few installations in the world which is capable of conducting a complete space science mission from theory through experiment conception, design and construction; satellite design, fabrication, testing, launching, and tracking; and data acquisition, reduction, analysis, interpretation and, most important of all, reporting.

Our present capabilities can be best characterized by their diversity. Substantial numbers of our people are engaged in scientific studies in systems engineering, in the development of advanced technology for flight spacecraft and their associated ground systems, and in the technical and administrative management of our projects.

Our scientific staff, one of the largest groups of space scientists in the free world, is concerned primarily with the scientific disciplines of magnetic fields, energetic particles, ionospheres and radio physics, planetary atmospheres, meteorology, interplanetary matter, solar physics, and astronomy. Of all the scientific experiments flown in spacecraft by the United States, approximately one-third have been conceived, designed, and built by Goddard scientists. These experiments were selected in open competition from proposals made by domestic and foreign scientists in universities, industry, and other Government laboratories. Meanwhile the Center has had the management responsibility for more than half of the earth satellites launched by the NASA. Some of these spacecraft have been designed and built by Goddard engineers and technicians; for example the Interplanetary Monitoring Platform (IMP). For other spacecraft, we have gone to industry, either as prime contractor, as in the case of the Orbiting Astronomical Observatory, or as our own prime contractor, as in the case of Nimbus.

Thus, our program provides much of the basic scientific data essential to a better understanding of our planet, of the solar system, and of the universe. At the same time, necessary technology is being developed for space flight projects, manned and unmanned. Our activities provide for and require considerable interaction among many scientific and engineering disciplines, such as physics, astronomy, geodesy, geology, mathematics, astrophysics, electronics, mechanics, and aerospace engineering.

The regions of space being studied by our scientists can be divided into five general areas.

The first of these includes the planet Earth, with its associated atmosphere, ionosphere, and magnetosphere. Within this entire region the magnetic field of earth is dominant over that of the sun, and in collaboration with the earth's atmosphere acts as a protective shield to prevent a major portion of the outside radiations and particles from reaching the surface of the earth.

The second study area is known an interplanetary space. It is separated from the near-earth region by the magnetopause, the outer edge of the earth's magnetosphere. Within the interplanetary space, phenomena are controlled by the sun, and are essentially independent of any influence of the Earth.

The third area concerns the sun itself, the "mother" star of our solar system and the source of virtually all of the energy which reaches Earth.

The fourth area of study includes the other large bodies in the solar system, that is our moon and the other planets.

The fifth and last area includes the remainder of the vast universe, specifically the stars of our own galaxy, other galaxies, and interstellar matter, as disclosed by the electromagnetic radiation emitted or absorbed by these objects. Thus, this scientific research is yielding new knowledge about the earth and its extended atmosphere and magnetosphere; the sun and its influence on the earth and other planets; physical life, its origins and fundamental nature; and about the universe itself, its history and evolution.

In our search for this new knowledge we use a variety of scientific satellites. Since 1958 we have launched over thirty major scientific satellites. These are, in fact, orbiting laboratories which allow us to conduct extended observations beyond the Earth's atmosphere. In the near future we plan to orbit similar satellites about the moon for more extensive studies of the interplanetary space beyond the magnetosphere and of the magnetospheric tail which streams away from the Earth in the direction opposite to that of the sun. We have also launched an average of more than one hundred sounding rockets each year, primarily to increase our knowledge of that interesting portion of the upper atmosphere which lies below satellite altitudes but above balloon altitudes, and also to flight-test instruments which are destined for more expensive satellite and space probe flights.

Scientific satellite projects managed by Goddard include:

PROJECT	OBJECTIVE
Orbiting Solar Observatory	Studies of electromagnetic radiation from the sun.
Orbiting Astronomical Observatories	Telescopic stellar observations in the ultraviolet spectrum.
Interplanetary Monitoring Platform, (IMP)	Detailed measurements of the cis-lunar environment.
Radio Astronomy Satellite	Investigate radio emissions in space at frequency ranges not detectable by ground-based radio observatories.
Atmospheric Structure Satellite	Study of composition, density, pressure and temperature of earth's upper atmosphere.
Swept Frequency Topside Sounder, and Fixed Frequency Topside Sounder	Studies of upper ionosphere.
Orbiting Geophysical Observatory	Broad scale geophysical studies encompassing radiation belts, ionospheric phenomena, and magnetic fields.
Energetic Particles Satellite	Radiation and magnetic fields.
International Satellites Ariel – UK/US Alouette – ISIS-X FR-I – French San Marco – Italian ESRO (now under development)	To provide cooperative experimental capabilities in space to the international scientific community.
Electron Density Profile Probe	Ionospheric electron concentration and radio wave propagation studies.

The majority of these satellites are launched from the Atlantic or Pacific Missile Ranges. Their orbits vary from circular to highly elliptical, and from equatorial to polar, as required by the objectives of the mission.

Another very important area of interest as far as this Center is concerned is the Applications Satellite program. We are learning very rapidly how to better our daily lives with the help of orbiting satellites.

TIROS and Nimbus are Goddard-managed meteorological satellites. Thus far we have launched 11 TIROS satellites with such reliability that the environmental science services administration has adopted the TIROS operational system (TOS) for regular weather prediction purposes. We are now concentrating our meteorological research and development activities on the Nimbus satellite, which is more versatile because of its larger size and its three-axis stabilization which directs its cameras continuously toward the Earth. Also, Nimbus cameras have a higher resolution that those used in TIROS, and infra-red radiation sensors are used at night to record cloud formations.

In the area of Communications satellites, Goddard helped develop Echo, the passive communication balloon, and Relay and Syncom, which amplify and rebroadcast radio signals back to Earth. The Syncom concept has been employed in Early Bird, the commercial satellite of the Communications Satellite Corporation.

Another very important function is Goddard's role as the hub of virtually all of NASA's tracking activities. Indeed, without telemetry, command and control, our unmanned spacecraft would be silent pieces of orbiting hardware, and our astronauts would be beyond the reach of the thousands who support each mission.

Perhaps the major use of the Goddard-managed communications net is the flow outward from the control center to the remote stations, and thence to the spacecraft, of the commands and instructions, sometimes in voice, but more usually in digital codes, that insure safety and proper functioning of man, spacecraft, and all its complex systems and instruments.

Three tracking and data acquisition networks support NASA's missions: the manned spaceflight network (MSFN), the satellite tracking and data acquisition network (STADAN), and the Jet Propulsion Laboratory's deep-space network (DSN). This world-wide system thus serves both manned and unmanned satellite cis-lunar and deep-space missions.

Each mission generates its own peculiar requirements with respect to timeliness of data, distances of data transmission, and geographical coverage requirements. Some flights, particularly manned missions, require that all information be gathered and centrally displayed in "real-time". Others require that each station be able to inform the next as to the predicted spacecraft position. Still others require control of telemetry sequences based upon specific events such as solar flares or magnetic storms. In the case of a weather satellite, proper commands "tell" it when to take pictures of storms and when to transmit the pictures to stations on the earth.

Goddard supports our astronauts with a world-wide net of tracking stations that link the precious cargo to the mission control center in Houston and to the recovery fleets deployed on two oceans.

Gemini involves not only a two-man capsule but also, on rendezvous missions, an Agena target vehicle, thereby imposing a dual tracking requirement on the stations. Moreover, Gemini astronauts are able to exercise considerable control over their orbital path in long-duration missions. In terms of information handled, the equipment used in the Gemini network absorbs some 40 times the amount generated by Mercury. Gemini capsule measurements of 275 telemetry items alone are three times those of Mercury.

For Project Apollo, the requirements placed upon us in the tracking area have been further increased. Here we must support three vehicles or modules which will perform major and complex maneuvers on missions that will extend for 8 to 14 days. This must be done not only in earth orbit but also between the earth and moon, in orbit around the moon, and landing on the moon, as well as during the complex return to earth.

An air and sea armada will support the tracking of Project Apollo. Currently we have five instrument-laden Apollo ships in various stages of modification and eight C-135 aircraft which are being modified to serve as Apollo Range Instrumented Aircraft.

The ships and aircraft will be dispersed around the globe to keep tab on all crucial phases of the Apollo mission. They will track the Saturn V/Apollo liftoff from Launch Complex 39 at Kennedy Space Center and will follow the rocket through separation of its three stages.

These ships and planes will be in contact with the Apollo pilots when the spacecraft is inserted into earth orbit; they will follow the spacecraft through as many as three revolutions until it is injected into its lunar trajectory. These same ships and aircraft will again take up their assigned stations to monitor and provide communications links with the Apollo command module during the final phases of its return to earth. This is just one example of our effort in the area of Apollo tracking.

This then is our mission. It is obvious that such a broad and extensive program on the frontiers of science and technology requires the work of many minds and many hands as well as materials, equipment, and energy. It is obvious also that no one organization could possibly do the whole job. The Space Act directs that NASA enlist the resources of the nation and provides many special authorizations, such as grant authority to universities, provision for detail of qualified personnel from the military services, support of NASA activities through use of facilities of the Department of Defense and other agencies, and so forth. About 90 percent of the appropriations to NASA are spent outside the agency. Thus the NASA program is conducted by a great university-industry-government team working cooperatively toward common ends.

NASA itself was created by the assembly of existing governmental groups with some additional growth. The nucleus was the 8000 employees of the former National Advisory Committee for Aeronautics with a budget of approximately $100 million in 1957. To these were added the Vanguard and upper air research groups from the Naval Research Laboratory and the Development Operations Division of the Army Ballistic Missile Agency which had launched Explorer I, the first U. S. Satellite. The facilities of the Jet Propulsion Laboratory of the California Institute of Technology were transferred from the Army, and this laboratory is now operated under contract with NASA. The total NASA budget jumped to $300 million in 1959, to $1.2 billion in 1962 and to $5.3 billion in 1966.

However, our most precious resource is our employees. Considered as a whole, NASA employees fall into three roughly equal groups: 32 percent professional scientists and engineers; 31 percent administrative technician, and clerical personnel, and 37 percent trades and craft personnel. This approximate balance has developed and persisted over many years.

When a young scientist or engineer who is well trained in the fundamentals enters NASA, whatever his field of science or branch of engineering, he has many doors open to him. He may specialize in a wide variety of fields. Guided by his education, abilities, and interests, we offer to him and give financial support for advanced graduate courses appropriate for his further career development. These courses usually yield academic credit toward graduate degrees, whether taught on a university campus or by NASA professionals accredited as university instructors. In addition, research work done for NASA in line of duty may be used as the basis for graduate dissertations.

We are also anxious to enable our staff to obtain professional recognition for outstanding work in their respective disciplines. This has several aspects. One is the very basic matter of public recognition of research and development contributions. In many activities, both public and private, this is made difficult in that publications are either anonymous or bear only the name of the chief of the project or the head of the organization. Here at goddard we have a tradition of many years standing, of listing the name and title of each significant contributor. This may, and often does, occur even during the first year of work for NASA of a fresh baccalaureate graduate. Such public recognition has a marked stimulating effect on productivity.

Closely related to this is our practice of having young researchers give lectures on their work before public or specialized technical audiences, and at professional society meetings. We pay for their attendance at professional meetings, not only to read technical papers, but also for the cross-fertilization of ideas which occurs during informal discussions.

We invite outstanding national and international authorities to lecture at Goddard on advanced topics and to engage in informal seminar discussions with our scientists and engineers. Finally, we recognize special achievement in a variety of ways. Among these are nominations for special awards by professional societies and awards, both honorary and monetary, by the Federal Government. We in NASA have been quite successful in capturing many such awards. These recognitions are both appreciated by those deserving and stimulating to those striving for recognition.

And what is your part in this important and exciting effort? Fabricating hardware? Negotiating contracts? Operating the tracking network? Testing meteorological satellites? Conducting experiments in X-ray astronomy? Whatever your job, you play an important role in our productive team of administrators, technicians, engineers and scientists who know that, truly, in the words of Dr. Robert H. Goddard, "It is difficult to say what is impossible for the dream of yesterday is the hope of today and the reality of tomorrow."

APPENDIX C

PROJECT SUMMARY DATA

PART I

GODDARD SPACE FLIGHT CENTER SATELLITE AND SPACE PROBE PROJECTS

Designation	Objectives	LAUNCH AND ORBIT DATA: Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles: Perigee	Apogee	Project Manager and Project Scientist	EXPERIMENT DATA: Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	Remarks
EXPLORER VI 1959 Delta 1 S-2	To measure three specific radiation levels of earth's radiation belts; test scanning equipment for earth's cloud cover; map earth's magnetic field; measure micrometeorites; study behavior of radiowaves.	Aug. 7, 1959 Oct. 6, 1959	Thor-Able ETR	12-½ hours	156	27,357	Dr. John C. Lindsay Dr. John C. Lindsay	Equipment to measure radiation levels; TV-type scanner; micrometeorite detector; two types of magnetometers and devices for space communication experiments.	Triple coincidence telescopes–A Scintillation counter–E Ionization chamber Geiger counter–E Spin-coil magnetometer–E Fluxgate magnetometer–E Aspect sensor Image-scanning television system Micrometeorite detector–P	J. A. Simpson, C. Y. Fan, P. Meyer T. A. Farley, Allen Rosen, C. P. Sonnett J. Winckler E. J. Smith, D. L. Judge P. J. Coleman	U. of Chicago TRW/STL U. of Minnesota TRW/STL TRW/STL TRW/STL TRW/STL AFCRL TWR/STL	Orbit achieved. All experiments performed. First complete televised cloud-cover picture was obtained. Detected large ring of electrical current circling earth; first detailed study of region now known as the Van Allen radiation belt. Weight: 142 lb. Power: Solar
VANGUARD III 1959 Eta	To measure the earth's magnetic field, X-radiation from the sun, and several aspects of the space environment through which the satellite travels.	Sep. 18, 1959 Dec. 12, 1959	Vanguard ETR	130	319	2329		Proton precisional magnetometer, ionization chambers for solar X-rays, micrometeorite detectors and thermistors.	Proton magnetometer–E Ionization chambers–E Environmental measurements	J. P. Heppner H. Friedman H. E. LaGow	GSFC NRL GSFC	Orbit achieved. Provided comprehensive survey of earth's magnetic field over area covered; surveyed location of lower edge of Van Allen radiation belt. Accurate count of micrometeorite impacts. Power: Solar
EXPLORER VII 1959 Iota 1 S-1a	Variety of experiments, including solar ultraviolet; X-ray; cosmic-ray; earth radiation, and micrometeor experiments.	Oct. 13, 1959 Aug. 24, 1961	Juno II ETR	101.33	342	680	H.E. LaGow	Sensors for measurements of earth-sun heat balance; Lyman-alpha and X-ray solar radiation detectors; micrometeorite detectors, Geiger-Mueller tubes for cosmic ray count; ionization chamber for heavy cosmic rays.	Thermal radiation balance Solar X-ray and Lyman-alpha–S Heavy cosmic radiation–E Radiation and solar-proton observation–E Ground-based ionospheric observations–I	V. Suomi H. Friedman, R. W. Kreplin, T. Chubb G. Groetzinger, P. Schwed, M. Pomerantz J. Van Allen, G. Ludwig, H. Whelpley G. Swenson C. Little G. Reid O. Villard, Jr. W. Ross	U. of Wisconsin NRL Martin Co. Bartol Research St. U. of Iowa U. of Illinois Nat. Bu. of Standards U. of Alaska Stanford U. Penn State U.	Orbit achieved. Provided significant geophysical information on radiation and magnetic storms; demonstrated method of controlling internal temperatures; first micrometeorite penetration of a sensor in flight. Weight: 91.5 lb. Power: Solar

ABBREVIATIONS:

AFCRL	Air Force Cambridge Research Lab.
ARC	Ames Research Center
BTL	Bell Telephone Labs.
CRPL	Central Radio Propagation Lab.
DRTE	Defense Research Telecommunications Establishment
DSIR	Department of Scientific and Industrial Research
ETR	Cape Kennedy
GSFC	Goddard Space Flight Center
JPL	Jet Propulsion Lab.
MIT	Massachusetts Institute of Technology
NRC	National Research Council
NRL	Naval Research Labs.
TRW/STL	Thompson-Ramo-Wooldridge/Space Technology Labs.
WTR	Vandenburg Air Force Base

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PART I
GODDARD SPACE FLIGHT CENTER SATELLITE AND SPACE PROBE PROJECTS (Cont.)

Designation	Objectives	LAUNCH AND ORBIT DATA					Project Manager and Project Scientist	EXPERIMENT DATA				Remarks
		Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles: Perigee	Statute Miles: Apogee		Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	
S-1a (Continued)									 Micrometeorite penetration–P	W. Dyke H. LaGow	Linfield Res. Inst. GSFC	
PIONEER V 1960 Alpha	To investigate interplanetary space between orbits of earth and Venus, test extreme long-range communications, study methods for measuring astronomical distances.	Mar. 11, 1960 June 26, 1960	Thor-Able ETR	311.6 days	Perihelion 74.9 million from sun	Aphelion 92.3 million from sun	Dr. John C. Lindsay Dr. John C. Lindsay	High-intensity radiation counter, ionization chamber Geiger-Mueller tube to measure plasmas, cosmic radiation, and charged solar particles. Magnetometer and micrometeorite temperature measurements.	Triple coincidence proportional counter cosmic-ray telescope–E Search-coil magnetometer and photo-electric cell aspect indicator–E Ionization chamber and G-M tube–E Micrometeorite counter–P	J. Simpson D. Judge J. Winckler E. Manring	U. of Chicago TRW/STL U. of Minnesota AFCRL	Highly successful exploration of interplanetary space between orbits of earth and Venus; established communication record of 22.5 million miles on June 26, 1960; made measurements of solar flare effects, particle energies and distribution, and magnetic-field phenomena in interplanetary space. Weight: 94.8 lb. Power: Solar
TIROS I Beta 1960 A-1	To test of experimental television techniques leading to eventual worldwide meteorological information system.	April 1, 1960 June 16, 1960	Thor-Able ETR	99.1	428.7	465.9	W. G. Stroud H. I. Butler	One wide and one narrow angle camera, each with tape recorder for remote operation. Picture data can be stored on tape or transmitted directly to ground stations.	TV camera systems (2)			Provided first global cloud-cover photographs (22,952 total) from near-circular orbit. Weight: 270 lb. Power: Solar
ECHO I 1960 Iota	To place 100-foot inflatable sphere into orbit; measure reflective characteristics of sphere and propagation; study effects of space environment.	Aug. 12, 1960 Passive satellite	Thor-Delta ETR	118.3	945	1049	R. J. Mackey	Two tracking beacons 107.94 Mc and 107.97 Mc	Communications	JPL BTL NRL		Demonstrated use of radio reflector for global communications; numerous successful transmissions. Visible to the naked eye. Orbit characteristics perturbed by solar pressure due to high area-to-mass ratio. Still in orbit. Weight: 132 lb. (including inflation powder) Power: Passive
EXPLORER VIII 1960 Xi S-30	To investigate the ionosphere by direct measurement of positive ion and electron composition; collect data on the frequency, momentum, and energy of micrometeorite	Nov. 3, 1960 Dec. 28, 1960	Juno II ETR	112.7	258	1423	Robert E. Bourdeau Robert E. Bourdeau	RF-impedance probe using a 20-foot dipole sensor; single-grid ion trap; four multiple-grid ion traps; Langmuir probe experiment, rotating shutter electric field meter; micro plier;	RF impedance–I Ion traps–I	J. Cain R. Bourdeau G. Serbu E. Whipple J. Donley	GSFC GSFC	The micrometeorite influx rate was measured. Weight: 90.14 lb. Power: Battery

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Designation	Objectives	Launch and Orbit Data: Launch Date/ Silent Date	Launch and Orbit Data: Vehicle & Launch Site	Launch and Orbit Data: Period (Min.)	Statute Miles: Perigee	Statute Miles: Apogee	Project Manager and Project Scientist	Experiment Data: Instrumentation Summary	Experiment Data: Experiment and Discipline*	Experiment Data: Experimenter	Experiment Data: Affiliation	Remarks
EXPLORER VIII (Continued)	impacts; establish the attitude of the base of the exosphere.							micrometeorite microphone; thermistors for reading internal and surface temperatures of the spacecraft, and despin mechanisms to reduce spin from 450 to 30 rpm.	Langmuir probe–I Rotating-shutter electric field meter–I Micrometeorite photomultiplier–I Micrometeorite microphone–I	R. Bourdeau, G. Serbu, E. Whipple, J. Donley J. Donley M. Alexander, C. McCracken, O. Berg M. Alexander, C. McCracken	GSFC GSFC GSFC GSFC	
TIROS II 1960 Pi I A-2	To test experimental television techniques and infrared equipment leading to eventual world-wide meteorological information system.	Nov. 23, 1960 July 12, 1961	Delta ETR	98.2	406	431	Dr. R. A. Stampfl	Included one wide-angle and one narrow-angle camera, each with tape recorder for remote operation; infrared sensors to map radiation in various spectral bands; attitude sensors; experimental magnetic orientation control.	Two TV camera systems Widefield radiometer Scanning radiometer	W. Nordberg R. Hanel	GSFC GSFC	Orbit achieved. Narrow-angle camera and IR instrumentation sent good data. Transmitted 36,156 pictures. Still operative. Weight: 277 lb. Power: Solar
EXPLORER IX 1961 Delta I S-56a (A project of the Langley Research Center with GSFC participation)	To study performance, structural integrity, and environmental conditions of Scout research vehicle and guidance controls system. Inject inflatable sphere into earth orbit to determine density of atmosphere.	Feb. 16, 1961 Passive satellite	Scout Wallops Island	118.3	395	1605		Radio beacon on balloon and in fourth stage.				Vehicle functioned as planned. Balloon and fourth stage achieved orbit. Transmitter on balloon failed to function properly requiring optical tracking of balloon. Weight: 80 lb. Power: Passive
EXPLORER X 1961 Kappa P-14	To gather definite information on earth and interplanetary magnetic fields and the way these fields effect and are affected by solar plasma.	March 25, 1961 March 27, 1961	Thor-Delta ETR	112 hours	100	186,000	Dr. J. P. Heppner Dr. J. P. Heppner	Included rubidium vapor magnetometer, two flux-gate magnetometers, a plasma probe, and an optical aspect sensor.	Rubidium-vapor magnetometer and flux-gate magnetometers–E Plasma probe–E Spacecraft attitude	J. P. Heppner, T. L. Skillman, C. S. Scearce H. Bridge, F. Scherb, B. Rossi J. Albus	GSFC MIT GSFC	Probe transmitted valuable data continuously for 52 hours as planned. Demonstrated the existence of a geomagnetic cavity in the solar wind and the existence of solar proton streams transporting solar interplanetary magnetic fields past the earth's orbit. Weight: 79 lb. Power: Battery

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Designation	Objectives	Launch and Orbit Data: Launch Date/ Silent Date	Launch and Orbit Data: Vehicle & Launch Site	Launch and Orbit Data: Period (Min.)	Launch and Orbit Data: Statute Miles: Perigee	Launch and Orbit Data: Statute Miles: Apogee	Project Manager and Project Scientist	Experiment Data: Instrumentation Summary	Experiment Data: Experiment and Discipline*	Experiment Data: Experimenter	Experiment Data: Affiliation	Remarks
EXPLORER XI 1961 Nu 1 S-15	To orbit a gamma-ray astronomy telescope satellite to detect high-energy gamma rays from cosmic sources and map their distribution in the sky.	April 27, 1961 Dec. 6, 1961	Juno II ETR	108.1	308	1113.2	Dr. J. Kupperian, Jr. Dr. J. Kupperian, Jr.	Gamma-ray telescope consisting of a plastic scintillator, crystal layers, and a Cerenkov detector; sun and earth sensors; micrometeorite shields; temperature sensor; damping mechanism.	Gamma-ray telescope—E	W. Kraushaar G. Clark	MIT	Orbit achieved. Detected first gamma rays from space. Directional flux obtained. Disproved one part of "steady-state" evolution theory. Weight: 82 lb. Power: Solar
TIROS III 1961 Rho 1 A-3	To develop satellite weather observation system; obtain photos of earth's cloud cover for weather analysis; determine amount of solar energy absorbed, reflected and emitted by the earth.	July 12, 1961 Feb. 1962	Delta ETR	100.4	461.02	506.44	Robert Rados	Two wide-angle cameras, two tape recorders and electronic clocks, infrared sensors, five transmitters, attitude sensors, magnetic attitude coil.	Omnidirectional radiometer Widefield radiometer Scanning radiometer Two T V Cameras	V. Suomi R. Hanel W. Nordberg	U. of Wisconsin GSFC GSFC	Orbit achieved. Cameras and IR instrumentation transmitted good data. Transmitted 35,033 pictures. Weight: 285 lb. Power: Solar
EXPLORER XII ENERGETIC PARTICLES EXPLORER 1961 Upsilon 1	To investigate solar wind, interplanetary magnetic fields, distant portions of earth's magnetic field, energetic particles in interplanetary space and in the Van Allen belts.	Aug. 15, 1961 Dec. 6, 1961	Thor-Delta ETR	26.45 hours	180	47,800	Paul Butler Dr. F. B. McDonald	Ten particle detection systems for measurement of protons and electrons and three orthogonally mounted fluxgate sensors for correlation with the magnetic fields, optical aspect sensor, and one transmitter. PFM telemetry transmitting continuously.	Two mass spectrometers—P Four vacuum (pressure) gauges—P Two electrostatic probes—I	C. Reber R. Horowitz G. Newton N. Spencer L. Brace	GSFC GSFC GSFC	Orbit achieved. All instrumentation operated normally. Ceased transmitting on Dec. 6, 1961, after sending 2568 hours of real-time data. Provided significant geophysical data on radiation and magnetic fields. Weight: 83 lb. Power: Solar
EXPLORER XIII 1961 Chi 1 (A project of the Langley Research Center with GSFC participation)	To test performance of the vehicle and guidance; to investigate nature and effects on space f flight of micrometeoroids.	Aug. 25, 1961 Aug. 27, 1961	Scout Wallops Island	97.5	74	722	C. T. D'Aiutolo	Micrometeoroids impact detectors; transmitters.	Cadmium sulphide photoconductor – A Wire grid	M. W. Alexander L. Secretan	GSFC	Orbit was lower than planned. Re-entered August 27, 1961. Weight: 187 lb. including 50-lb. 4th stage and 12-lb. transition section. Power: Solar
P-21 ELECTRON DENSITY PROFILE PROBE P-21	To measure electron densities and to investigate radio propagation at 12.3 and 73.6 Mc under daytime conditions.	Oct. 19, 1961 Oct. 19, 1961	Scout Wallops Island				John E. Jackson Dr. S. J. Bauer	Continuous-wave propagation experiment for the ascent portion of the trajectory, and an RF-probe technique for the descent.	RF probe—I CW propagation—I	H. Whale G. H. Spaid J. E. Jackson	GSFC GSFC GSFC	Probe achieved altitude of 4261 miles and transmitted good data. Electron density was obtained to about 1500 miles, the first time such measurements had been taken at this altitude.

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Designation	Objectives	LAUNCH AND ORBIT DATA: Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles: Perigee	Statute Miles: Apogee	Project Manager and Project Scientist	EXPERIMENT DATA: Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	Remarks
ARIEL 1 INTER-NATIONAL SATELLITE 1962 Omicron 1 (UK-1)	To study the relationship between ionosphere and cosmic rays.	April 26, 1962 Active (see remarks)	Delta ETR	100.9	242.1	754.2	R. C. Baumann Robert E. Bourdeau	Electron density sensor, electron temperature gauge, solar aspect sensor, cosmic-ray detector, ion mass sphere, Lyman-alpha gauges, tape recorder, X-ray sensors.	Electron density sensor–I Electron temperature gauge–I Cosmic-ray detector–E Ion mass sphere–I Lyman-alpha gauge–I X-ray emission–I	J. Sayers R. L. F. Boyd H. Elliot R. L. F. Boyd R. L. F. Boyd R. L. F. Boyd	U. of Birmingham, (U.K.) U. College, London (U.K.) Imperial College, London (U.K.) U. College, London (U.K.) U. College, London (U.K.) U. College, London (U.K.)	Orbit achieved. First international satellite. Contained six British experiments launched by American Delta vehicle. All experiments except Lyman-alpha transmitted as programmed. Lyman-alpha gauge failed during launch, ion mass sphere, Sept. 1962; X-ray emission, Oct. 1962; cosmic-ray detector, Dec. 1962, and electron density sensor, Mar. 1963. Tracking and data acquisition stopped on request of the project on June 30, 1964. Restarted on Aug. 25, 1964 for a 2-month period. Good data is being acquired from electron temperature gauge.
TIROS V 1962 Alpha Alpha 1 A-50	To develop principles of a weather satellite system; obtain cloud-cover data for use in meteorology.	July 19, 1962 May 4, 1963	Delta ETR	100.5	367	604	Robert Rados	Two TV camera systems with tape recorders for recording remote picture areas, magnetic orientation control, horizon sensor, north indicator.	Two TV camera systems			Launched at a higher inclination (58°) than previous TIROS satellites, to provide greater coverage. Time of launch chosen to include normal hurricane season for South Atlantic. One TV system transmitted good data for 10½ months. Weight: 285 lb. Power: Solar
TELSTAR NO. 1 (A project of AT&T) 1962 Alpha Epsilon 1	Joint AT&T–NASA investigation of wideband communications.	July 10, 1962 Feb. 21, 1963	Delta ETR	157.8	592.6	3503.2	C. P. Smith, Jr.	The system provided TV, radio, telephone and data transmission via a satellite repeater system.	Included electron detector for range 250,000-1 Mev; proton detectors in the following energy ranges 2.5-25.0 Mev, ranges greater than 50 Mev	W. Brown	BTL	Orbit achieved. Television and voice transmissions were made with complete success. BTL provided spacecraft and ground stations facilities. Government was reimbursed for cost incurred. Conducted more than 300 technical tests and over 400

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Designation	Objectives	LAUNCH AND ORBIT DATA: Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles: Perigee	Apogee	Project Manager and Project Scientist	EXPERIMENT DATA: Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	Remarks
TELSTAR NO. 1 (Continued)												demonstrations; 50 TV programs–5 in color. Weight: 175 lb. Power: Solar
TIROS VI 1962 Alpha Psi 1 A-51	To study cloud cover and earth heat balance; measurement of radiation in selected spectral regions as part of a program to develop meteorological satellite systems.	Sep. 18, 1962 Oct. 11, 1963	Delta ETR	98.73	425	442	Robert Rados	Two TV camera systems (78° and 104° lens), clocks and tape recorders for remote operation, infrared and attitude sensors, magnetic-attitude coil.	Two TV camera systems			Inclination 58.3 ; velocity at perigee 16,822; apogee, 16,756. Medium-angle camera failed Dec. 1, 1962 after taking 1074 pictures. TV camera provided good data for 13 months after launch. Weight: 300 lb. Power: Solar
ALOUETTE I SWEPT FREQUENCY TOPSIDE SOUNDER (Canada) 1962 Beta Alpha 1	To measure the electron density distribution in the ionosphere between the satellite height (620 miles) and the F2 peak (approx. 180 miles) and to study for a period of 1 year the variations of electron density distribution with time of day and with latitude under varying magnetic and auroral conditions with particular emphasis on high-latitude effects. To obtain galactic-noise measurements, study the flux of energetic particles, and investigate whistlers.	Sep. 29, 1962	Thor-Agena WTR	105.4	620	638	John E. Jackson	The satellite was spin-stabilized and contained a swept-frequency pulse sounder covering the frequency range 0.5 to 11.5 Mc. Sounder data was transmitted via a 2-watt FM telemetry system. Data from the other experiments and housekeeping data was transmitted through a ¼-watt PM-telemetry system. There were two sets of sounder antennas, the longest set measuring 150 ft. tip to tip. Data was acquired on command and in real time only.	Topside sounder–I Energetic particle counters–E VLF receiver (whistler)–I Cosmic noise–A	E. S. Warren G. L. B. Nelms G. E. Lockwood E. L. Hagg L. E. Petrie D. B. Muldrew R. W. Knecht T. E. Van Zandt W. Calvert J. W. King S. J. Bauer L. Blumle R. Fitzenreiter J. E. Jackson D. C. Rose I. B. McDiarmid J. S. Belrose T. R. Hartz	DRTE CRPL NBS DSIR England GSFC NRC Canada DRTE DRTE	The Alouette satellite is a project of the Canadian Defence Research Board. This international project is a part of NASA's topside sounder program and was the first NASA-launched satellite from the WTR. Alouette has the distinction of being the first spacecraft designed and built by any country other than the U.S. and the USSR. After almost 2 years in orbit, the satellite has experienced no failures and its operation was nominal. Weight: 320 lb. Power: Solar
EXPLORER XIV ENERGETIC PARTICLES SATELLITE 1962 Beta Gamma 1 EPE-B	To correlate energetic particles activity with observations of the earth's magnetic fields; to monitor the existence of transient magnetic fields associated with plasma streams.	Oct. 2, 1962 Feb. 1964	Delta ETR	36.58 hours	184	54,123	Paul G. Marcotte Dr. F. B. McDonald	A low-energy (0.1 to 20 kev) proton analyzer; a three-core magnetometer; one omnidirectional and three directional electron-proton detectors; a three-basic unit cosmic-ray package; an ion-electron scintillation detector; and devices to determine the	Proton analyzer–E Magnetic field (magnetometer)–E Trapped-particle radiation–E Cosmic-ray, ion-electron detector, solar-cell, and electrolytic timer–E	M. Bader L. Cahill J. A. Van Allen B. J. O'Brien F. B. McDonald L. R. Davis U. Desai	ARC U. of New Hampshire State U. of Iowa GSFC	Velocity at apogee 1507 mph; perigee 23,734 mph. Inclination to equator 33° Weight: 89.25 lb. Power: Solar

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GODDARD SPACE FLIGHT CENTER SATELLITES AND SPACE PROBE PROJECTS (Cont.)

Designation	Objectives	LAUNCH AND ORBIT DATA: Launch Date/ Silent Date	LAUNCH AND ORBIT DATA: Vehicle & Launch Site	LAUNCH AND ORBIT DATA: Period (Min.)	Statute Miles: Perigee	Statute Miles: Apogee	Project Manager and Project Scientist	EXPERIMENT DATA: Instrumentation Summary	EXPERIMENT DATA: Experiment and Discipline*	EXPERIMENT DATA: Experimenter	EXPERIMENT DATA: Affiliation	Remarks
EXPLORER XIV (Continued)								effects of radiation on solar cells and the effects of space on electrolytic timers.				
EXPLORER XV	To study artificial radiation belt created by nuclear explosion.	Oct. 27, 1962 Feb. 9, 1963	Delta ETR	5 hours (C. 315 min.)	195	10,950	Dr. John W. Townsend Dr. Wilmot Hess	Similar to Explorer XII	Electron energy distribution–I	W. Brown U. Desai	BTL GSFC	Good data received on artificial radiation belt. Weight: 100 lb. Power: Solar
									Omnidirectional detector–I	C. McIlwain	U. of California	
									Angular distributor–E	W. Brown	BTL	
									Directional detector–I	C. McIlwain	U. of California	
									Ion-electron detector–E	L. Davis	GSFC	
									Magnetic field–E	L. Cahill	U. of New Hampshire	
									Solar cell damage–I	H. K. Gummel	BTL	
RELAY I 1962 B Upsilon 1	To investigate wideband communications between ground stations by means of low-altitude orbiting spacecraft. Communications signal to be evaluated will be an assortment of TV signals, multichannel telephony, and other communications. To measure the effects of the space environment on the system; to include radiation damage to solar cells and radiation flux density. To provide tests and demonstrations of low-altitude communications satellite.	Dec. 13, 1962	Delta ETR	185.09	819.64	4612.18	Wendell Sunderlin Dr. Ramond Waddel	The spacecraft contained an active communications repeater to receive and retransmit communications between the U.S. and Europe, U.S. and South America, U.S. and Japan, and Europe and South America; and an experiment to assess radiation damage to solar cells, and to measure proton and electron energy.	Determine radiation damage to solar cells and semiconductor diodes–E	R. Waddel	GSFC	Orbit achieved. TV, telephone, teletype, facsimile, and digital-data transmissions were made with very satisfactory results. Conducted more than 2000 technical tests and 172 successful demonstrations. Weight: 172 lb. Power: Solar
									Measure proton energy (2.5-25.0 Mev)–E	W. Brown	BTL	
									Measure electron energy (1.25-2.0 Mev)–E	W. Brown	BTL	
									Measure integral omnidirectional proton flux energy (35.0-300.0 Mev)–E	C. McIlwain	U. of California	
									Measure directional electron energy (0.5-1.2 Mev)–E	C. McIlwain	U. of California	
									Measure directional proton energy (15.0-60.0 Mev)–E	C. McIlwain	U. of California	
									Measure directional proton energy (1.0-8.0 Mev)–E	C. McIlwain	U. of California	
SYNCOM I 1963 4A A-25	To provide experience in using communications satellites in a 24-hour orbit. To flight-test a new, simple approach to satellite attitude and period control. To develop transportable ground facilities to be used in conjunction with communications satellites. To develop capability of launching satellites	Feb. 14, 1963 Feb. 14, 1963	Delta ETR	24 hours	Near-synchronous orbit	22,300	R. J. Darcey	The 24-hour communications satellite consists of a spin-stabilized active repeater in a near-synchronous low-inclination orbit. The spacecraft is in the form of a cylinder 28 inches in diameter and 15 inches high. The repeater consists of a 7200-Mc receiver and an 1800-Mc transmitter with an output of 2 watts. In addition, the spacecraft contains				Twenty seconds after firing apogee rocket, all satellite transmissions stopped. The satellite was sighted on Feb. 28, 1963 and later dates. It was travelling in a near-synchronous orbit eastward at about 2.8° per day. Weight: 78 lb. Power: Solar

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Designation	Objectives	LAUNCH AND ORBIT DATA					Project Manager and Project Scientist	EXPERIMENT DATA				Remarks
		Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles			Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	
					Perigee	Apogee						
SYNCOM I (Continued)	into 24-hour orbit using existing vehicles, plus apogee kick techniques and to test components life at 24-hour-orbit altitude.							a vernier velocity control system for orientation of spin axis and adjustment of the orbit.				
EXPLORER XVII ATMOSPHERE EXPLORER 1963 9A	To measure the density, composition, pressure, and temperature of the earth's atmosphere from 135 to 540 nautical miles and to determine the variations of these parameters with time of day, latitude, and in part, season.	April 2, 1963 July 10, 1963	Delta ETR	96.4	158.1	598.5	N. W. Spencer	Primary detectors to be employed (two each) are: Double focusing magnetic sector mass spectrometer, hot-cathode total-pressure ionization gauges and cold-cathode total-pressure ionization gauges. The remaining satellite instrumentation converts the outputs from six detectors to radio signals.	Two mass spectrometers—P Four vacuum (pressure) gauges—P Two electrostatic probes—I	C. Reber R. Horowitz G. Newton N. Spencer L. Brace	GSFC GSFC GSFC GSFC	Confirmed that the earth is surrounded by a belt of neutral helium at an altitude of from 150 to 600 miles. Weight: 405 lb. Power: Silver zinc batteries
TELSTAR II 1963 13A (A project of AT&T)	Joint AT&T-NASA investigation of wideband communications.	May 7, 1963	Delta ETR	221	575	6559	C. P. Smith, Jr.	The system provides for TV, radio, telephone and data transmission via a satellite repeater system.	Included electron detector for energy range 750,000 to 2 Mev			"Evacuated" transistors in one of the encoders. Weight: 175 lb. Power: Solar
TIROS VII 1963 24A	To launch into orbit a satellite capable of viewing cloud cover, and the earth's surface and atmosphere by means of television cameras and radiation sensors. To acquire and process collected data from satellite and to control its attitude by magnetic means.	June 19, 1963	Delta ETR	97.4	385.02	401.14	Robert Rados	Two vidicon cameras each with a wide-angle lens, five-channel medium-resolution radiometer, electron temperature probe, and magnetic attitude coil.	Omnidirectional radiometer—P Scanning radiometer Electron temperature experiment—R	V. Suomi A. McCulloch N. Spencer	U. of Wisconsin GSFC GSFC	TV coverage extended to 65° N and 65° S latitudes. Launch date selected to provide maximum northern hemisphere coverage during 1963 hurricane season. Electron temperature probe malfunction 26 days after launch. First TIROS to have two operational camera systems and fully functioning IR subsystem 15 months after launch. Weight: 297 lb. Power: Solar Inclination: 58° to equator
SYNCOM II 1963 31A A-26	To provide experience in using communications satellites in a 24-hour orbit. To flight-test a new, simple approach to satellite attitude and period control. To	July 26, 1963	Delta ETR	24 hours	22,300 near-synchronous orbit		R. J. Darcey	The 24-hour communications satellite consists of a spin-stabilized active repeater in a near-synchronous low-inclination orbit. The spacecraft is in the form of a cylinder 28 inches				Orbit and attitude control of the spin-stabilized synchronous satellite achieved. Data, telephone, and facsimile transmission were excellent.

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GODDARD SPACE FLIGHT CENTER SATELLITES AND SPACE PROBE PROJECTS (Cont.)

Designation	Objectives	Launch and Orbit Data: Launch Date/ Silent Date	Launch and Orbit Data: Vehicle & Launch Site	Launch and Orbit Data: Period (Min.)	Statute Miles: Perigee	Statute Miles: Apogee	Project Manager and Project Scientist	Experiment Data: Instrumentation Summary	Experiment Data: Experiment and Discipline*	Experiment Data: Experimenter	Experiment Data: Affiliation	Remarks
SYNCOM II (Continued)	develop transportable ground facilities to be used in conjunction with communications satellites. To develop capability of launching satellites into 24-hour orbit using existing vehicles, plus apogee kick techniques and to test components life at 24-hour orbit altitude.							in diameter and 15 inches high. The repeater consists of a 7200-Mc receiver and an 1800-Mc transmitter with an output of 2 watts. In addition, the spacecraft contains a vernier velocity-control system for orientation of spin axis and adjustment of the orbit.				Television video signals also were successfully transmitted, even though the satellite was not designed for this capability. Weight: 70 lb. Power: Solar
EXPLORER XVIII INTERPLANETARY EXPLORER PLATFORM 1963 46A (IMP)	To study in detail the radiation environment of cislunar space and to monitor this region over a significant portion of a solar cycle. To study the quiescent properties of the interplanetary magnetic field and its dynamical relationships with particle fluxes from the sun. To develop a solar flare prediction capability for Apollo. To extend the knowledge of solar-terrestrial relationships. To further the development of simple, inexpensive, spin-stabilized spacecraft for interplanetary investigations.	Nov. 27, 1963	Delta ETR	93 hours	122	121,605	Paul Butler Dr. F. B. McDonald	To carry 10 experiments; essentially a combination of the successful GSFC Explorer X and XII satellites. It is spin-stabilized and powered by solar cells. The system is designed so that data can be received from apogee by the GSFC Minitrack stations.	Plasma-measure thermal ions and electrons 0.10 ev–I Magnetic field experiment (fluxgate magnetometer)–E Measure solar and galactic protons and alpha particles–E Measure total ionization produced per unit time in a unit volume of standard density air–E Measure flux of low-energy interplanetary plasma–E Measure solar and galactic protons, electrons, alpha particles, heavy primaries, and isotropy of solar proton events and of cosmic-ray modulation–E Magnetic field (rubidium-vapor magnetometer)–E Solar wind proton concentrations–E	G. P. Serbu R. Bourdeau N. F. Ness J. A. Simpson K. A. Anderson H. S. Bridge F. McDonald G. Ludwig N. F. Ness John Wolfe	GSFC GSFC U. of Chicago U. of California MIT GSFC GSFC ARC	All experiments and equipment operating satisfactorily except for thermal ion experiment which is giving only 10 percent good data. Continues to provide significant data since launch. First accurate measure of the interplanetary magnetic field, and the shock front. First satellite to survive a severe earth shadow of 7 hr., 55 min. Electronics equipment estimated to have cooled to below -60°C. Weight: 137.5 lb. Power: 38 watts solar
TIROS VIII 1963 54A	To launch into orbit a satellite capable of viewing cloud cover and the earth's atmosphere by means of television cameras. To acquire and process collected data from satellite and to control its attitude by magnetic means.	Dec. 21, 1963	Delta ETR	99.35	435.01	468.30	Robert Rados	One standard TIROS vidicon with a wide-angle lens camera system, and one automatic picture transmission camera system; magnetic attitude coil.				This satellite proved for the first time the feasibility of APT (automatic picture transmission) an inexpensive direct facsimile readout. Weight: 265 lb. Power: Solar

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Designation	Objectives	LAUNCH AND ORBIT DATA					Project Manager and Project Scientist	EXPERIMENT DATA				Remarks
		Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles			Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	
					Perigee	Apogee						
RELAY II 1964 3A	To investigate wideband communications between ground stations by means of low-altitude orbiting spacecraft. Communications signal to be evaluated will be an assortment of TV signals, multichannel telephony, and other communications. To measure also the effects of the space environment on the system; to include radiation damage to solar cells and radiation flux density. To provide tests and demonstration of low-altitude communications satellite.	Jan. 21, 1964	Delta ETR	194.7	1298	4606	Wendell Sunderlin Dr. Ramond Waddel	The spacecraft contains an active communications repeater to receive and retransmit communications between the U.S. and Europe, U.S. and South America, U.S. and Japan, and Europe and South America; and an experiment to assess radiation damage to solar cells, and to measure proton and electron energy.	Determine radiation damage to solar cells and semiconductor diodes–E Measure proton energy (2.5-25.0 Mev)–E Measure electron energy (0.6-1.6 Mev)–E Measure integral omnidirectional proton flux energy (40.0-300.0 Mev and electrons greater than 5 Mev)–E Measure directional electron energy (0.4-1.2 Mev)–E Measure directional proton energy (18.0-60.0 Mev)–E Measure directional proton energy (1.0-8.0 Mev)–E	R. Waddel W. Brown W. Brown C. McIlwain C. McIlwain C. McIlwain C. McIlwain	GSFC BTL BTL U. of California U. of California U. of California U. of California	Orbit achieved. TV, telephone, teletype facsimile, and digital-data transmissions were made with very satisfactory results. Conducted more than 1500 technical tests and 95 successful demonstrations. Weight: 184 lb. Power: Solar
ECHO II Passive Communications Satellite (Rigidized sphere) 1964 4A	To demonstrate a spacecraft deployment and rigidization technique applicable to passive-communications satellites; to advance the state-of-the-art represented by the presently orbiting Echo I satellite; to provide development directly applicable to the accomplishment of the Advanced Passive Communications Satellite Program; to constitute a step toward the development of the technology necessary for establishment of a global passive communications network for civilian use.	Jan. 25, 1964	Thor-Agena B WTR	109	557.9	709.1	Herbert L. Eaker	Two beacon transmitters	Communications Propagation Acquisition and tracking Radar Optical	U.S. Air Force, U.S. Navy, United Kingdom, Soviet Union, Ohio State University		Weight: 650 lb. Power: Solar Inclination: 82°
BEACON EXPLORER BE-A	To study for a minimum period of 1 year the variations of electron density distribution as a function of latitude, and seasonal and diurnal time, under varying magnetic and solar conditions.	Mar. 19, 1964 Mar. 19, 1964	Delta ETR	Note Remarks			Frank T. Martin Robert E. Bourdeau	Four coherent, ultra-stable, unmodulated CW transmitters (operating at 20, 40, 41, and 360 Mc) radiate signals from dipole antennas for reception by a worldwide network of over 100 observing stations.	Measurement of electron content–I Absorption, scintillation–I	Frank T. Martin Robert E. Bourdeau	U. of Illinois Pennsylvania State U. NBS Stanford U. and international participants	Observing Stations: Stations operated by prime experimenters: a. University of Illinois: Urbana, Illinois; Houghton, Michigan; Baker Lake, Canada; Adak, Alaska

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Designation	Objectives	LAUNCH AND ORBIT DATA: Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles: Perigee	Statute Miles: Apogee	Project Manager and Project Scientist	EXPERIMENT DATA: Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	Remarks
BE-A (Continued)												b. Pennsylvania State U. University Park, Pennsylvania Huancayo, Peru c. Stanford University: Stanford, California Honolulu, Hawaii; Macapa, Brazil; Guarapes, Brazil; S. J. dos Campos Brazil; Santiago, Chile; Ushuaia, Argentina d. Central Radio Propagation Laboratory (NBS): Boulder, Colorado; 2 mobile stations within 100-mile radius of Boulder, Colorado International Participation: More than 100 international observing ground stations participated in the program. Doppler tracking data both from Antigua and Brazil tracking stations indicated that the satellite did not achieve orbital velocity. The satellite re-entered the earth's atmosphere over the South Atlantic coast of Argentina and disintegrated. This was the first Delta vehicle failure in 23 launch attempts. Weight: 172 lb.
ARIEL II INTERNATIONAL SATELLITE 1964 15A	To continue U.S. - U.K. cooperative satellite program. This is second phase of a three-satellite program. The satellite mission is to make scientific measurements using the	Mar. 27, 1964	Scout Wallops Island	102	180	840	Emil Hymowitz Lawrence Dunkelman	Ariel II is designed to perform three experiments: the galactic-noise experiment to record galactic noise in the 0.75- to 3.0-Mc region and to explore the ionosphere; the ozone	Measurement of galactic radio noise in the 0.75- to 3.0-Mc frequency range—I Measure vertical distribution of atmospheric ozone—P	F. G. Smith K. H. Stewart	U. of Cambridge (U.K.) Air Ministry (U.K.)	This satellite is a cooperative U.S.-U.K. effort. The U.K. was responsible for all flight instrumentation pertaining to the experiments and for

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		Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles: Perigee	Statute Miles: Apogee		Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	
ARIEL II (Continued)	U.K.-furnished experiments.							experiment to measure the vertical distribution of ozone in the earth's atmosphere; and the micrometeorite experiment to obtain quantitative measurements of particle flux.	Measurement of the micrometeoroid flux—A	R. C. Jennison	U. of Manchester, Jodrell Bank (U.K.)	data-reduction analysis. The U.S. was responsible for the design, fabrication, and testing of the prototype-flight spacecraft and all subsystems, except for the experiment requirements. Tracking and data acquisition are joint responsibility. Inclination: 52° Power: Solar
SYNCOM III 1964 47A A-27	To provide experience in using communications satellites in a 24-hour near-equatorial orbit. To flight-test a new, simple approach to satellite attitude and period control. To develop transportable ground facilities to be used in conjunction with communications satellites. To develop capability of launching satellites into 24-hour near-equatorial orbit using existing vehicles plus apogee-kick techniques and to test components life at 24-hour orbit altitude.	Aug. 19, 1964	Thrust-augmented Delta ETR		22,300 synchronous orbit		R. J. Darcey	The 24-hour communications satellite consists of a spin-stabilized active repeater in a near-synchronous low-inclination orbit. The spacecraft is in the form of a cylinder, 28 inches in diameter and 15 inches high. The repeater consists of a 7200-Mc receiver and an 1800-Mc transmitter with an output of 2 watts. In addition, the spacecraft contains a vernier velocity-control system for orientation of spin axis and adjustment of the orbit.				Orbit and attitude control of the spin-stabilized satellite into near-equatorial synchronous orbit achieved. Data, telephone, and facsimile transmissions were excellent. Television video signals were successfully transmitted through the wideband (13-Mc) transponder. Weight: 70 lb. Power: Solar
EXPLORER XX IE-A 1964 51A	To measure the electron density distribution in space and time between the height of the maximum electron density in the F2 region (approximately 180 miles) and the height of the satellite (620 miles) including the geometry and number of irregularities. To determine the ion and electron densities and temperatures in the vicinity of the satellite and to estimate cosmic noise in the 2- to 7-Mc frequency range.	Aug. 25, 1964	Scout WTR	104	538	628	E. Dale Nelsen	Six ionosphere explorers from 1.50- to 7.22 Mc and an ion mass spectrometer (U.K.). The longest set of sounding antenna will measure 122 feet, tip to tip. Scientific data will be transmitted via a 2-watt FM telemetry system; upon command, data acquired in real time only. Housekeeping data acquired from a ¼-watt PM telemetry transmitter.	Fixed-frequency sounder—I Ion probe—I	R. Knecht R. L. F. Boyd A. P. Willmore	CRPL/NBS U. College, London	26 inches in diameter and 32-½ inches high; 2400 solar cells mounted round side of satellite. Weight: 97.9 lb. Power: Solar

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Designation	Objectives	LAUNCH AND ORBIT DATA					Project Manager and Project Scientist	EXPERIMENT DATA				Remarks
		Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles Perigee	Statute Miles Apogee		Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	
NIMBUS I	To provide a large amply powered earth-stabilized spacecraft and tests of a variety of sensors for atmospheric research coupled with a ground data-handling system to acquire and process atmospheric data in real time.	Aug. 28, 1964 Sept. 23, 1964	Thor-Agena B WTR	98.7	263	579	Harry Press William Nordberg	Television cameras to photograph earth's cloud cover; equipment for infrared radiation measurements. Two large paddles of solar cells convert the sun's energy into electric power. Spacecraft also has tape recorders, PCM telemetry, and 128 coded commands.	Advanced vidicon camera system	G. Burdett	GSFC	Due to premature burnout of Thor-Agena second stage, the spacecraft was launched into a highly elliptical orbit instead of the intended 550-mile circular orbit. Weight: 830 lb.
									Automatic picture transmission system	G. Hunter	GSFC	
									High-resolution infrared radiometer	L. Foshee	GSFC	
ORBITING GEOPHYSICAL OBSERVATORY OGO-I 1964 54A	To launch and operate an orbital spacecraft carrying experiments to make scientific geophysical measurements about the earth.	Sep. 4, 1964	Atlas-Agena B ETR	63.983 hr.	175	92,827	Wilfred E. Scull Dr. G. H. Ludwig	The first in a series of standarized "street car" satellites. This concept envisions a basic scientific spacecraft, capable of accommodating as many as 30 different experiments.	Triaxial search-coil magnetometer–E	E. J. Smith R. E. Holzer	JPL UCLA	Performance of the Atlas-Agena launch rocket was normal. However, shortly after separation from the Agena second stage it appeared that the mission might be in jeopardy because of nondeployment of two booms. This resulted in abnormal operation of the automatic control system to lock the spacecraft into its earth-stabilized orbit. The inability to lock on the earth was later attributed to the fact that the satellite's earth-seeking sensor was obscured by one of the undeployed booms. About 4½ hours after launch, OGO I was commanded into a "hold" condition while project officials evaluated telemetry data and prepared a contingency operations plan for a spin-stabilized spacecraft. Weight: 1048 lb. Power: Solar Inclination: 31°
									Rubidium-vapor magnetometer–E	J. P. Heppner	GSFC	
									Spherical ion and electron trap–I	R. C. Sagalyn	AFCRL	
									Planar ion and electron trap–I	E. C. Whipple	GSFC	
									Radio propagation–I	R. S. Lawrence	NBS	
									Atmospheric mass spectrum–R	H. A. Taylor, Jr.	GSFC	
									Interplanetary dust particles–P	W. M. Alexander	GSFC	
									VLF noise and propagation–I	R. A. Helliwell	Stanford U.	
									Radio astronomy–A	F. T. Haddock	U. of Michigan	
									Geocoronal Lyman-alpha scattering–P	P. W. Mange	NRL	
									Gegenschein photometry–P	C. L. Wolff K. Hallam S. P. Wyatt	GSFC GSFC U. of Illinois	
									Solar cosmic rays–S	K. A. Anderson	U. of California	
									Plasma, electrostatic analyzer–E	J. H. Wolfe	ARC	
									Plasma, Faraday Cup–E	H. J. Bridge	MIT	
									Positron search and gamma-ray spectrum–ES	T. L. Cline E. W. Hones, Jr.	GSFC Inst. Def. Anal.	
									Trapped radiation, scintillation counter–E	A. Konradi	GSFC	
									Cosmic-ray isotope abundance–E	G. H. Ludwig F. B. McDonald	GSFC GSFC	

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OGO-I (Continued)									Cosmic-ray spectra and fluxes–E	J. A. Simpson	U. of Chicago	
									Trapped radiation, omnidirectional counters–E	J. A. Van Allen	U. of Iowa	
									Trapped radiation, electron spectrometer–E	J. R. Winckler R. L. Arnoldy	U. of Minnesota	
EXPLORER XXI INTERPLANETARY EXPLORER PLATFORM (IMP II) 1964 60A	A detailed study of the radiation environment of cislunar space and monitoring this region over a significant portion of a solar cycle (11 years). To study the quiescent properties of the interplanetary magnetic field and its dynamical relationships with particle fluxes from the sun. Development of a solar flare prediction capability for Apollo. The extension of knowledge of solar terrestrial relationships. To further the development of simple, inexpensive, spin-stabilized spacecraft for interplanetary investigation.	Oct. 4, 1964	Delta ETR	35 hours	120	59,400	Paul Butler Dr. F. B. McDonald	Carries 9 experiments; it is spin-stabilized and powered by solar cells. The system is designed so that data can be received from apogee by the GSFC Minitrack stations.	MAGNETIC FIELD Rubidium vapor magnetometer–E	N. F. Ness	GSFC	The satellite failed to achieve the required orbit of 161,000-mile apogee. Weight: 136 lb. Power: Solar
									Two fluxgate magnetometers–E	N. F. Ness	GSFC	
									COSMIC RAY Range versus energy loss–E	J. A. Simpson C. Y. Fan G. Gloeckler	Enrico Fermi Inst. U. of Chicago	
									Energy versus energy loss–E	F. B. McDonald	GSFC GSFC	
									Orthogonal telescope array–E	F. B. McDonald	GSFC GSFC	
									Neher-type ion chamber–E	K. A. Anderson	U. of California	
									SOLAR WIND Low-energy proton analyzer–E	J. H. Wolfe	ARC	
									Plasma probe–E	H. S. Bridge	MIT	
									Thermal ion electron sensor–E	R. Bourdeau G. P. Serbu	GSFC GSFC	
EXPLORER XXII BEACON EXPLORER-B 1964 64A	To study for a minimum period of 1 year the variations of electron content distribution as a function of latitude, and seasonal and diurnal time, under varying magnetic and solar conditions. To support the beacon experiment by determining the electron density in the vicinity of the spacecraft. To test the feasibility of laser tracking.	Oct. 9, 1964	Scout WTR	104	549	669	Frank T. Martin Robert E. Bourdeau	Four coherent, ultra-stable, unmodulated CW transmitters (operating at 20, 40, 41, and 360 Mc) radiate signals from dipole antennas which are received by a world-wide network of over 80 observing stations. Two electron density probes. Laser corner reflector.	Ionosphere beacon–I	G. W. Swenson W. J. Ross U. K. Garriott R. S. Lawrence L. J. Blumle	U. of Illinois Pennsylvania State U. Stanford U. NBS GSFC International participants	Observing Stations: Stations operated by prime experimenters: a. University of Illinois: Urbana, Illinois; Houghton, Michigan; Baker Lake, Canada; Adak, Alaska b. Pennsylvania State University; University Park, Pennsylvania Huancayo, Peru
									Electron density–I	L. Brace	GSFC	
									Laser tracking	H. Plotkin	GSFC	

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GODDARD SPACE FLIGHT CENTER SATELLITES AND SPACE PROBE PROJECTS (Cont.)

Designation	Objectives	LAUNCH AND ORBIT DATA					Project Manager and Project Scientist	EXPERIMENT DATA				Remarks
		Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles			Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	
					Perigee	Apogee						
EXPLORER XXII (Continued)												c. Stanford University: Stanford, California; Honolulu, Hawaii; Macapa, Brazil; S. J. dos Campos, Brazil; Santiago, Chile; Ushuaia, Argentina d. Central Radio Propagation Laboratory (NBS): Boulder, Colorado: 2 mobile stations within 100-mile radius of Boulder, Colorado. e. Goddard Space Flight Center (GSFC): Blossom Point, Maryland International Participation: More than 80 international observing ground stations are participating in the program. Laser stations located at Wallops Island and GSFC. Weight: 115 lb.
SAN MARCO-1	To measure air density of the upper atmosphere and electron density. To study radio wave propagation known as "ducting."	Dec. 15, 1964	Scout ETR	95	128	510	Anthony J. Caporale	Spacecraft spin-stabilized at 3 rpm. Powered by non-rechargeable batteries.	As the atmosphere exerts a force on the spacecraft, a three-axis balance measures relative movement between the outer, lighter sphere and the heavy inner mass. Electron content measured by Faraday rotation method.	L. Broglio N. Carrara	U. of Rome, Italy U. of Florence, Italy	An Italian satellite project. First satellite to be built and instrumented in Western Europe; first satellite launched in U.S. by non-U.S. crew.
EXPLORER XXVI ENERGETIC PARTICLES EXPLORER-D 1964 86A	To study the injection, trapping, and loss of mechanisms of the trapped radiation belt (natural and artificial). The particle measurements will be correlated with data from the magnetic field experiment.	Dec. 21, 1964	Delta ETR	456	190	16,250	Gerald W. Longanecker Leo Davis	The spacecraft is spin-stabilized at 25 rpm/ nominal and powered by p-on-n solar cells.	Electron-proton angular distribution and energy spectra Electron-proton directional-omnidirectional detectors Magnetic field measurements	W. L. Brown C. E. McIlwain Laurence Cahill	Bell Telephone Lab. U. of California U. of New Hampshire	The satellite continues the work of earlier satellites in the explorer series which measured the Van Allen and the artificial radiation belts, produced by the Starfish nuclear

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Designation	Objectives	LAUNCH AND ORBIT DATA					Project Manager and Project Scientist	EXPERIMENT DATA				Remarks
		Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles			Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	
					Perigee	Apogee						
EXPLORER XXVI (Continued)									Ion-electron detector Solar-cell damage	Leo R. Davis J. M. Williamson L. W. Slifer	GSFC GSFC	explosion in the Pacific. Weight: 101 lb. Power: Solar Inclination: 20.1° Results have shown an apparent diffusion of > 40 Mev protons in the L = 2 vicinity and an increase in the intensity of > 500 kev protons by a factor of 2 in the L = 2.5 to L = 5 region; over the same region the 100 to 300 kev protons are greatly depleted.
TIROS-9 A-54 1965 4A	To launch a wheel-mode TIROS spacecraft that will contribute to the development of a global meteorological observation system.	Jan. 22, 1965	Delta ETR	119	436	1602	Robert Rados	Two standard TIROS cameras with recorders, two IR horizon sensors for attitude determination, a magnetic attitude control system; horizon sensors will be used with an on-board spacecraft computer to provide camera shutter at spacecraft local vertical. Magnetic spin control and spacecraft digital clock to be used.				To increase the area of meteorological observation, to improve the accuracy of TV picture location and to eliminate attitude constraints through the use of a cartwheel-configured satellite in a nearly sun-synchronous (82° retrograde) polar orbit. This configuration permits the cameras to view the earth and its cloud cover and is limited in coverage only by the sun's coverage of the earth. Weight: 305 lb. Power: Solar Inclination: 96.4°
ORBITING SOLAR OBSERVATORY OSO-II 1965 7A	To conduct experiments in solar physics above the earth's atmosphere; experiments will detect and measure electromagnetic radiation from the sun and determine its energy level.	Feb. 3, 1965 Nov. 6, 1965	Delta ETR	97	343	393	Laurence T. Hogarth Dr. John C. Lindsay	Stabilized platform for solar-oriented scientific instruments. Experiments not requiring fixed orientation with respect to the sun are housed in the spinning wheel section of the satellite. Electrical power is supplied by	POINTED Ultraviolet spectrometer-spectroheliograph 300-1400A-S Monitor solar X-ray bursts 2-8A, 8-20A, and 44-60A-S	L. Goldberg E. M. Reeves W. H. Parkinson W. Liller T. A. Chubb	Harvard U. NRL	Weight: 545 lb. (320 for spacecraft and 225 for experiments) Power: Solar Inclination: 33° Due to diminishing pitch gas supply, terminal maneuver

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Designation	Objectives	LAUNCH AND ORBIT DATA					Project Manager and Project Scientist	EXPERIMENT DATA				Remarks
		Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles Perigee	Statute Miles Apogee		Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	
ORBITING SOLAR OBSERVATORY (Continued)								an array of solar cells mounted on the stabilized section. A complete telemetry and command system is provided to transmit information back to earth. Essential difference between OSO-1 and OSO-II is ability of OSO-II to scan solar disc and corona with pointed instruments.	White light coronagraph-spectroheliograph Lyman-alpha, He I and He II lines—S WHEEL Monitor intensity and direction of polarized light from interplanetary space—A Measure arrival direction and energies of primary cosmic-gamma rays 100 Mev to 1 Bev—A Detect gamma rays and analyze their energy spectrum 0.1-0.7 Mev—S Ultraviolet stellar and nebular spectrophotometer 1500-3200A—A Measurement of thermal-radiation characteristics of surfaces to determine emissivity stability of spacecraft temperature-control coatings—E	R. Tousey E. P. Ney C. P. Leavitt K. J. Frost K. L. Hallam C. B. Neel	NRL U. of Minnesota U. of New Mexico GSFC GSFC ARC	was begun on September 24, 1965
EARLY BIRD HS-303 (First satellite project of the Communications Satellite Corp.) 1965 28A	Communications	April 6, 1965	TAD ETR		22,300		C. P. Smith					GSFC provided launching and associated services. Satellite operation was the responsibility of the Communications Satellite Corp.
EXPLORER XXVII BE-C (IONOSPHERE BEACON) 1965 32A	Ionosphere: To study for a minimum period of 1 year the variations of electron content distribution as a function of latitude, and seasonal and diurnal time, under varying magnetic and solar conditions. To support the beacon experiment by determining the electron density in the vicinity of the spacecraft. To test the feasibility of laser tracking. Geodesy: To study detailed perturbations in orbits of satellites to deduce the size and shape of the	April 29, 1965	Scout WI	108	584	819	Frank T. Martin Ionosphere: Robert E. Bourdeau Geodesy: Robert Newton	Ionosphere: Four-coherent, ultrastable, unmodulated CW transmitters (operating at 20, 40, 41, and 360 Mc) radiate signals from dipole antennas which are received by a world-wide network of over 80 observing stations. Two electron density probes. Laser corner reflector. Geodesy: Two coherent, ultrastable, unmodulated CW transmitters (operating at 162 and 324 Mc) radiate signals from dipole antennas which are received by a world-wide network of over 80 observing	Ionosphere beacon-1 Electron density-1 Laser tracking Geodesy	G. W. Swenson W. J. Ross U. K. Garriott R. S. Lawrence L. J. Blumle L. Brace H. Plotkin Geodesy: R. Newton	U. of Illinois Pennsylvania State Stanford U. NBS GSFC International participants GSFC GSFC APL	Observing Stations: Stations operated by prime experimenters Ionosphere: a. University of Illinois Urbana, Illinois; Houghton, Michigan; Baker Lake, Canada; Adak, Alaska b. Pennsylvania State University; University Park, Pennsylvania Huancaye, Peru Geodesy: Tranet – APL

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Designation	Objectives	LAUNCH AND ORBIT DATA					Project Manager and Project Scientist	EXPERIMENT DATA				Remarks
		Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles			Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	
					Perigee	Apogee						
EXPLORER XXVII (Continued)	earth and the nature of its gravity field.							stations. Two electron density probes. Laser corner reflector.				Laser: GSFC Inclination: 41°
EXPLORER XXVIII IMP III 1965 42A	To study in detail the radiation environment of cislunar space and to monitor this region over a significant portion of a solar cycle. To study the quiescent properties of the interplanetary magnetic field and its synamical relationships with particle fluxes from the sun. To develop a solar flare prediction capability for Apollo. To extend the knowledge of solar terrestial relationships. To further the development of simple, inexpensive, spin-stabilized spacecraft for interplanetary investigations.	May 29, 1965	Delta ETR	5 days 22-1/2 hr.	120	164,000	Paul Butler F. B. McDonald	Carries 9 experiments. Spin-stabilized and powered by solar cells. The system is designed so that data can be received from apogee by the GSFC Minitrack stations.	MAGNETIC FIELD Rubidium vapor magnetometer–E	N. F. Ness	GSFC	Inclination: 34°
									Two fluxgate magnetometers–E	N. F. Ness	GSFC	
									COSMIC RAY Range versus energy loss–E	J. A. Simpson C. Y. Fan G. Gloeckler	Enrico Fermi Inst. U. of Chicago	
									Energy versus energy loss–E	F. B. McDonald	GSFC	
									Orthogonal telescope array–E	F. B. McDonald	GSFC	
									Neher-type ion chamber–E	K. A. Anderson	U. of California	
									SOLAR WIND Low-energy proton analyzer–E	J. Wolfe	ARC	
									Plasma probe–E	H. S. Bridge	Massachusetts Inst. of Tech.	
									Thermal ion electron sensor	R. Bourdeau G. P. Serbu	GSFC GSFC	
TIROS X 1965 51A OT-1	To provide additional operational data for WB requirements.	July 1, 1965	Delta ETR	100	458	518	Robert Rados					First operational TIROS weather satellite. Inclination: 98.63° The satellite was launched into a near-perfect sun-synchronous orbit. Procession of orbit was less than 2 degrees per year.
ORBITING SOLAR OBSERVATORY OSO-C	To conduct experiments in solar physics above the earth's atmosphere; experiments will detect and measure electromagnetic radiation from the sun and determine its energy level.	Aug. 25, 1965	Delta ETR	95.73	FAILURE		Laurence T. Hogarth Dr. John C. Lindsay	Stabilized platform for solar-oriented scientific instruments. Experiments not requiring fixed orientation with respect to the sun are housed in the spinning wheel section of the satellite. Electrical power is supplied by	POINTED Ultraviolet monochromator 250-1300A–S	H. E. Hinteregger	AFCRL	Weight: 619 lb. (367 for spacecraft and 252 for experiments) Power: Solar Inclination: 33° The Delta's third stage failed; the satellite is believed
									Solar spectrometer 1-400A–S	W. M. Neupert	GSFC	
									WHEEL Earth's albedo in ultraviolet and visible regions	C. B. Neel	ARC	

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GODDARD SPACE FLIGHT CENTER SATELLITES AND SPACE PROBE PROJECTS (Cont.)

Designation	Objectives	LAUNCH AND ORBIT DATA: Launch Date/ Silent Date	LAUNCH AND ORBIT DATA: Vehicle & Launch Site	LAUNCH AND ORBIT DATA: Period (Min.)	Statute Miles: Perigee	Statute Miles: Apogee	Project Manager and Project Scientist	EXPERIMENT DATA: Instrumentation Summary	EXPERIMENT DATA: Experiment and Discipline*	EXPERIMENT DATA: Experimenter	EXPERIMENT DATA: Affiliation	Remarks
ORBITING SOLAR OBSERVATORY (Continued)								an arry of solar cells mounted on the stabilized section. A complete telemetry system is provided to transmit information back to earth. Spacecraft has pointing capability similar to OSO-I and OSO-II.	3200-7800A and infrared to 30μ–A			to have impacted in the South Atlantic Ocean.
									Emissivity stability of low-temperature coatings–E	C. B. Neel	ARC	
									Celestial gamma-ray astronomy 100 Mev and greater–A	W. L. Kraushaar	MIT	
									Solar X-ray 8-20A–S	R. Teske	U. of Michigan	
									Cosmic-ray charge spectrum detector to measure nuclear component of primary radiation and high-energy gamma radiation > 100 Mev from sun and galaxy–S	M. F. Kaplon	U. of Rochester	
									Directional radiometer 1-30μ	C. B. Neel	ARC	
									Solar X-ray telescope 7-190 Kev and anti-coincidence events at 100 Kev and 2.5 Mev–S	L. E. Peterson	U. of California	
ORBITING GEOPHYSICAL OBSERVATORY OGO-II	To launch and operate an orbital spacecraft carrying experiments to make scientific geophysical measurements about the earth.	Oct. 14, 1965	TAT-Agena D WTR	104	257	938	Wilfred E. Scull N. W. Spencer	The third in a series of standardized "street car" satellites. The spacecraft can accommodate as many as 50 experiments.	Radio astronomy–A	F. T. Haddock	U. of Michigan	Weight: 1150 lb. Power: Solar Inclination: 87° Due to difficulties encountered in the attitude control system and the abnormal consumption of control gas, the satellite exhausted its supply of control gas and entered a random tumbling mode.
									VLF measurements–I	R. A. Helliwell	Stanford U.	
									VLF measurements–I	M. G. Morgan T. Laaspere	Dartmouth College	
									Triaxial search-coil magnetometer–E	R. E. Holzer E. J. Smith	UCLA JPL	
									Rubidium-vapor magnetometer–E	J. P. Heppner	GSFC	
									Cosmic-ray and polar-region ionization study–E	H. R. Anderson H. V. Neher	Rice Inst. Calif. Inst. Tech.	
									Energetic particles survey–E	J. A. Simpson	U. of Chicago	
									Galactic and solar-cosmic rays–E	W. R. Webber	U. of Minnesota	
									Corpuscular radiation in auroral and polar zones–E	J. A. Van Allen	U. of Iowa	
									Trapped-radiation scintillation detector–E	R. A. Hoffman	GSFC	
									Air-glow study–R	J. Blamont E. Reed	U. of Paris GSFC	

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Designation	Objectives	Launch and Orbit Data: Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles: Perigee	Statute Miles: Apogee	Project Manager and Project Scientist	Experiment Data: Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	Remarks
ORBITING GEOPHYSICAL OBSERVATORY (Continued)									Lyman-alpha and air-glow study–R	P. W. Mange	NRL	
									Air-glow study, under-voltage spectrometer–R	C. A. Barth L. Wallace	JPL Kitt Peak Nat. Obs.	
									Neutral particles and ion-composition study–R	R. J. Leite	U. of Michigan	
									Positive ion study–R	H. A. Taylor, Jr.	GSFC	
									Neutral particle study–R	G. P. Newton	GSFC	
									Micrometeorites–P	W. M. Alexander	GSFC	
									Ionospheric composition and undervoltage flux–I	R. E. Bourdeau	GSFC	
									Solar X-rays–S	R. W. Kreplin	NRL	
									Undervoltage spectrometer–S	H. E. Hinteregger	AFCRL	
ISIS-X (DME-A ALOUETTE B)	Sounding the top side of the ionosphere by utilizing topside sounder and measurement techniques	Nov. 28, 1965	Thor-Agena B WTR	121	329	1837	E. Dale Nelsen J. E. Jackson		Topside Sounding of the Ionosphere Galactic and solar radio noise Investigating whistlers Energetic particles Langmuir probes			Inclination: 80° A second Canadian Alouette satellite and another U. S. Explorer satellite were launched simultaneously. This double-launch project, known as ISIS-X, was the first in a new cooperative NASA/Canadian Defense Research Board program for international satellites for ionospheric studies (ISIS). Alouette II was designed and built by Canada's DRB; the Explorer was designed and built for GSFC by APL.
FRENCH FR 1-A	To study the properties of the VLF wave field in the magnetosphere; to study the irregularities and the distribution of ionization in the magnetosphere.	Dec. 6, 1965	Scout WTR	100	480	462	S. R. Stevens R. W. Rochelle			L. R. O. Storey	CNET France (Centre National d'Etudes de Tele-Communication)	Inclination: 76°

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SCHEDULED SATELLITE PROJECTS PARTIAL LISTING

Designation	Objectives	LAUNCH AND ORBIT DATA					Project Manager and Project Scientist	EXPERIMENT DATA				Remarks
		Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles Perigee	Statute Miles Apogee		Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	
ATMOSPHERE EXPLORER AE-B	To study the structure and physics of the upper atmosphere between 135 and 650 statute miles.	1966	Delta ETR	99	135	650	C. C. Stephanides L. H. Brace	Experiments consist of two double-focusing magnetic neutral-particle mass spectrometers, three cold-cathode total pressure ionization gauges, two electrostatic probes, and one Bennett-type ion-mass spectrometer. The spacecraft contains an active magnetic attitude control system, redundant PCM telemetry systems, and a tape recorder.	Neutral particle mass spectrometers - RP Pressure gauges - RP Electrostatic probes - RPI Ion mass spectrometer - RPI	C. Reber J. Cooley G.P. Newton L. Brace H. A. Taylor H. Brinton R. A. Pickett		Weight: 485 lb. Power: Battery (Primary) Limited solar recharging capability
ANCHORED IMP IMP D&E (AIMP)	To anchor a satellite about the moon, to measure in detail the energetic particle population, magnetic fields and cosmic dust in this orbit, and to explore the variations of the moon's gravitational field.	1966	Improved TAD ETR				P. G. Marcotte N.F. Ness					
NIMBUS C	To extend the meteorological data obtained with Nimbus I to a broad range of seasonal and hemispheric variations in weather systems, and to test new sensors in the infrared radiation region.	1966	TAT-Agena B WTR	107	690 circular orbit		Harry Press William Nordberg	Television cameras to photograph earth's cloud cover; equipment for infrared radiation measurements. Two large paddles of solar cells convert the sun's energy into electric power. Spacecraft also has tape recorders, PCM telemetry, and 128 coded commands.	Advanced vidicon camera system Automatic picture transmission system High-resolution infrared radiometer Medium-resolution infrared radiometer	J. R. Schulman J. R. Schulman L. L. Foshee A. W. McCulloch	GSFC GSFC GSFC GSFC	Weight: 935 lb. Power: Solar Inclination: 80° retrograde Direct readout of infrared pictures at APT stations.
ORBITING ASTRONOMICAL OBSERVATORIES OAO-A1 OAO-B OAO-A2 OAO-C	To make precise telescope observations from above the earth's atmosphere with satellites under control from the ground. The area of interest is that of the emission	1966	Atlas-Agena ETR		434 ± 22 circular orbit		Robert R. Ziemer Dr. J. E. Kupperian, Jr.	Carries a wide variety of astronomical experiments.	OAO-A1 Broadband photometric studies of stellar energy distribution (3000-800A) The discovery and location of new sources of soft x-ray emissions	A. Code P.C. Fisher	U. of Wisconsin Lockheed	Experiments for the first four observations have been selected and are scheduled as follows: OAO A-1: U. of Wisconsin experiment #1. Backup

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Designation	Objectives	LAUNCH AND ORBIT DATA: Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles: Perigee	Statute Miles: Apogee	Project Manager and Project Scientist	EXPERIMENT DATA: Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	Remarks
OAO-A1 OAO-B OAO-A2 OAO-C (Continued)	and absorption characteristics of the sun, stars, planets, nebulae and interplanetary, and interstellar media in the relatively unexplored infrared, ultraviolet, X-ray, and gamma-ray regions of the spectrum. To develop a basic spacecraft which will have the precise pointing capability, power, and data-handling equipment, etc.											experiments (BEP): Lockheed, MIT and GSFC
									To measure intensity and arrival direction of energetic gamma rays	W. Kraushaar	MIT (U. of Wisconsin)	OAO B: GSFC experiment
									To survey the celestial sphere for photons in the 2- to 180-kev range and to measure the spectrum of the fluxes detected	K. Frost	GSFC	OAO-A-2: Smithsonian Astrophysical Observatory experiment, and U. of Wisconsin Experiment #2
									OAO-B Absolute spectrophotometry measurement (1000-4000A with 2A resolution)–A	J. Kupperian J. Mulligan	GSFC GSFC	OAO C: Princeton U. experiment, U. College, London experiment (piggyback)
									OAO-A2 Broadband photometric studies of stellar energy distribution (3000-800A)	A. Code	U. of Wisconsin	Wisconsin experiment: To investigate the amount and distribution of ultraviolet light in selected stars
									Mapping stellar under-voltage radiation in ranges 3000-1700A, 200-1050A, 1500-1050A	F. Whipple R. Davis	Smithsonian Astrophysical Observatory	Smithsonian experiment: To map the sky as it looks in ultraviolet light
									OAO-C Inter-stellar absorption measurement (800-3000A with 0.1 resolution)–A	L. Spitzer	Princeton Univ.	GSFC experiment: To obtain more detailed data on selected stars using a 36-inch telescope and a spectrophotometer
									To study x-ray radiation in wavelength bands 3-9A, 8-18A and 44-60A	R. Boyd	U. College, London	Princeton experiment: For high-resolution ultraviolet studies, of characteristics of the gas between stars University College, London experiment: To locate and identify x-ray and gamma-ray sources Approx. observatory weight: 3900 lb.
ORBITING GEOPHYSICAL OBSERVATORY OGO-B	To launch and operate an orbital spacecraft carrying experiments to make scientific geophysical measurements about the earth.	1966	Atlas-Agena B ETR	63 hr.	172	92,000	Wilfred E. Scull Dr. G. H. Ludwig	The second in a series of standardized "street car" satellites. The spacecraft can accomodate as many as 50 experiments.	Solar cosmic rays-S Plasma, electrostatic analyzer-E	K. A. Anderson J. H. Wolfe	U. of California ARC	To be placed in a highly eccentric orbit (31°) Weight: 1069 lb. Power: Solar

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Designation	Objectives	LAUNCH AND ORBIT DATA					Project Manager and Project Scientist	EXPERIMENT DATA				Remarks
		Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles			Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	
					Perigee	Apogee						
OGO-B (continued)									Plasma, Faraday Cup-E	H. J. Bridge	MIT	
									Positron search and gamma-ray spectrum-E&S	T. L. Cline E. W. Hones, Jr.	GSFC Inst. Def. Anal.	
									Trapped radiation, scintillation counter-E	A. Konradi	GSFC	
									Cosmic-ray isotopic abundance-E	G. H. Ludwig F. B. McDonald	GSFC GSFC	
									Cosmic-ray spectra and fluxes-E	J. A. Simpson	U. of Chicago	
									Trapped radiation, omnidirectional counters-E	J. A. Van Allen	U. of Iowa	
									Trapped radiation, electron spectrometer and ionization chamber-E	J. R. Winckler R. L. Arnoldy	U. of Minnesota	
									Triaxial search-coil magnetometer-E	E. J. Smith R. E. Holzer	JPL UCLA	
									Rubidium-vapor magnetometer-E	J. P. Heppner	GSFC	
									Spherical ion and electron trap-I	R. C. Sagalyn	AFCRL	
									Planar ion and electron trap-I	E. C. Whipple	GSFC	
									Radio propagation-I	R. S. Lawrence	NBS	
									Atmospheric mass spectrum-R	H. A. Taylor, Jr.	GSFC	
									Interplanetary dust particles-P	W. M. Alexander	GSFC	
									VLF noise and propagation-I	R. A. Helliwell	Stanford U.	
									Radio astronomy-A	F. T. Haddock	U. of Michigan	
									Geocoronal Lyman-alpha scattering-P	P. W. Mange	NRL	
									Gegenschein photometry-P	C. L. Wolff K. Hallam S. P. Wyatt	GSFC GSFC U. of Illinois	

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Designation	Objectives	Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles Perigee	Statute Miles Apogee	Project Manager and Project Scientist	Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	Remarks
ORBITING GEOPHYSICAL OBSERVATORY OGO-D	To launch and operate an orbital spacecraft carrying experiments to make scientific geophysical measurements about the earth.	1966	TAT/Agena D WTR	97	207	575	Wilfred E. Scull N. W. Spencer	The fourth in a series of standardized "street car" satellites. The spacecraft can accomodate as many as 50 experiments.	Radio Astronomy-A	F. T. Haddock	U. of Michigan	Weight: 1118 lb. Power: Solar Inclination: 86°
									VLF measurements-I	R. A. Helliwell	Stanford U.	
									VLF measurements-I	M. G. Morgan T. Laaspere	Dartmouth College	
									Triaxial search-coil magnetometer-E	R. E. Holzer E. J. Smith	UCLA JPL	
									Rubidium-vapor magnetometer–E	J. P. Heppner	GSFC	
									Cosmic-ray and polar-region ionization study-E	H. R. Anderson H. V. Neher	Rice Inst. California Inst. Tech.	
									Energetic particles survey-E	J. A. Simpson	U. of Chicago	
									Galactic and solar-cosmic rays-E	W. R. Webber	U. of Minnesota	
									Corpuscular radiation in auroral and polar zones-E	J. A. Van Allen	U. of Iowa	
									Trapped-radiation scintillation detector-E	R. A. Hoffman	GSFC	
									Air-glow study-R	J. Blamont E. Reed	U. of Paris GSFC	
									Lyman-alpha and air-glow study-R	P. W. Mange	NRL	
									Air-glow study, under-voltage spectrometer-R	C. A. Barth L. Wallace	JPL Kitt Peak Nat. Obs.	
									Neutral particles and ion-composition study-R	E. J. Schaefer	U. of Michigan	
									Positive ion study-R	H. A. Taylor, Jr.	GSFC	
									Neutral particle study-R	G. P. Newton	GSFC	
									Micrometeorites-P	W. M. Alexander	GSFC	
									Ionospheric composition and undervoltage flux-I	R. E. Bourdeau	GSFC	
									Solar undervoltage spectrometer-S	H. E. Hinteregger	AFCRL	
									Solar X-rays-S	R. W. Kreplin	NRL	

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PART II

SCHEDULED SATELLITE PROJECTS PARTIAL LISTING (Cont.)

Designation	Objectives	Launch and Orbit Data: Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles: Perigee	Statute Miles: Apogee	Project Manager and Project Scientist	Experiment Data: Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	Remarks
ORBITING SOLAR OBSERVATORY OSO-D	To conduct experiments in solar physics above the earth's atmosphere; experiments will detect and measure electromagnetic radiation from the sun and determine its energy level.	1966	Delta ETR	95.73	345 circular orbit		Laurence T. Hogarth	Stabilized platform for solar-oriented scientific instruments. Experiments not requiring fixed orientation with respect to the sun are housed in the spinning wheel section of the satellite. Electrical power is supplied by an array of solar cells mounted on the stabilized section. A complete telemetry system is provided to transmit information back to earth. Spacecraft has pointing and scanning capability similar to OSO-B2.	POINTED			Weight: 570 lb. (330 for spacecraft and 240 for experiments) Power: Solar Inclination: 33°
									Solar X-ray telescope 3-13A, 3-14A, 3-38A, B-50A, 18-37A, 44-75A, and map the sun in X-rays–S	R. Giacconi	American Science & Engineering, Inc.	
									Bragg crystal X-ray spectrometer 1-8A–S	T. A. Chubb R. W. Kreplin	NRL	
									Improved normal incidence 300-1300A scanning spectrometer spectroheliograph–S	L. Goldberg E. M. Reeves	Harvard U. Observatory	
									WHEEL			
									Measure extrasolar X-radiation 0.5-30 kev, 0.1-10A possibly to 50A-A	R. Giacconi H. Gursky	American Science & Engineering Inc.	
									Distribution of total solar X-ray emission over a wide band 1-20A and 44-75A–S	R. L. F. Boyd	U. College, London; & Leicester U.	
									Study of solar He II 304A resonance emission –S	R. L. F. Boyd	U. College, London	
									Proton-electron detector; electrons > 100 kev; to 5 Mev, proton/2 to about 30 Mev–E	J. Waggoner	U. of Cal. Lawrence Radiation Lab.	
									X-ray ion chamber monitoring 0.5-3A, 2-8A, 8-16A, and 44-60A–S	T. A. Chubb R. W. Kreplin	NRL	
									Lyman-alpha nightsky glow 1050-1350A which includes the alpha line 1216A–A	P. W. Mange	NRL	
ORBITING SOLAR OBSERVATORY OSO-E1	To conduct experiments in solar physics above the earth's atmosphere; experiments will detect and measure electromagnetic radiation from the sun and determine its energy level.	1966	Delta ETR				Laurence T. Hogarth	Stabilized platform for solar-oriented scientific instruments. Experiments not requiring fixed orientation with respect to the sun are housed in the spinning wheel section of the satellite. Electrical power is supplied by an array of solar cells mounted on the stabilized section.	POINTED			Weight: 619 lbs. (367 for spacecraft and 252 for experiments) Power: Solar Inclination: 33°
									Ultraviolet monochromator 250-1300A–S	H. E. Hinteregger	AFCRL	
									Solar spectrometer 1-400A–S	W. M. Neupert	GSFC	
									WHEEL			
									Earth's albedo in ultraviolet and visible regions	C. B. Neel	ARC	

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PART II

SCHEDULED SATELLITE PROJECTS PARTIAL LISTING (Cont.)

Designation	Objectives	LAUNCH AND ORBIT DATA: Launch Date/ Silent Date	LAUNCH AND ORBIT DATA: Vehicle & Launch Site	LAUNCH AND ORBIT DATA: Period (Min.)	Statute Miles: Perigee	Statute Miles: Apogee	Project Manager and Project Scientist	EXPERIMENT DATA: Instrumentation Summary	EXPERIMENT DATA: Experiment and Discipline*	EXPERIMENT DATA: Experimenter	EXPERIMENT DATA: Affiliation	Remarks
OSO-E1 (Continued)								A complete telemetry system is provided to transmit information back to earth. Spacecraft has pointing capability similar to OSO-I and OSO-II.	3200-7800A and infrared to 30 μ–A			
									Emissivity stability of low-temperature coatings–E	C. B. Neel	ARC	
									Celestial gamma-ray astronomy 100 Mev and greater–A	W. L. Kraushaar	MIT	
									Solar X-ray 8-20A–S	R. Teske	U. of Michigan	
									Cosmic-ray charge spectrum detector to measure nuclear component of primary radiation and high-energy gamma radiation > 100 Mev from sun and galaxy–S	M. F. Kaplon	U. of Rochester	
									Directional radiometer 1-30 μ	C. B. Neel	ARC	
									Solar X-ray telescope 7-190 Kev and anti-coincidence events at 100 Kev and 2.5 Mev–S	L. E. Peterson	U. of California	
SAN MARCO SM-B	To measure upper atmosphere air density. To measure electron density and to study radio wave propagation effect known as "ducting."	1966	Scout ETR		200 - 300 circular orbit		A. J. Caporale	Spacecraft is spin-stabilized. Powered by nonrechargeable batteries.	Air density measured by triaxial balance	L. Broglio	U. of Rome, Italy	
									Electron content and wave propagation	N. Carrara	U. of Florence, Italy	
SAN MARCO (BU) SM-C	To measure upper atmosphere air density. To measure electron density and to study radio wave propagation effect known as "ducting."	1966	Scout ETR		200 - 300 circular orbit		A. J. Caporale	Spacecraft is spin-stabilized. Powered by nonrechargeable batteries.	Air density measured by triaxial balance	L. Broglio	U. of Rome, Italy	
									Electron content and wave propagation	N. Carrara	U. of Florence, Italy	
OPERATIONAL TIROS OT-2	To provide continuing observation of the earth's cloud cover with direct readout TV data on a global basis.	1966	Improved TAD ETR	113	862 circular orbit		W. W. Jones					
TIROS 1965 51A OT-3	To provide additional operational data for WB requirements	1966	Delta-DSV-3 ETR	100	480 circular orbit		Robert Rados	Two standard TIROS cameras with recorders, two IR horizon sensors for attitude determination, a magnetic attitude control system; horizon				To increase the area of meteorological observation, to improve the accuracy of TV picture

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PART II
SCHEDULED SATELLITE PROJECTS PARTIAL LISTING (Cont.)

Designation	Objectives	LAUNCH AND ORBIT DATA: Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles: Perigee	Apogee	Project Manager and Project Scientist	EXPERIMENT DATA: Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	Remarks
TIROS OT-3 (Continued)								sensors will be used with an on-board spacecraft computer to provide camera shutter at spacecraft local vertical. Magnetic spin control and spacecraft digital clock to be used.				location, and to eliminate attitude constraints through the use of a cart-wheel configured satellite in a nearly sun-synchronous (82° retrograde) polar orbit. This configuration will permit the cameras to view the earth and its cloud cover and will be limited in coverage only by the sun's coverage of the earth. Weight: 305 lb. Power: Solar Inclination: 96.4°
APPLICATIONS TECHNOLOGY SATELLITE (24-hour spinner) ATS-A -B C D E	To obtain engineering data on earth-oriented gravity-gradient stabilization at medium altitudes to extend techniques to synchronous altitudes; also, meteorological, environmental, and communication measurements. To provide a platform both spin-stabilized and earth-oriented at medium and synchronous altitudes.	1966 (first launch)	Atlas-Agena D ETR Atlas-Agena D ETR	360 1436	6000 circular orbit 22,200 circular orbit		Robert J. Darcey	Gravity-gradient control stabilization system will provide performance data utilizing attitude data and cameras to observe boom deflections. Gravity-gradient camera, meteorological pictures and communications will be transmitted via a 4-kMc transmitter. Environmental and technical experiments will be transmitted at 136 Mc. For the spin-stabilization mission, a 4-kMc signal will be directed towards the earth by an electrical or mechanical despun antenna.	ATS-A Omnidirectional particle detectors Multi-element silicon junction particle detector VLF whistler mode power detector Electron spectrometer Solar-cell radiation damage Thermal coating Cosmic radio noise measurement	 C. McIlwain W. L. Brown W. L. Brown J. Winckler R. Waddel J. J. Triolo R. G. Stone	 U. of California BTL BTL U. of Minnesota GSFC GSFC GSFC	Weight: 800 lb. ATS-A 1550 lb. ATS-B,C, D, and E Power: Solar array Inclination: 30° ATS-A 0° ATS-B,C,D, and E
TIROS OPERATIONAL SATELLITE TOS A C E B D	To provide continuous observation of the earth's cloud cover with direct readout TV data on a global basis	1966 1967 1966	Improved TAD ETR Improved TAD WTR Improved TAD WTR	113	862 circular orbit		W. W. Jones					An operational weather satellite system developed by NASA for the U. S. Weather Bureau

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SCHEDULED SATELLITE PROJECTS PARTIAL LISTING (Cont.)

Designation	Objectives	Launch and Orbit Data: Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles: Perigee	Statute Miles: Apogee	Project Manager and Project Scientist	Experiment Data: Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	Remarks
ORBITING GEOPHYSICAL OBSERVATORY OGO-E	To launch and operate an orbital spacecraft carrying experiments to make scientific geophysical measurements about the earth.	1967	Atlas-Agena D ETR	63.35 hours	172	92,000	Wilfred E. Scull Dr. G. H. Ludwig	The fifth in a series of standardized "street car" satellites. The spacecraft can accomodate as many as 50 experiments.	Electron temperature and density–IE	R. L. F. Boyd	Univ. College, London	Weight: 1190 lb. Power: Solar Inclination: 31°
									Thermal and epithermal plasma measurements–IE	R. C. Sagalyn	AFCRL	
									Electron and ion measurement 0-100 ev –IE	G. P. Serbu	GSFC	
									Energetic radiations from solar flares–SE	K. A. Anderson	U. of California	
									Low-rigidity interplanetary electrons, positrons, and protons –E	T. L. Cline	GSFC	
									Electron and proton spectrometer–E	R. D'arcy	LRL	
									Low-energy electron and proton detector–IE	L. A. Frank	U. of Iowa	
									Energetic protons in primary cosmic rays –EA	G. W. Hutchison	U. of Southhampton, England	
									Cosmic-ray electrons –E	P. Meyer	U. of Chicago	
									Galactic and solar-cosmic rays–E	F. B. McDonald	GSFC	
									Triaxial electron analyzer–IE	K. W. Ogilvie T. D. Wilkerson	GSFC U. of Maryland	
									Plasma spectrometer –IE	C. W. Snyder	JPL	
									Energetic cosmic ray electrons–E	A. H. Wapstra	Netherlands Inst. of Nuclear Physics	
									Hydromagnetic waves and trapped particles –E	P. J. Coleman D. L. Judge	UCLA U. of Southern California and TRW	
									Magnetic field measurements–E	J. P. Heppner	GSFC	
									Search coil magnetometer–E	E. J. Smith R. E. Holzer	JPL JPL & UCLA	

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PART II
SCHEDULED SATELLITE PROJECTS PARTIAL LISTING (Cont.)

Designation	Objectives	LAUNCH AND ORBIT DATA: Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles: Perigee	Statute Miles: Apogee	Project Manager and Project Scientist	EXPERIMENT DATA: Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	Remarks
OGO-E (Continued)									Plasma waves	G. M. Crook	TRW	
									Ultraviolet photometric measurements–AI	C.A. Barth	U. of Colorado	
									Geocoronal hydrogen –ASE	J. E. Blamont	U. of Paris	
									Solar X-rays	R. W. Kreplin	NRL	
									Light ion mass spectrometer–PI	C. W. Sharp	LMSC	
									Interplanetary dust particles–P	W. M. Alexander	GSFC	
									Radio astronomy–A	F. T. Haddock	U. of Michigan	
ORBITING SOLAR OBSERVATORY OSO-F	To conduct experiments in solar physics above the earth's atmosphere; experiments will detect and measure electromagnetic radiation from the sun, and determine its energy level.	1967	DELTA ETR	95.73	345 circular orbit		Laurence T. Hogarth	Stabilized platform for solar-oriented scientific instruments. Experiments not requiring fixed orientation with respect to the sun are housed in the spinning wheel section of the satellite. Electrical power is supplied by an array of solar cells mounted on the stabilized section. A complete telemetry system is provided to transmit information back to earth. Spacecraft has pointing and scanning capability similar to OSO-B2.	POINTED			Weight: Estimated 575 lb. (300 for spacecraft and 245 for experiments) Power: Solar Inclination: 32.91°
									X-ray spectroheliograph 3-9A and 8-18A–S	R. L. F. Boyd E. A. Stewardson P. J. Bowen	U. College, London & U. of Leicester	
									Extreme ultraviolet solar spectroheliograph, Lyman-alpha 1216A, He I 584A and He II 304A lines–S	R. Tousey J. D. Purcell H. Friedman	NRL	
									Continuation of the studies of solar spectrum 1-400A–S	W. Neupert	GSFC	
									WHEEL			
									Measurement of self-reversal of the solar Lyman-alpha line–S	J. E. Blamont	U. of Paris	
									Solar X-ray radiation ion-chamber photometer, monitoring experiments 0.5-3A, 2-8A, 8-16A, and 44-60A–S	R. W. Kreplin	NRL	
									Low-energy gamma-ray region 2-150 kev–S	K. J. Frost	GSFC	
									Dim-light monitoring experiment measuring intensity and polarization of the light from the airglow layer–A	E. P. Ney	U. of Minnesota	

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PART II
SCHEDULED SATELLITE PROJECTS PARTIAL LISTING (Cont.)

Designation	Objectives	LAUNCH AND ORBIT DATA: Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles: Perigee	Apogee	Project Manager and Project Scientist	EXPERIMENT DATA: Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	Remarks
OSO-F (Continued)									Solar for ultraviolet radiation monitoring in three EUV bands 280-370A, 465-630A, and 760-1030A and for effect on ionization rates in F and E upper atmosphere layers	W. A. Rense	U. of Colorado	
TIROS J	To contribute to the development of a synchronous orbit meteorological satellite system for continuous observation of the earth's atmospheric phenomena. To demonstrate the feasibility of providing and using radiometric measurements from high-resolution infrared radiometer for nighttime cloud cover in both automatic transmissions and recorder modes.	1967	Improved TAD WTR	113.5	862 circular orbit		Robert Rados	Two high-resolution infrared radiometer subsystems, on APT mode and a record made wheel-type spacecraft.				Weight: 310 lb. Power: Solar Sun synchronous Inclination: 101.4°
INTERNATIONAL SATELLITE UK-E&F (UK-3)	To measure vertical distribution of molecular oxygen in earth's atmosphere. To map large scale RF-noise sources in the galaxy, 2- to 5 Mc. To investigate VLF radiation, 3 to 16 kc, both natural and man-made. To measure ionization density and temperature above the F_2 maximum. To investigate terrestrial radio noise at 5, 10, and 15Mc (thunderstorms).	1967	Scout WTR	100	340 circular orbit		E. Hymowitz	Photomultiplier, three radio receivers, and RF plasma probe.	Photomultiplier–P Three radio receivers -A–P Radio receivers-A–P RF plasma probe–I Radio receiver-A–P	R. Frith F. G. Smith T. R. Kaiser J. Sayers J. A. Ratcliffe, FRS	Meteorological Office, Brackwell U. of Manchester U. of Sheffield U. of Birmingham Radio Research Station, Slough	Weight: 167 lb. (orbital) Power: Solar Inclination: 78°

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PART II
SCHEDULED SATELLITE PROJECTS PARTIAL LISTING (Cont.)

Designation	Objectives	LAUNCH AND ORBIT DATA					Project Manager and Project Scientist	EXPERIMENT DATA				Remarks
		Launch Date/ Silent Date	Vehicle & Launch Site	Period (Min.)	Statute Miles Perigee	Statute Miles Apogee		Instrumentation Summary	Experiment and Discipline*	Experimenter	Affiliation	
ADVANCED ORBITING SOLAR OBSERVATORIES AOSO	To conduct a continuous systematic study of solar phenomena through measurements that cannot be made inside the earth's atmosphere. To develop a spacecraft system to provide sophistication in control, pointing accuracy, experiment instrumentation capability, and data and communications-handling capability. To develop experimental instrumentation techniques for making best use of this spacecraft system. To sponsor solar physics experiments which must be made on a platform outside the earth's atmosphere.	1967	TAT-Agena-D WTR		345 circular orbit		A. J. Cervenka		To be selected			Weight: 1200 lb. Power: Solar

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NOTES
1. Numbering System:

NASA 4. AEROBEE 150, 150A
6. AEROBEE 300
8. ARGO D-4
10. NIKE CAJUN
11. ARGO D-8
NASA 12. SPECIAL PROJECTS
14. NIKE APACHE
16. ASTROBEE 1500
17. AEROBEE 350

NASA 1. AEROBEE 100, 2. ARCON, 3. NIKE ASP, 5. IRIS, 7. ARGO E-5, 9. SKYLARK, and 15. ARCAS, are not listed for use on this schedule.

2. Identifying letters: The letters which follow each rocket number identify
(1) the instrumenting agency, and
(2) the experiment according to the following list:

AGENCY

G–Goddard
N–Other NASA Centers
U–College or University
D–DOD
A–Other Government Agency
C–Industrial Corporations
I–International

EXPERIMENT

A–Aeronomy
E–Energetic Particles and Fields
I–Ionospheric Physics
S–Solar Physics
G–Galactic Astronomy
R–Radio Astronomy
B–Biological
P–Special Projects
T–Test and Support

FIRING SITES

ASC Ascension Island
AUS Australia
EGL Eglin
FC Fort Churchill
IND India
NOR Norway
PAK Pakistan
PMR Pacific Missile Range
Pt. A Point Arguello
SWE Sweden
WI Wallops Island

PART III
NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING			PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
	DATE	SITE	PERF*			
				AERONOMY		
	1960					
4.09 GA	April 29	WI	S	Horowitz	Atmospheric Composition	S
10.03 GA	June 16	WI	P	Nordberg	Grenade	X
10.04 GA	July 9	WI	S	Nordberg	Grenade	S
10.01 GA	14	WI	S	Nordberg	Grenade	X
4.14 GA	Nov. 15	WI	S	Taylor	Atmospheric Composition	S
10.06 GA	Dec. 14	WI	S	Nordberg	Grenade	S
	1961					
10.07 GA	Feb. 14	WI	S	Nordberg	Grenade	S
10.08 GA	17	WI	P	Nordberg	Grenade	S
10.33 GA	April 5	WI	S	Nordberg	Grenade	P
10.34 GA	27	WI	X	Smith	Grenade	X
10.02 GA	May 5	WI	S	Smith	Grenade	S
10.28 GA	6	WI	S	Smith	Grenade	S
10.29 GA	9	WI	S	Smith	Grenade	P
10.30 GA	July 13	WI	S	Smith	Grenade	S
10.31 GA	14	WI	S	Smith	Grenade	S
10.32 GA	20	WI	S	Smith	Grenade	S
10.35 GA	21	WI	S	Smith	Grenade	X
10.36 GA	Sep. 16	WI	P	Smith	Grenade	P
10.37 GA	17	WI	S	Smith	Grenade	X
1.08 GA	23	FC	S	Varian-Martin	Atmospheric Structure	S
1.09 GA	30	FC	S	Varian-Martin	Atmospheric Structure	S
8.23 GA	Oct. 10	WI	S	Taylor	Ionosphere	S
1.10 GA	15	FC	S	Varian-Martin	Atmospheric Structure	S
1.07 GA	17	FC	S	Varian-Martin	Atmospheric Structure	S
1.11 GA	Nov. 2	FC	S	Varian-Martin	Atmospheric Structure	S
1.12 GA	5	FC	S	Varian-Martin	Atmospheric Structure	S
10.64 GA	Dec. 21	WI	S	U/M-Spencer	Atmospheric Structure	S
	1962					
10.38 GA	Mar. 2	WI	S	Smith	Grenade	S
10.39 GA	2	WI	S	Smith	Grenade	S
4.18 GA	19	WI	X	U/M-Spencer	Atmospheric Structure	X
10.40 GA	23	WI	S	Smith	Grenade	S

*S–Successful
P–Partial Success
X–Unsuccessful
} – – Subject to Interpretation

PART III
NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING			PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
	DATE	SITE	PERF*			
10.41 GA	Mar. 28	WI	S	Smith	Grenade	S
10.42 GA	April 17	WI	S	Smith	Grenade	S
5.04 GA	May 3	WI	P	Taylor	Atmospheric Structure	S
10.43 GA	June 7	WI	S	Smith	Grenade	S
10.44 GA	8	WI	S	Smith	Grenade	S
10.65 GA	Nov. 16	FC	X	Smith	Grenade	X
6.06 GA	20	WI	S	Brace	Thermosphere Probe	S
10.45 GA	Dec. 1	WI	S	Smith	Grenade	S
10.68 GA	1	FC	S	Smith	Grenade	X
10.46 GA	4	WI	S	Smith	Grenade	X
10.67 GA	4	FC	X	Smith	Grenade	S
10.47 GA	6	WI	S	Smith	Grenade	S
10.66 GA	6	FC	S	Smith	Grenade	S
	1963					
10.48 GA	Feb. 20	WI	S	Smith	Grenade	S
10.58 GA	20	FC	S	Smith	Grenade	S
10.53 GA	28	WI	S	Smith	Grenade	S
10.59 GA	28	FC	S	Smith	Grenade	S
10.54 GA	Mar. 9	WI	S	Smith	Grenade	S
10.60 GA	9	FC	S	Smith	Grenade	S
6.07 GA	April 18	WI	S	Brace	Thermosphere Probe	S
10.55 GA	Dec. 7	WI	S	Smith	Grenade	S
	1964					
10.61 GA	Jan. 24	WI	S	Smith	Grenade	S
10.86 GA	24	FC	X	Smith	Grenade	X
6.09 GA	29	WI	S	Brace	Thermosphere Probe	S
10.71 GA	29	WI	S	Smith	Grenade	S
10.89 GA	29	FC	S	Smith	Grenade	S
10.81 GA	29	ASC	S	Smith	Grenade	S
10.62 GA	Feb. 4	WI	S	Smith	Grenade	S
10.87 GA	5	FC	S	Smith	Grenade	S
10.63 GA	5	WI	S	Smith	Grenade	S
10.136 GA	13	WI	S	Smith	Grenade	S
10.82 GA	13	ASC	S	W. Smith	Grenade	S
10.88 GA	13	FC	S	W. Smith	Grenade	S
10.137 GA	Mar. 7	WI	S	W. Smith	Grenade	S
10.73 GA	April 18	FC	S	W. Smith	Grenade	S
10.83 GA	18	WI	S	W. Smith	Grenade	S
4.113 GA–GI	21	WS	X	Berg-Aikin	Astrochemistry and Ionospheres	X
6.10 GA	July 29	FC	S	Brace	Thermosphere Probe	S
10.114 GA	Aug. 5	ASC	S	W. Smith	Grenade	X
10.138 GA	7	SWE	S	W. Smith	Grenade	S
10.78 GA	7	WI	S	W. Smith	Grenade	S
10.104 GA	8	FC	S	W. Smith	Grenade	S
10.139 GA	12	SWE	S	W. Smith	Grenade	X
10.84 GA	12	WI	S	W. Smith	Grenade	S
10.105 GA	12	FC	S	W. Smith	Grenade	S
10.140 GA	16	SWE	S	W. Smith	Grenade	S
10.85 GA	16	WI	S	W. Smith	Grenade	S
10.115 GA	16	ASC	S	W. Smith	Grenade	S
10.116 GA	16	ASC	S	W. Smith	Grenade	S
10.141 GA	17	SWE	S	W. Smith	Grenade	S
10.106 GA	18	FC	S	W. Smith	Grenade	S
10.113 GA	18	WI	S	W. Smith	Grenade	S

*S–Successful
P–Partial Success } – – Subject to Interpretation
X–Unsuccessful

PART III
NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING DATE	FIRING SITE	FIRING PERF*	PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
10.132 GA	Nov. 3	WI	S	W. Smith	Grenade	X
10.107 GA	5	WI	S	W. Smith	Grenade	S
10.133 GA	6	WI	S	W. Smith	Grenade	S
10.134 GA	6	WI	S	W. Smith	Grenade	S
10.135 GA	6	WI	S	W. Smith	Grenade	S
4.45 GA	16	WI	S	Brace	Thermosphere Probe	S
10.117 GA	19	WI	S	W. Smith	Grenade	S
4.83 GA	Dec. 1	WI	S	Hennes	Middle UV Airglow	S
4.132 GA–GI	16	WI	S	Burg	Micrometeorites	S
	1965					
10.124 GA	Jan. 27	PB	S	W. Smith	Grenade	S
10.121 GA	27	FC	S	W. Smith	Grenade	S
10.118 GA	27	WI	S	W. Smith	Grenade	S
10.125 GA	Feb. 4	PB	S	W. Smith	Grenade	S
10.119 GA	4	WI	S	W. Smith	Grenade	S
10.122 GA	4	FC	S	W. Smith	Grenade	S
10.126 GA	8	PB	S	W. Smith	Grenade	S
10.120 GA	8	WI	S	W. Smith	Grenade	S
10.123 GA	8	FC	S	W. Smith	Grenade	S
12.05 GA**	Mar. 19	WI	S	Brace	Thermosphere Probe	S
6.11 GA	20	WI	S	Brace	Thermosphere Probe	S
10.150 GA	Apr. 28	PB	S	W. Smith	Grenade	X
10.127 GA	May 3	WI	S	W. Smith	Grenade	X
	1961					
10.72 NA	Nov. 18	WI	S	LRC/Hord	Airglow	S
	1962					
10.79 NA	April 5	WI	S	LRC/Potter	Ozone	S
1.13 NA	Sep. 6	WI	S	JPL/Barth	U. V. Airglow	S
1.14 NA	Nov. 20	WI	X	JPL/Barth	U. V. Airglow	X
	1963					
10.80 NA	Jan. 17	WI	S	LRC/Potter	Ozone	S
10.92 NA	Sep. 25	WI	S	LRC	Chemical Release	S
10.93 NA	25	WI	S	LRC	Chemical Release	S
14.102 NA	Oct. 9	WI	S	LRC/Potter	Chemical Release	S
14.103 NA	10	WI	S	LRC/Potter	Chemical Release	S
4.85 NA	Nov. 18	WI	S	JPL/Barth	Airglow	S
	1964					
4.86 NA	April 14	WS	X	Jet Propulsion Lab.	Airglow	X
4.115 NA	Sep. 18	WI	S	JPL/Barth	Dayglow	S
4.118 NA	Nov. 16	WI	S	Ames	Micrometeroid	X
	1965					
14.142 NA	Jan. 7	WI	S	LeRC/Potter	Airglow	P
4.111 NA	13	WI	S	JPL/Dubin	Airglow	S
14.132 NA	Apr. 1	WI	S	LeRC/Potter	Airglow	S
10.171 NA	23	WI	S	LeRC/Tolefson	Chemiluminescent Cloud	S
14.255 NA	23	WI	S	LeRC/Tolefson	Chemiluminescent Cloud	S
4.112 NA	June 29	WS	S	JPL/Dubin	Airglow	S
14.133 NA	Aug. 19	WI	S	Potter (LeRC)	Airglow	X

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PART III

NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING			PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
	DATE	SITE	PERF*			
	1960					
10.09 UA	Nov. 2	WI	S	U/M-Dubin	Atmospheric Composition	X
10.10 UA	16	WI	S	U/M-Dubin	Atmospheric Composition	X
	1961					
10.50 UA	June 6	WI	S	U/M-Dubin	Atmospheric Structure	S
10.56 UA	9	WI	S	U/M-Dubin	Atmospheric Composition	X
10.57 UA	July 26	WI	S	U/M-Dubin	Atmospheric Composition	X
	1962					
10.90 UA	Feb. 20	WI	S	U/M-Dubin	Atmospheric Composition	X
10.91 UA	May 18	WI	S	U/M-Dubin	Atmospheric Composition	S
14.19 UA	June 6	WI	S	U/M-Spencer	Atmospheric Structure	S
14.20 UA	Dec. 1	WI	S	U/M-Spencer	Atmospheric Structure	S
4.74 UA	13	WI	X	JHU/Dubin	Airglow	X
	1963					
4.73 UA	Jan. 29	WI	X	JHU/Dubin	Airglow	X
14.08 UA	Mar. 28	WI	S	U/M-Dubin	Atmospheric Composition	S
14.09 UA	28	WI	S	U/M-Dubin	Atmospheric Composition	X
4.98 UA	May 7	WI	S	JHU/Dubin	Airglow	S
4.75 UA	July 20	FC	X	JHU/Dubin	Airglow	X
10.75 UA	Aug. 2	WI	S	U/M-Holtz	Atmospheric Density	S
4.76 UA	Nov. 12	WI	S	JHU/Dubin	Airglow	S
14.10 UA	26	WI	S	U/M-Dubin	Atmospheric Composition	S
10.131 UA	26	WI	S	U/M-Dubin	Atmospheric Density	S
14.21 UA	Dec. 7	WI	S	U/M-W. Smith	Atmospheric Structure	S
	1964					
14.22 UA	Feb. 4	ASC	S	U/M-W. Smith	Atmospheric Structure	S
4.124 UA	Feb. 27	FC	P	JHU/Dubin	Aurora	S
14.24 UA	April 15	ASC	S	U/M-W. Smith	Atmospheric Structure	S
14.23 UA	15	ASC	S	U/M-W. Smith	Atmospheric Structure	S
10.142 UA	17	WI	S	U/M-Dubin	Atmospheric Density	S
8.34 UA	Nov. 5	WI	S	JHU/Dubin	Airglow	S
14.233 UA	17	SHIP	S	U. of Mich./Dubin	Atmospheric Density	S
10.153 UA	17	SHIP	S	U. of Mich./Dubin	Atmospheric Density	S
14.29 UA	19	SHIP	X	U. of Mich./W. Smith	Pitot Probe	X
4.125 UA	Dec. 17	WI	S	JHU/Dubin	Airglow	S
	1965					
14.11 UA	Feb. 18	FC	S	U. Mich./Dubin	Composition	S
4.129 UA	19	FC	S	JHU/Dubin	Auroral Studies	S
14.95 UA	19	FC	S	U. Mich./Dubin	Composition	S
10.155 UA	26	SHIP	S	U. Mich./Dubin	Air Density	S
14.64 UA	Mar. 8	SHIP	S	U. Mich./W. Smith	Atmospheric Structure	S
14.65 UA	9	SHIP	S	U. Mich./W. Smith	Atmospheric Structure	S
14.98 UA	11	SHIP	S	U. Mich./Dubin	Composition	S
10.156 UA	11	SHIP	S	U. Mich./Dubin	Air Density	S
14.99 UA	11	SHIP	S	U. Mich./Dubin	Composition	S
14.62 UA	18	WI	S	SCAS/Horowitz	Composition	P
14.66 UA	April 4	SHIP	S	U. Mich./W. Smith	Atmospheric Structure	S
14.26 UA	6	SHIP	S	U. Mich./W. Smith	Atmospheric Structure	S
14.63 UA	9	SHIP	S	U. Mich./W. Smith	Atmospheric Structure	S
14.67 UA	13	SHIP	S	U. Mich./W. Smith	Atmospheric Structure	S

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PART III
NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING DATE	FIRING SITE	FIRING PERF*	PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
14.27 UA	April 13	SHIP	S	U. Mich./W. Smith	Atmospheric Structure	S
14.101 UA	13	SHIP	S	U. Mich./Dubin	Composition	X
4.127 UA	15	WS	S	Minn./Dubin	Composition	S
14.100 UA	15	SHIP	S	U. Mich./Dubin	Composition	X
14.25 UA	15	SHIP	S	U. Mich./W. Smith	Atmospheric Structure	S
14.47 UA	May 22	ASC	S	U. Mich./W. Smith	Pitot Probe	S
14.48 UA	22	ASC	S	U. Mich./W. Smith	Pitot Probe	S
4.128 UA	Jul 15	WS	S	U. Minn./Dubin	Composition	S
10.154 UA	Aug 7	WI	S	U. Mich./Dubin	Air Density	S
10.157 UA	8	WI	S	U. Mich./Dubin	Air Density	S
10.144 UA	11	WS	S	Dudley Obs./Dubin	Micrometeorite	X
8.11 UA	25	WI	S	U. Pitt/Dubin	Helium Ionization	S
	1963					
14.140 DA	May 18	EGL	S	AFCRL/Ga. Tech.	Sodium Vapor	S
14.141 DA	18	EGL	S	AFCRL/Ga. Tech.	Sodium Vapor	S
10.130 DA	22	EGL	S	AFCRL/Ga. Tech.	Sodium Vapor	S
	1964					
8.31 DA	Jan. 17	WI	S	NRL/Dubin	Composition Airglow	S
14.54 DA	May 28	WI	X	ARCRL/W. Smith	Air Sampling	X
14.55 DA	Aug. 6	SWE	S	AFCRL/W. Smith	Air Sampling	X
14.56 DA	12	SWE	S	AFCRL/W. Smith	Air Sampling	S
14.57 DA	16	SWE	S	AFCRL/W. Smith	Air Sampling	S
14.58 DA	17	SWE	S	AFCRL/W. Smith	Air Sampling	S
	1962					
14.45 AA	Dec. 1	EGL	S	AFCRL/Dubin	Sodium Vapor	X
14.46 AA	3	EGL	S	AFCRL/Dubin	Sodium Vapor	P
	1959					
3.13 CA	Aug. 17	WI	S	GCA/Dubin	Sodium Vapor	S
3.14 CA	Aug. 19	WI	X	GCA/Dubin	Sodium Vapor	X
3.15 CA	Nov. 18	WI	S	GCA/Dubin	Sodium Vapor	S
3.16 CA	19	WI	S	GCA/Dubin	Sodium Vapor	X
3.17 CA	20	WI	S	GCA/Dubin	Sodium Vapor	X
	1960					
3.23 CA	May 24	WI	X	GCA/Dubin	Sodium Vapor	X
3.24 CA	25	WI	S	GCA/Dubin	Sodium Vapor	S
10.05 CA	Sep. 20	WI	S	Nordberg	Grenade	X
8.04 CA	Nov. 10	WI	S	Lockheed/Dubin	Ionosphere	P
10.11 CA	Dec. 9	WI	X	GCA/Dubin	Sodium Vapor	X
10.12 CA	9	WI	S	GCA/Dubin	Sodium Vapor	S
8.05 CA	10	WI	S	GCA/Dubin	Sodium Vapor	S
	1961					
3.05 CA	April 19	WI	S	GCA/Dubin	Sodium Vapor	S
3.06 CA	21	WI	S	GCA/Dubin	Sodium Vapor	S
3.07 CA	21	WI	X	GCA/Dubin	Sodium Vapor	X
3.08 CA	21	WI	S	GCA/Dubin	Sodium Vapor	S
8.06 CA	Sep. 13	WI	S	GCA/Smith	Sodium Vapor	S
8.22 CA	13	WI	S	GCA/Smith	Sodium Vapor	S
3.09 CA	16	WI	X	GCA/Smith	Sodium Vapor	X
3.18 CA	16	WI	S	GCA/Smith	Sodium Vapor	S
3.19 CA	17	WI	S	GCA/Smith	Sodium Vapor	S

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PART III
NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING			PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
	DATE	SITE	PERF*			
	1962					
10.100 CA	Mar. 1	WI	S	GCA/Smith	Sodium Vapor	S
10.101 CA	2	WI	S	GCA/Smith	Sodium Vapor	S
10.102 CA	23	WI	S	GCA/Smith	Sodium Vapor	S
10.103 CA	27	WI	S	GCA/Smith	Sodium Vapor	S
3.20 CA	April 17	WI	S	GCA/Smith	Sodium Vapor	S
3.21 CA	June 7	WI	S	GCA/Smith	Sodium Vapor	S
3.22 CA	7	WI	X	GCA/Smith	Sodium Vapor	X
14.30 CA	Aug. 23	WI	P	Lockheed/Depew	Atmospheric Structure	X
14.16 CA	Nov. 7	WI	S	GCA/Smith	Sodium Vapor	S
14.17 CA	30	WI	S	GCA/Smith	Sodium Vapor	S
14.18 CA	Dec. 5	WI	S	GCA/Smith	Sodium Vapor	P
	1963					
3.11 CA	Feb. 18	WI	X	GCA/Smith	Sodium Vapor	X
14.35 CA	20	WI	S	GCA/Smith	Sodium Vapor	S
14.39 CA	21	WI	S	GCA/Smith	Sodium Vapor	S
14.110 CA	May 8	WI	S	Lockheed/Bordeau	Massenfilter	X
14.13 CA	22	FC	S	GCA/Dubin	Sodium Vapor	S
14.14 CA	22	FC	S	GCA/Dubin	Sodium Vapor	S
14.15 CA	23	FC	S	GCA/Dubin	Sodium Vapor	S
14.40 CA	24	WI	S	GCA/Dubin	Sodium Vapor	S
14.41 CA	24	WI	S	GCA/Dubin	Sodium Vapor	X
14.42 CA	25	WI	S	GCA/Dubin	Sodium Vapor	S
	1964					
14.38 CA	Jan. 15	WI	X	GCA/Smith	Sodium Vapor	X
14.106 CA	15	WI	P	GCA/Smith	Sodium Vapor	S
14.125 CA	16	WI	S	GCA/Smith	Sodium Vapor	S
14.126 CA	16	WI	S	GCA/Smith	Sodium Vapor	S
14.49 CA	July 15	WI	S	GCA/W. Smith	Sodium Vapor	S
14.50 CA	15	WI	S	GCA/W. Smith	Sodium Vapor	S
14.51 CA	15	WI	S	GCA/W. Smith	Sodium Vapor	S
14.52 CA	15	WI	S	GCA/W. Smith	Sodium Vapor	S
14.195 CA	Oct. 7	WI	S	GCA/Dubin	Luminous Cloud Ionospheres	S
8.03 CA	8	WI	S	Lockheed/Dubin	Ion Composition	S
14.194 CA	8	WI	S	GCA/Dubin	Luminous Cloud Ionospheres	S
14.197 CA	Nov. 1	FC	S	GCA/Dubin	Luminous Cloud Ionospheres	S
14.114 CA	10	SHIP	S	GCA/W. Smith	Sodium Vapor	S
14.53 CA	10	WI	S	GCA/W. Smith	Sodium Vapor	S
14.115 CA	11	SHIP	S	GCA/W. Smith	Sodium Vapor	S
14.112 CA	11	WI	S	GCA/W. Smith	Sodium Vapor	S
14.116 CA	12	SHIP	S	GCA/W. Smith	Sodium Vapor	S
14.113 CA	12	WI	S	GCA/W. Smith	Sodium Vapor	X
	1965					
14.196 CA	Feb. 28	FC	S	GCA/Dubin	Ionospheres-Luminescent Cloud	S
14.198 CA	28	FC	X	GCA/Dubin	Ionospheres-Luminescent Cloud	X
14.199 CA	28	FC	X	GCA/Dubin	Ionospheres-Luminescent Cloud	X
14.200 CA	28	FC	X	GCA/Dubin	Ionospheres-Luminescent Cloud	X
14.201 CA	Jun 23	WI	S	GCA/Dubin	Ionospheres-Luminescent Cloud	S
	1963					
10.77 IA	May 16	PAK	S	Pakistan	Sodium Vapor	X
14.137 IA	20	Italy	S	Italy	Sodium Vapor	S

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PART III
NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING DATE	FIRING SITE	FIRING PERF*	PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
14.138 IA	21	Italy	S	Italy	Sodium Vapor	S
14.139 IA	21	Italy	S	Italy	Sodium Vapor	S
14.128 IA	Nov. 21	IND	S	India/Dubin	Sodium Vapor	P
	1964					
14.129 IA	Jan. 8	IND	S	India/Dubin	Sodium Vapor	S
14.130 IA	12	IND	S	India/Dubin	Sodium Vapor	S
14.134 IA	Apr. 9	PAK	S	Pakistan	Sodium Vapor	X
14.131 IA	Nov. 6	IND	S	India	Sodium Vapor	S
14.204 IA	Nov. 9	IND	S	India	Sodium Vapor	S
14.205 IA	10	IND	S	India	Sodium Vapor	S
14.135 IA	30	PAK	S	Pakistan	Sodium Vapor	S
14.136 IA	Dec. 1	PAK	S	Pakistan	Sodium Vapor	S
14.253 IA	Mar. 1	NOR	S	Sweden	Discharge of TNT	S
14.254 IA	3	NOR	S	Sweden	Discharge of TNT	S
10.94 IA	29	PAK	S	Pakistan	Grenade	S
10.95 IA	30	PAK	S	Pakistan	Grenade	X
14.224 IA	Sep. 18	Surinam	S	Netherlands/Dubin	Sodium Vapor	S
14.225 IA	21	Surinam	S	Netherlands/Dubin	Sodium Vapor	S
	1962					
Rehbar 1**	June 7	PAK	S	Mustafa	Sodium Vapor	X
Rehbar 2**	11	PAK	S	Mustafa	Sodium Vapor	X
				ENERGETIC PARTICLES AND FIELDS		
	1960					
10.17 GE	June 6	FC	S	Fichtel	SBE	S
8.07 GE	30	WI	X	Heppner	Magnetic Field	S
10.18 GE	July 22	FC	X	Fichtel	SBE	S
10.19 GE	Sep. 3	FC	S	Fichtel	SBE	S
10.20 GE	3	FC	S	Fichtel	SBE	S
11.01 GE	19	PMR	S	Naugle	NERV 1	S
10.21 GE	27	FC	S	Fichtel	SBE	S
10.22 GE	Nov. 11	FC	S	Fichtel	SBE	S
10.23 GE	11	FC	S	Fichtel	SBE	P
10.24 GE	12	FC	S	Fichtel	SBE	S
10.15 GE	12	FC	S	Fichtel	SBE	S
10.16 GE	13	FC	S	Fichtel	SBE	S
10.13 GE	16	FC	S	Fichtel	SBE	S
10.14 GE	17	FC	S	Fichtel	SBE	S
10.26 GE	18	FC	S	Fichtel	SBE	S
10.27 GE	18	FC	S	Fichtel	SBE	S
8.08 GE	Dec. 12	WI	S	Heppner	Magnetic Fields	S
	1961					
10.76 GE	Dec. 10	FC	S	Ogilvie-Fichtel	Cosmic Ray	S
	1963					
4.91 GE	Sep. 4	FC	S	Fichtel	Heavy Cosmic Rays	S
	1964					
14.43 GE	Feb. 20	FC	S	Evans	Aurora	P
14.44 GE	29	FC	S	Evans	Aurora	P
14.118 GE	Mar. 24	FC	S	Evans	Aurora	S
14.120 GE	25	FC	S	Evans	Aurora	X
14.119 GE	26	FC	S	Evans	Aurora	P

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PART III
NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING: DATE	FIRING: SITE	FIRING: PERF*	PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
14.155 GE	June 10	WI	S	N. Davis	Magnetic Fields	S
14.156 GE	25	WI	S	N. Davis	Magnetic Fields	S
14.157 GE	26	WI	S	N. Davis	Magnetic Fields	S
4.107 GE	July 23	FC	S	Fichtel	Heavy Cosmic Rays	P
4.108 GE	25	FC	S	Fichtel	Heavy Cosmic Rays	S
14.158 GE	Oct. 7	WI	X	N. Davis	Magnetic Fields	X
14.159 GE	8	WI	S	N. Davis	Magnetic Fields	S
	1965					
14.160 GE	Mar. 8	SHIP	S	T. N. Davis	Magnetic Fields	S
14.171 GE	16	SHIP	S	T. N. Davis	Geomagnetism	S
14.172 GE	18	SHIP	S	T. N. Davis	Geomagnetism	S
14.174 GE	24	SHIP	S	T. N. Davis	Geomagnetism	S
14.173 GE	26	SHIP	S	T. N. Davis	Geomagnetism	S
14.175 GE	27	SHIP	S	T. N. Davis	Geomagnetism	S
14.70 GE	29	SHIP	S	T. N. Davis	Geomagnetism	S
4.140 GE	Jun 17	FC	S	Fichtel	Energetic Particles	S
4.141 GE	23	FC	S	Fichtel	Energetic Particles	S
	1960					
4.16 UE	Aug. 23	WI	S	NYU/Meredith	Cosmic Ray	S
	1961					
14.03 UE	July 14	WI	S	UNH/Heppner	Magnetic Field	S
14.04 UE	14	WI	S	UNH/Heppner	Magnetic Field	S
14.05 UE	20	WI	S	UNH/Heppner	Magnetic Field	S
	1963					
11.06 UE	Feb. 12	PMR	S	U. Minn./Cline	Electron Spect.	S
14.06 UE	Sep. 9	WI	S	UNH/Schardt	Electrojet	S
	1964					
14.150 UE	Jan. 15	WI	P	Rice/Schardt	Sodium Vapor	X
14.79 UE	25	IND	S	UNH/Schardt	Equitorial Electrojet	S
14.180 UE	27	IND	S	UNH/Schardt	Equitorial Electrojet	S
14.81 UE	29	IND	S	UNH/Schardt	Equitorial Electrojet	S
14.82 UE	31	IND	S	UNH/Schardt	Equitorial Electrojet	S
14.151 UE	Mar. 18	FC	S	Rice/Schardt	Aurora	S
14.152 UE	20	FC	S	Rice/Schardt	Aurora	S
14.153 UE	23	FC	S	Rice/Schardt	Aurora	S
14.121 UE	April 11	FC	S	Alaska/Schardt	Aurora	S
14.122 UE	15	FC	S	Alaska/Schardt	Aurora	X
14.123 UE	22	FC	S	Alaska/Schardt	Aurora	S
14.154 UE	July 9	WI	S	Rice/Schardt	Airglow	S
14.60 UE	Dec. 7	WI	S	UNH/Schardt	Energetic Particles	X
	1965					
14.61 UE	Feb. 3	WI	S	UNH/Schardt	Energetic Particles	S
14.85 UE	9	SHIP	S	UNH/Opp	Magnetic Fields	S
14.83 UE	10	SHIP	S	UNH/Opp	Magnetic Fields	S
14.07 UE	12	SHIP	S	UNH/Opp	Magnetic Fields	S
14.84 UE	12	SHIP	S	UNH/Opp	Magnetic Fields	S
14.185 UE	Apr. 2	SHIP	S	UNH/Schardt	Energetic Particles	P
14.207 UE	3	FC	S	Rice/Schardt	Aurora	S
14.184 UE	5	SHIP	S	UNH/Schardt	Energetic Particles	P
14.186 UE	13	SHIP	S	UNH/Schardt	Energetic Particles	P

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PART III
NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING			PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
	DATE	SITE	PERF*			
11.07 UE	Apr. 14	WI	S	Minn./Opp	Energetic Particles	X
14.234 UE	Sep. 16	FC	X	U. Cal./Schardt	Energetic Particles	X
14.235 UE	17	FC	S	U. Cal./Schardt	Energetic Particles	S
14.237 UE	20	FC	X	U. Cal./Schardt	Energetic Particles	X
14.236 UE	20	FC	S	U. Cal./Schardt	Energetic Particler	S
				IONOSPHERIC PHYSICS		
	1959					
4.08 GI	Sep. 11	FC	S	Jackson	Ionosphere	S
4.07 GI	14	FC	S	Jackson	Ionosphere	S
	1960					
1.01 GI	Nov. 23	FC	S	Whipple	Ionosphere	S
1.02 GI	27	FC	S	Whipple	Ionosphere	S
	1961					
8.10 GI	April 27	WI	S	Jackson	Ionosphere	P
8.09 GI	June 13	WI	S	Jackson	Ionosphere	P
10.74 GI	Dec. 21	WI	S	Kane	Ionosphere	S
	1962					
10.110 GI	April 26	WI	S	Serbu	Electron Temperature	S
8.21 GI	May 3	WI	S	Serbu	ELF Electron Trap	S
10.112 GI	16	WI	S	Serbu	Electron Temperature	S
10.111 GI	17	WI	S	Serbu	Electron Temperature	S
14.12 GI	June 15	WI	S	Kane	Ionosphere	S
K63-1**	July 27	SWE	S	Martin-Läf/Witt	Grenade	S
K63-2**	29	SWE	S	Martin-Läf/Witt	Grenade	S
K63-3**	Aug. 1	SWE	S	Martin-Läf/Witt	Grenade	S
K63-4**	7	SWE	S	Fichtel	Heavy Cosmic Rays	S
K62-1**	7	SWE	S	Ortner/Witt	Air Sample	S
K62-3**	11	SWE	S	Ortner/Witt	Air Sample	S
K62-4**	11	SWE	S	Ortner/Witt	Air Sample	P
K62-5**	31	SWE	S	Ortner/Witt	Air Sample	X
14.31 GI	Oct. 16	WI	S	Bauer	Ionosphere	S
14.32 GI	Dec. 1	WI	S	Bauer	Ionosphere	S
	1963					
14.107 GI	Mar. 8	WI	S	Whipple	Ionosphere	P
14.108 GI	April 9	WI	S	Kane	D-Region	S
4.44 GI	23	WI	S	Bauer	Electron Density	S
8.14 GI	July 2	WI	S	Bauer	Ionosphere	S
6.08 GI	20	WI	S	Brace	Thermosphere Probe	S
4.65 GI	Sep. 25	WI	S	Serbu/Hirao	Ionosphere	S
4.64 GI	28	WI	S	Serbu/Hirao	Ionosphere	S
8.18 GI	29	WI	S	Bauer	Ionosphere	
14.37 GI	Dec. 13	WI	P	Whipple	Ionosphere	
	1964					
12.03 GI	April 15	WI	S	Guidotti	Ionosphere	S
4.113 GA-GI	21	WI	X	Berg-Aikin	Ionosphere and Astrochemistry	X
14.33 GI	June 3	WI	S	Bauer	Ionosphere	P
14.127 GI	July 16	WI	S	Stone	Ionosphere	S
14.34 GI	Aug. 26	WI	S	Bauer	Ionosphere	S
8.24 GI-II	Oct. 19	WI	S	Serbu	Ionosphere	P

*S–Successful
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X–Unsuccessful

PART III
NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING: DATE	FIRING: SITE	FIRING: PERF*	PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
14.117 GI	Nov. 23	WI	S	Bauer	Ionosphere	S
14.209 GI	Dec. 16	WI	S	Aikin	Ionosphere	S
	1965					
15.01 GI	Mar. 15	NOR	S	Kane	Ionospheres	X
14.177 GI	16	SHIP	S	Aikin, Blumle	Ionospheres	S
14.178 GI	18	SHIP	S	Aikin, Blumle	Ionospheres	S
14.176 GI	18	SHIP	S	T. N. Davis	Geomagnetism	S
14.179 GI	18	SHIP	S	Aikin, Blumle	Ionospheres	S
15.02 GI	21	NOR	S	Kane	Ionospheres	S
14.180 GI	24	SHIP	S	Aikin, Blumle	Ionospheres	S
14.181 GI	26	SHIP	S	Aikin, Blumle	Ionospheres	S
14.182 GI	27	SHIP	S	Aikin, Blumle	Ionospheres	S
15.18 GI	May 25	NZ	S	Kane	D-region Ionospheres	S
8.37 GI	26	WI	X	Maier	Ionospheres	X
15.05 GI	30	NZ	S	Kane-Aikin	Eclipse Ionospheres	S
15.06 GI	30	NZ	S	Kane-Aikin	Eclipse Ionospheres	S
15.07 GI	30	NZ	S	Kane-Aikin	Eclipse Ionospheres	S
15.08 GI	30	NZ	S	Kane-Aikin	Eclipse Ionospheres	S
15.09 GI	30	NZ	S	Kane-Aikin	Eclipse Ionospheres	S
15.10 GI	30	NZ	S	Kane-Aikin	Eclipse Ionospheres	S
14.210 GI	Aug. 24	WI	S	Bourdeau	Ionospheres	S
8.36 GI	Sep. 23	WI	S	Maier	Ionospheres	S
	1960					
6.01 UI	Mar. 16	FC	S	U/M Bourdeau	Ionosphere	S
3.10 UI	16	FC	X	U/M Bourdeau	Ionosphere	X
6.02 UI	June 15	FC	S	U/M Bourdeau	Ionosphere	S
6.03 UI	Aug. 3	WI	S	U/M Bourdeau	Ionosphere	S
	1961					
6.04 UI	Mar. 26	WI	S	U/M Bourdeau	Ionosphere	S
6.05 UI	Dec. 22	WI	S	U/M Wright	Ionosphere	S
	1963					
4.58 UI	April 3	WI	S	Stanford/Bourdeau	Ionosphere	S
4.59 UI	July 10	WI	S	Stanford/Bourdeau	Ionosphere	S
	1964					
14.143 UI	April 16	WI	S	U. of Ill./Schardt	Ionosphere	S
14.144 UI	July 15	WI	S	U. of Ill./Schardt	Ionosphere	S
14.145 UI	15	WI	S	U. of Ill./Schardt	Ionospheres	S
14.146 UI	15	WI	S	U. of Ill./Schardt	Ionospheres	S
14.147 UI	Nov. 10	WI	S	U. of Ill./Schardt	IQSY Ionosphere	S
14.149 UI	19	WI	S	U. of Ill./Schardt	IQSY Ionosphere	S
14.148 UI	19	SHIP	S	U. of Ill./Schardt	IQSY Ionosphere	S
	1965					
8.28 UI	Jan. 13	WI	S	Penn State/Schmerling	Mother-Daughter Ionospheres	X
14.228 UI	20	SHIP	S	U. Ill./Schmerling	Ionospheres	S
14.229 UI	23	SHIP	S	U. Ill./Schmerling	Ionospheres	X
14.230 UI	5	SHIP	S	U. Ill./Schmerling	Ionospheres	S
14.231 UI	9	SHIP	S	U. Ill./Schmerling	Ionospheres	S
14.232 UI	12	SHIP	S	U. Ill./Schmerling	Ionospheres	S
8.29 UI	5	WI	S	Penn State/Schmerling	Mother-Daughter Ionospheres	S
14.245 UI	14	WI	S	U. Ill./Schmerling	Ionospheres	S

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PART III
NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING DATE	FIRING SITE	FIRING PERF*	PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
14.246 UI	Jan. 17	WI	S	U. Ill./Schmerling	Ionospheres	S
14.213 UI	Sep. 1	WI	S	SCAS/Schmerling	Ionospheres	S
14.214 UI	3	WI	S	SCAS/Schmerling	Ionospheres	X
14.244 UI	15	WI	S	U. Ill./Schardt	IQSY Ionospheres	S
	1963					
14.36 DI	Oct. 7	FC	S	BRL/Bourdeau	Ionosphere	P
	1964					
14.104 DI	Nov. 5	FC	S	BRL/Bourdeau	Ionosphere	S
8.19 DI	5	FC	S	BRL/Bourdeau	Ionosphere	S
14.105 DI	7	FC	S	BRL/Bourdeau	Ionosphere	S
8.20 DI	7	FC	S	BRL/Bourdeau	Ionosphere	S
	1961					
8.15 AI	June 24	WI	S	CRPL/AIL-Jackson	Ionosphere	S
8.17 AI	Oct. 14	WI	S	Jackson	Ionosphere	S
	1962					
8.16 AI	Feb. 7	WI	S	Jackson	Ionosphere	X
	1965					
14.215 AI	Jun. 18	WI	S	BuStds/Schmerling	Ionospheres	X
	1960					
3.12 CI	Aug. 22	WI	X	GCA/Bourdeau	Langmuir Probe	X
10.25 CI	Dec. 8	WI	S	GCA/Bourdeau	Langmuir Probe	S
	1961					
10.51 CI	Aug. 18	WI	S	GCA/Wright	Langmuir Probe	S
10.52 CI	Oct. 27	WI	S	GCA/Bourdeau	Langmuir Probe	S
	1962					
10.99 CI	Nov. 7	WI	S	GCA/Bourdeau	Ionosphere	S
10.108 CI	30	WI	S	GCA/Bourdeau	Ionosphere	S
10.109 CI	Dec. 5	WI	S	GCA/Bourdeau	Ionosphere	S
	1963					
14.86 CI	Feb. 27	WI	S	GCA/Bourdeau	Ionosphere	S
14.87 CI	Mar. 28	WI	P	GCA/Bourdeau	Ionosphere	S
14.88 CI	July 14	FC	P	GCA/Bourdeau	Ionosphere	P
14.89 CI	20	FC	X	GCA/Bourdeau	Eclipse Ionosphere	X
14.90 CI	20	FC	X	GCA/Bourdeau	Eclipse Ionosphere	X
14.91 CI	20	FC	S	GCA/Bourdeau	Eclipse Ionosphere	S
14.92 CI	20	FC	S	GCA/Bourdeau	Eclipse Ionosphere	S
14.93 CI	20	FC	S	GCA/Bourdeau	Eclipse Ionosphere	S
14.94 CI	20	FC	S	GCA/Bourdeau	Eclipse Ionosphere	S
	1959					
4.02 II	Sep. 17	FC	S	DRTE-Jackson	Ionosphere	S
4.03 II	20	FC	P	DRTE-Jackson	Ionosphere	X
	1961					
8.13 II	June 15	WI	S	DRTE-Jackson	Antenna Test	S

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X–Unsuccessful

PART III
NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING			PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
	DATE	SITE	PERF*			
	1962					
4.79 II	Nov. 16	WI	X	AUS/Cartwright	Ionosphere	X
4.80 II	Dec. 11	WI	X	AUS/Cartwright	Ionosphere	X
Ferdinand III	11	NOR	S	Kane	Ionosphere	S
Ferdinand II	14	NOR	S	Norway	NASA T/M only	S
	1963					
4.96 II	Apr. 12	WI	S	AUS/Cartwright	VLF	S
4.97 II	May 9	WI	S	AUS/Cartwright	VLF	S
Ferdinand V	Sep. 8	NOR	S	Kane	Ionosphere	X
Ferdinand IV	11	NOR	S	Kane	Ionosphere	S
4.93 II	Oct. 17	WI	S	France/Shea	Ionosphere	S
4.94 II	31	WI	S	France/Shea	Ionosphere	S
	1964					
Ferdinand VI	Mar. 12	NOR	S	Kane	Ionosphere	S
Ferdinand VII	15	NOR	S	Kane	Ionosphere	S
Ferdinand VIII	19	NOR	S	Kane	Ionosphere	S
1 64-1 II	Dec. 1	ARG	S	Argentina/Bauer	Ionosphere	S
1 64-2 II	4	ARG	S	Argentina/Bauer	Ionosphere	S
	1965					
15.03 II	Mar. 1	NOR	S	Sweden	Ionospheres	S
15.04 II	3	NOR	S	Sweden	Ionospheres	S
4.138 II	Sep. 17	WI	S	France/Stevens	VLF Experiment	S
Ferdinand IX*	7	NOR	S	Norway/Kane	Auroral Absorption	X
Ferdinand X*	15	NOR	P	Norway/Kane	Auroral Absorption	X
Ferdinand XI*	20	NOR	P	Norway/Kane	Auroral Absorption	X
				SOLAR PHYSICS		
	1960					
3.01 GS	Mar. 1	WI	S	Hallam	Solar Study	X
3.02 GS	3	WI	S	Hallam	Solar Study	X
3.03 GS	April 27	WI	X	Hallam	Solar Study	X
3.04 GS	May 25	WI	X	Hallam	Solar Study	X
	1961					
4.25 GS	Sep. 30	WI	S	Behring	Solar Studies	S
	1963					
4.77 GS	July 20	WI	S	Hallam-Wolff	Solar Studies	X
4.78 GS	Oct. 1	WI	S	Hallam	Solar Studies	P
4.33 GS	15	WI	S	Money	Solar Studies	S
	1964					
4.116 GS	Oct. 30	WI	S	Muney	Solar Studies	S
	1965					
4.63 GS	Mar. 17	WS	S	Muney	Solar Studi es	S
4.49 GS	Apr. 12	WS	S	Fredga	Solar Studies	S
	1962					
4.23 US	June 24	WI	S	U. Colo./Lindsay	Sunfollower	P
4.21 US	Oct. 27	WI	S	Harvard/Lindsay	Solar	X

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PART III
NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING: DATE	FIRING: SITE	FIRING: PERF*	PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
	1963					
4.22 US	Sep. 6	WI	S	Harvard/Lindsay	Solar Studies	S
	1963					
4.61 AS	June 20	WI	S	NRL/Packer	Coronograph	P
4.62 AS	28	WI	S	NRL/Packer	Coronograph	P
				GALACTIC ASTRONOMY		
	1960					
4.04 GG	April 27	WI	P	Kupperian	Stellar Fluxes	P
4.05 GG	May 27	WI	S	Boggess	Stellar Fluxes	P
4.06 GG	June 24	WI	S	Boggess	Stellar Fluxes	S
4.11 GG	Nov. 22	WI	S	Stecher	Stellar Spectra	S
	1961					
4.34 GG	Mar. 31	WI	P	Boggess	Stellar Fluxes	P
9.01 GG	Sep. 18	AUS	S	Boggess	Stellar Photo	S
9.02 GG	Oct. 4	AUS	S	Boggess	Stellar Photo	S
9.03 GG	Nov. 1	AUS	S	Boggess	Stellar Photo	P
9.04 GG	20	AUS	S	Boggess	Stellar Photo	S
	1962					
4.35 GG	Feb. 7	WI	X	Stecher	Stellar Spectra	X
4.36 GG	Sep. 22	WI	S	Stecher	Stellar Photo	S
	1963					
4.30 GG	Mar. 28	WI	S	Boggess	Stellar Spectra	S
4.37 GG	July 19	WI	S	Stecher	Stellar Spectra	S
4.29 GG	23	WI	S	Stecher	Stellar Spectra	S
4.31 GG	Oct. 10	WI	X	Boggess	Stellar Spectra	X
	1964					
4.15 GG	April 3	WI	S	Boggess	Stellar Spectra	X
4.81 GG	10	WI	X	Boggess	Stellar Spectra	X
4.82 GG	Aug. 11	WI	S	Boggess	Stellar Spectra	X
4.126 GG	22	WI	P	Boggess	Stellar Spectra	S
4.109 GG	Nov. 7	WI	S	Stecher	Stellar Spectra	S
4.110 GG	14	WI	S	Stecher	Stellar Spectra	S
	1965					
4.56 GG	Mar. 13	WS	S	Boggess	Stellar Spectra	X
4.57 GG	19	WS	S	Boggess	Stellar Studies	S
4.114 GG	Apr. 24	WS	X	Boggess	Stellar Studies	X
4.89 GG	May 5	WI	S	Boggess	Stellar Studies	X
	1962					
4.54 UG	Sep. 30	WI	S	U. of Wisc./Kupperian	Stellar Studies	S
	1964					
4.55 UG	Sep. 2	WI	S	U. of Wisc./Kupperian	Stellar Studies	S
4.52 UG	Nov. 3	WI	P	Princeton	Stellar Spectra	P
	1965					
4.133 UG	Mar. 6	WS	S	Princeton/Kupperian	Stellar Spectra	X
4.17 UG	Jun 2	WS	S	Princeton/Kupperian	Stellar Spectra	P

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PART III
NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING: DATE	FIRING: SITE	FIRING: PERF*	PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
	1962					
4.69 CG	Sep. 30	WI	S	Lockheed/Dubin	Night Sky Mapping	S
	1963					
4.70 CG	Mar. 16	WI	S	Lockheed/Depew	Stellar Spectra	S
	1964					
4.122 CG	Aug. 29	WI	S	AS&E/Roman	Stellar Studies	S
4.120 CG	Oct. 2	WI	S	Lockheed/Roman	Stellar X-ray	S
4.123 CG	Oct. 27	WI	S	AS&E/Roman	Stellar Studies	S
	1965					
4.147 CG	Sep. 22	WS	S	AS&E/Roman	Celestial X-ray	S
				RADIO AND ASTRONOMY		
	1964					
8.33 GR	Oct. 23	WI	S	Stone	Radio Astronomy	S
	1965					
14.75 GR	Sep. 9	WI	S	Stone	Radio Propagation	S
	1962					
11.02 UR	Sep. 22	WI	S	U. of Mich./Haddock	Radio Astronomy	S
	1965					
11.03 UR	Jun 30	WI	S	U. Mich./Roman	Radio Astronomy	S
				BIOLOGICAL		
	1961					
11.04 GB	Nov. 15	Pt. A	S	Campbell	BIOS 1	X
11.05 GB	18	Pt. A	P	Campbell	BIOS 1	X
				SPECIAL PROJECTS		
	1960					
1.03 GR	Sep. 15	FC	S	Baumann	AMPP	S
1.05 GP	24	FC	S	Baumann	AMPP	P
4.43 GP	Oct. 5	FC	S	NRL-Baumann	AMPP	S
	1961					
1.04 GP	May 17	FC	S	Baumann	AMPP	P
1.06 GP	19	FC	S	Baumann	AMPP	S
	1964					
4.13 GP-GT	Sep. 26	WI	S	Busse	Multiple piggyback	S
	1961					
4.38 NP	Feb. 5	WI	S	LRC/Gold	Hydrogen Zerog	P
4.39 NP	April 21	WI	S	LRC/Gold	Hydrogen Zerog	S
4.42 NP	Aug. 12	WI	S	LRC/Plohr	Hydrogen Zerog	P
4.40 NP	Oct. 18	WI	S	LRC/Regetz	Hydrogen Zerog	S

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PART III

NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING DATE	SITE	PERF*	PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
	1962					
4.41 NP	Feb. 17	WI	S	LRC/Dillon	Hydrogen Zerog	S
4.46 NP	May 8	WI	P	JPL/Brown	Radar	X
4.26 NP	June 20	WI	S	LRC/Flagge	Hydrogen Zerog	P
4.47 NP	July 10	WI	S	JPL/Brown	Radar	X
4.27 NP	Nov. 18	WI	S	LRC/Corpas	Hydrogen Zerog	S
	1963					
4.66 NP	May 14	WI	S	LRC/Kinard	Paraglider	X
4.28 NP	June 19	WI	S	LRC/Corpas	Hydrogen Zerog	P
4.32 NP	Sep. 11	WI	S	LRC/Corpas	Hydrogen Zerog	S
	1964					
4.67 NP	June 10	WI	S	LRC/Kinard	Paraglider	S
	1965					
4.105 NP	June 30	WS	S	JPL/Gaugler	High Altitude Radar	X
	1962					
4.71 UP	June 29	WI	S	JHU/Depew	Airglow	S
4.72 UP	29	WI	S	JHU/Depew	Airglow	S
				TEST AND SUPPORT		
	1959					
2.01 GT	May 14	WI	X	Medrow	Rocket Test	S
2.02 GT	15	WI	X	Medrow	Rocket Test	S
2.03 GT	15	WI	X	Medrow	Rocket Test	X
2.04 GT	Aug. 7	WI	X	Medrow	Rocket Test	X
2.05 GT	7	WI	X	Medrow	Rocket Test	X
2.06 GT	7	WI	X	Medrow	Rocket Test	S
8.01 GT	Dec. 22	WI	S	GSFC/NRL/DRTE	X248 Vibration Test	S
	1960	WI				
8.02 GT	Jan. 26	WI	S	GSFC/NRL/DRTE	X248 Vibration Test	S
4.01 GT	Feb. 16	WI	X	Medrow	Rocket Test	X
4.12 GT	Mar. 25	WI	S	Medrow	Rocket Test	S
4.10 GT	April 23	WI	S	Medrow	Rocket Test	S
5.01 GT	July 22	WI	S	Sargnit	Rocket Test	S
3.28 GT	Aug. 9	WI	S	Sargnit	Rocket Test	S
5.02 GT	Oct. 18	WI	S	Sargnit	Rocket Test	S
3.29 GT	Nov. 3	WI	S	Sargnit	Rocket Test	S
	1961					
3.36 GT	Jan. 17	WI	S	Sargnit	Rocket Test	S
5.03 GT	19	WI	X	Sargnit	Rocket Test	P
10.49 GT	Mar. 15	WI	S	Sargnit	Cajun Fin Test	S
4.19 GT	April 14	WI	S	Russell	Attitude Control	P
12.01 GT	May 2	WI	S	U/M-Spencer	Cone Test	S
14.01 GT	25	WI	S	Sargnit	Rocket Test	S
4.20 GT	June 26	WI	S	Russell	Attitude Control	P
14.02 GT	Aug. 16	WI	S	Sargnit	Rocket Test	S
	1962					
4.68 GT	Jan. 13	WI	S	Russell	Attitude Control	S

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PART III
NASA SOUNDING ROCKET FLIGHTS (Cont.)

NASA NO.	FIRING DATE	FIRING SITE	FIRING PERF*	PRINCIPAL NASA SCIENTIST / COOPERATING INVESTIGATOR	EXPERIMENT	RESULTS*
	1962					
10.69 GT	Mar. 1	WI	X	Donn	Water Launch	S
10.70 GT	Mar. 2	WI	S	Donn	Water Launch	S
4.48 GT	May 25	WI	S	Pressly	Sea Recovery	S
4.60 GT	Aug. 8	WI	P	Russell	Attitude Control	P
	1963					
16.01 GT	April 8	WI	X	Sargnit	ACS Test	X
4.87 GT	June 17	WI	S	Russell	Attitude Control	S
14.111 GT	Oct. 31	WI	S	Williams	Vibration Test	S
	1964					
4.88 GT	Jan. 28	WI	S	Russell	Attitude Control	S
14.28 GT	Feb. 12	WI	S	Sargnit	Rocket Fin Test	S
12.03 GT	April 15	WI	S	Guidotti	Rocket Test	S
4.13 GT	Sep. 26	WI	S	Busse	Rocket Test	S
16.02 GT	Oct. 21	WI	S	Sargnit	Rocket Test	S
12.02 GT	Dec. 11	WI	S	Lane	Rocket Test	S
	1965					
17.01 GT	Jun 18	WI	S	Lane	Rocket Test	S
				METEOROLOGY		
	1965					
10.128 GM	23	WI	S	W. Smith	Grenade	S
10.151 GM	Aug. 7	PB	S	W. Smith	Grenade	S
10.96 GM	7	FC	S	W. Smith	Grenade	S
10.162 GM	7	PB	S	W. Smith	Grenade	S
10.165 GM	7	FC	S	W. Smith	Grenade	S
10.168 GM	7	WI	S	W. Smith	Grenade	S
10.169 GM	8	WI	S	W. Smith	Grenade	S
10.166 GM	8	FC	S	W. Smith	Grenade	S
10.163 GM	8	PB	S	W. Smith	Grenade	S
10.167 GM	8	FC	S	W. Smith	Grenade	S
10.170 GM	8	WI	S	W. Smith	Grenade	S
10.164 GM	9	PB	S	W. Smith	Grenade	S
	1965					
14.71 CM	23	WI	S	GCA/W. Smith	Luminescent Cloud	S
14.72 CM	23	WI	S	GCA/W. Smith	Luminescent Cloud	S
14.73 CM	23	WI	S	GCA/W. Smith	Luminescent Cloud	S
14.74 CM	23	WI	S	GCA/W. Smith	Luminescent Cloud	S

NUMBER OF VEHICLES FIRED 1959 – 1965

AEROBEE 100	14	JAVELIN	28
ARCON	6	SKYLARK	4
NIKE ASP	27	NIKE CAJUN	158
AEROBEE 150	55	JOURNEYMAN	7
AEROBEE 150A	59	SPECIAL	3
IRIS	4	NIKE APACHE	193
AEROBEE 300/300A	11	ASTROBEE 1500	2

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★ U.S. GOVERNMENT PRINTING OFFICE : 1966 O—211-657