GSFC

Two Scientific Satellites Launched From Opposite Coasts

SPECIAL PHOTO REPORT ON MA-8

GODDARD NEWS

GODDARD SPACE FLIGHT CENTER / GREENBELT, MARYLAND

VOLUME III, NUMBER 8 — THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION — OCTOBER 8, 1962

From The West Coast . . .

ALOUETTE (S-27)

At the Pacific Missile Range, the first NASA launch from the West Coast site placed the Canadian-built Alouette Topside Sounder satellite into a polar orbit. Overall NASA project manager is John Jackson, physicist in the planetary ionospheres branch at Goddard.

Primary experiment of the 320-pound satellite is to conduct vertical soundings into the ionosphere below the spacecraft, which is in near-circular orbit at an altitude of about 600 miles.

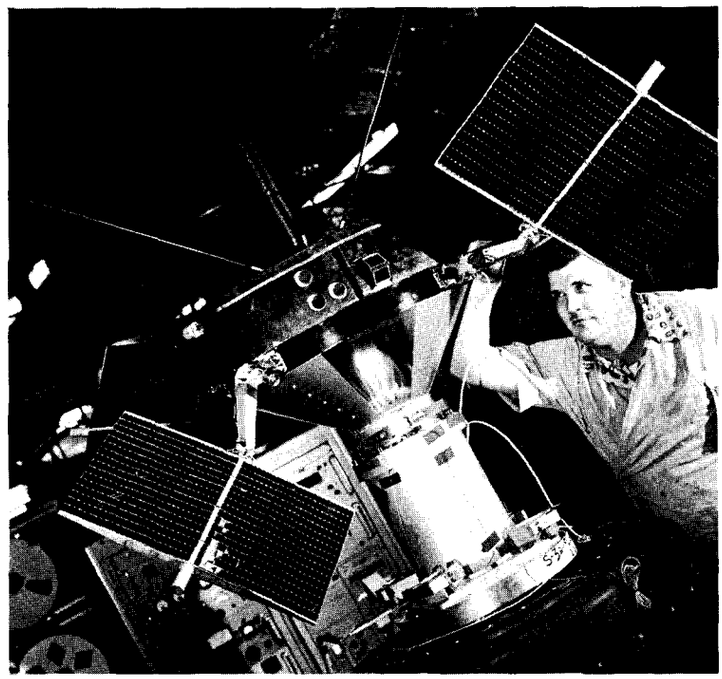
The ionosphere is an electrically charged part of the atmosphere from 50 to at least 1000 miles in space. It acts like a reflecting mirror from which radio waves are bounced. Reflection of radio waves is accomplished only if the electrons at a given height are dense enough to act as a wall for the frequency used.

Purpose of the sounder instrumentation is to measure for a year the way the number of free electrons in the ionosphere changes daily with the time of day and latitude. This will be accomplished by sending out sweeping radio signals from long antennas, one 150 feet and the other 75 feet in length.

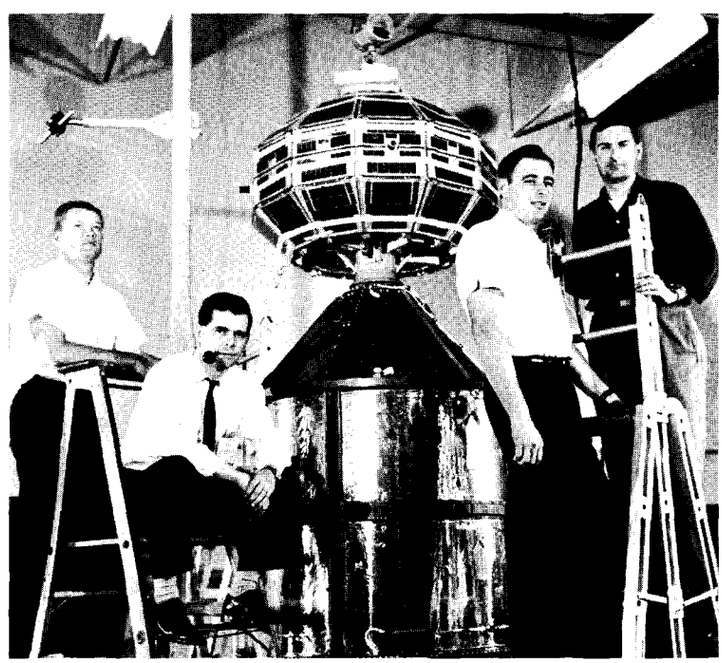
Swept Frequency

"Sweeping" frequencies is like running up the musical scale and then starting at the bottom again. The S-27 does this from 2 megacycles to 12 megacycles, transmitting on about 700 frequencies in the process. The satellite is thus comparable to 700 little radar sets, each one probing to a different depth into the iono-

(See ALOUETTE, Page 2)



Paul McConnell, fabrication division checks Explorer XIV while undergoing vibration tests at Goddard.



Alouette is shown after the final mating check with the vehicle interstage structure in the GSFC spacecraft assembly facility at Point Arguello. (l. to r.) Al Hughes, launch vehicle system office at MSFC, George Hinshellwood, GSFC Agena project office, Tom LaVelle, Lockheed Missiles and Space Co., and Robert Russey, GSFC Agena project office.

From The East Coast . . .

EXPLORER XIV (S-3a)

At Cape Canaveral, the 12th straight success for the Thor-Delta rocket was recorded when the 89-pound S-3a satellite designated Explorer XIV swept into orbit last Tuesday. The satellite should give world scientists a more complete picture of the changes induced by declining solar activity and by effects of the nuclear explosion in the natural radiation zones.

Orbit Under Study

An accurate orbit confirmation was not available when the Goddard News went to press. It is expected that several days will elapse before receiving such a confirmation.

The orbit is expected to take the satellite 60,000 miles in space and bring it back to 185 miles from earth each 36 hours.

Main Goals

The principal purpose of the Explorer XIV is to determine the particle population and their energies in the magnetosphere and the regions of interplanetary space beyond. The magnetosphere begins several hundred miles up and stretches thousands of miles into space. In this region are the natural Van Allen radiation belts discovered by the Explorer I satellite in 1958.

On Board

Aboard the satellite is a cosmic ray experiment by Dr. Frank McDonald, an ion-electron detector experiment by Leo Davis, and a solar cell experiment by Gerry Longanecker. A Goddard photocell optical sensing system by James Albus furnishes information on the satellite's orientation in space.

(See EXPLORER XIV, Page 7)

ALOUETTE

(Continued from Page 1)

sphere. The ionosphere varies in the density of electron population at different heights. It has long been known that a particular radio frequency will be reflected when it hits a given electron density. When reflection occurs the echo-return time tells the height and the frequency used discloses the electron density at that height.

Why Go Topside?

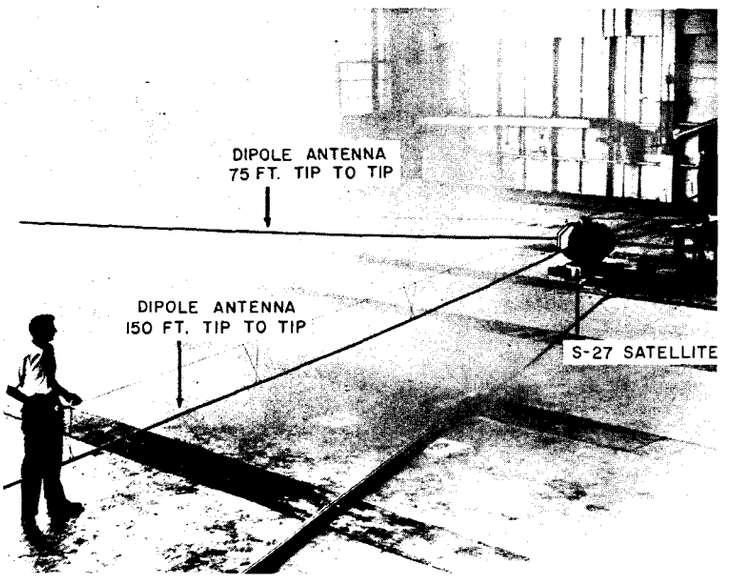
A series of reflected frequencies therefore gives a profile of the electron density in the upper atmosphere. However, it only gives a profile of the underside of the ionosphere: that is, the region below the peak electron density level which is at about 200 miles altitude. From within a cave you can tell a lot about the overhead structure, but not much about the ground terrain above. Similarly, to best see the topside of the ionosphere it should be "seen" from above. Alouette does this job. Techniques from the ground cannot do this job.

Probes Paved Way

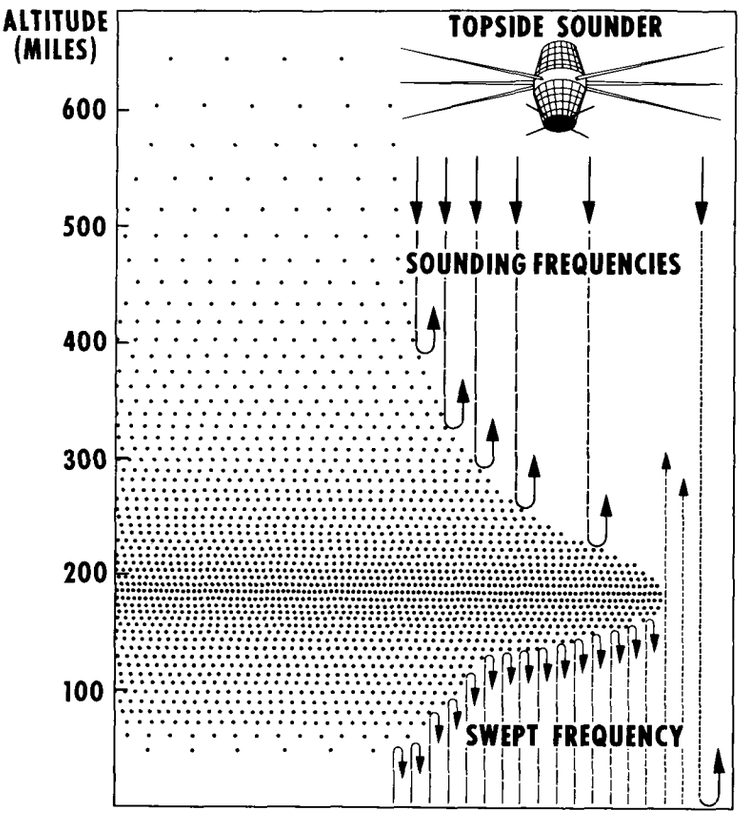
Mr. Jackson indicated that the first topside sounding was accomplished with two sounding rocket probes sent up from Wallops Island on Javelin rockets in 1961. The equipment used was a simplified version of the coming U.S. Fixed Frequency Topside Sounder satellite. These probes resolved many unknowns and provided basic data used by the Canadian-U.S. team in their designs. The probes established the feasibility of this type of experiment and showed that transistors could supply adequate power to do the soundings from above. The concurrent vacuum tube design for Alouette was then dropped.

Canadian Jubilation

The Alouette countdown was carried over 36 radio stations in Canada on a coast to coast hookup. A score of leading Canadian scientists were present at PMR for the firing, which was heavily covered in the Canadian press. Dr. Dryden and other top NASA officials were also present.



To make Alouette's antennas, thin spring steel (.004") was shaped and annealed into a circular tube with an open overlapping seam. Then it was forced flat and wound tightly on a spool. When reeled out, the edges curled in, recreating the tubular shape. In this ground test, the antennas had to be supported from wires, but in space they need no support because weightless.



As shown, the swept frequency sounding technique can be used from above or below the ionosphere. In the illustration the sounding signals increase in frequency from left to right. Signals of increasingly high frequency reflect at increasingly high electron density until a frequency is reached at which complete penetration occurs.

Cooperation Throughout

From the start the project has been a joint Canadian-NASA effort. Design information was shared even before the probes were launched. Data now being received by the Canadian and MiniTrack networks is being shared and scientists from both countries are working jointly on data analysis.

No Need to Hold

Concern about the effect of the artificial radiation belt on Alouette was allayed because the satellite has such ample power supply that degradation of the solar cells won't interfere with its mission. It was decided that it could be flown under existing space conditions.

Goddard Inputs

Most of the testing of Alouette was done under the supervision of Royal Tysdal at Goddard's test and evaluation Division; all flight tests were done at the Center. Others at the Center who contributed significantly to the project were E. D. Nelsen, Dr. R. J. Coates, J. F. South, G. H. Melton, R. V. Borchers, E. D. Quirey, and G. W. Ousley.

Other Activity

While the antennas sound the top levels of the ionosphere, ground-based equipment will sound the lower layers for comparison.

Other experiments are measuring the galactic or radio noise appearing to originate from outer space and radio noise produced in the ionosphere itself. Additional instrumentation is observing cosmic rays, the energetic particles which enter the earth's atmosphere from the sun and cosmic space. The Alouette may also provide further information about the artificial radiation belt.

Some "Firsts"

Several things are being accomplished for the first time by Alouette: the antennas are believed to be the longest ever used on a space vehicle. They were designed and built in Canada. Apparently this is the first time for a large scale three dimensional mapping function by a satellite, as Alouette determines electron density in great depth and laterally. In addition, Alouette is the first satellite completely designed and built by a nation other than the U.S. or Russia.

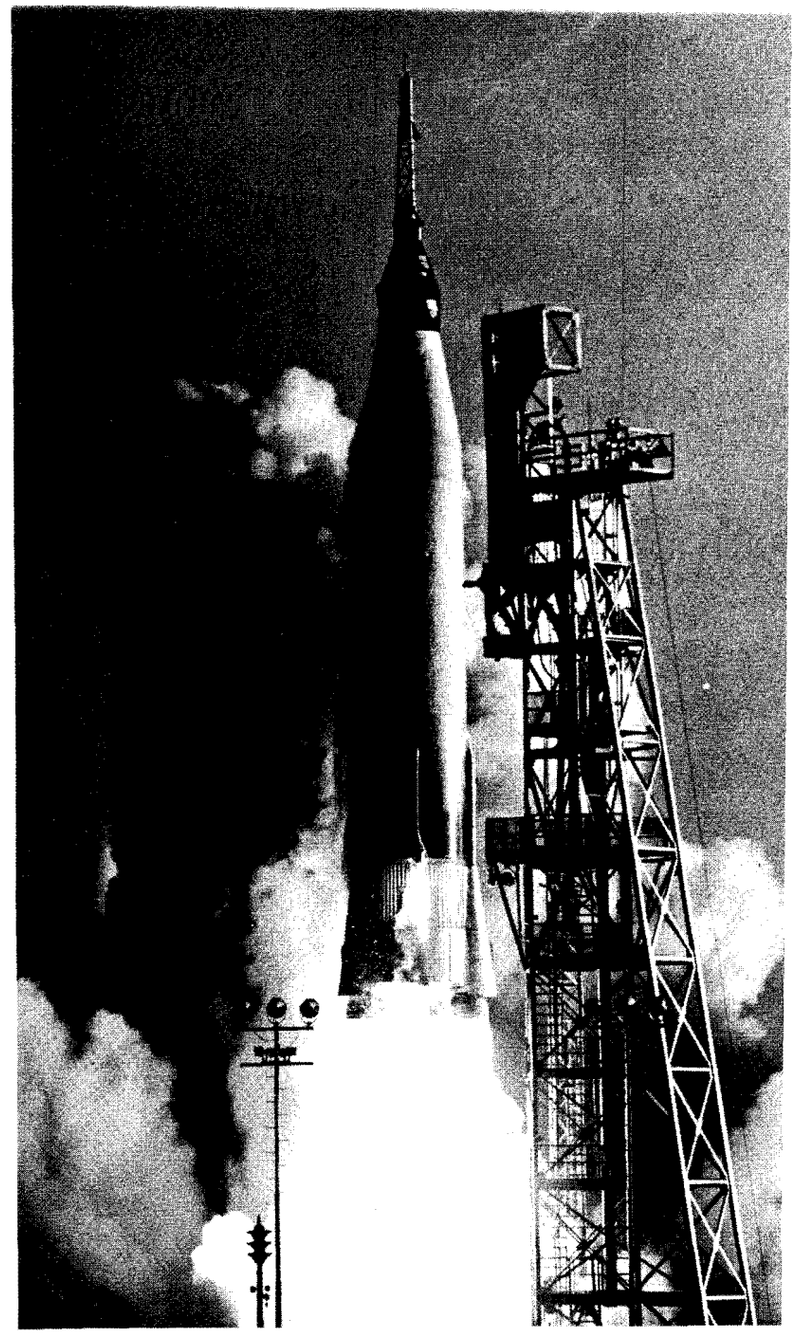
Another Perfect Mercury Mission

At Home and Abroad, A Vital Assist from Goddard's Team

At the far corners of the earth last week an array of people and equipment were at their posts. Wherever they were, their mission had one goal—success of another manned flight in America's expanding exploration of space. Alert and eager, they were ready for the task.

At a world-wide network of ground stations, at sea, in the air, and at Cape Canaveral they performed their tasks well. And so they did at Goddard. Through the computing and communications center, they provided a smooth flow of information to all operational units—another demonstration of Goddard teamwork, and another contribution to America's new frontier in space. Here is a picture report of Wednesday, Oct. 3.

ASTRONAUT WALTER Schirra in spacecraft in Hangar "S" for communication check.



5-4-3-2-1 "LIFT-OFF". The "Sigma 7" spacecraft being launched at 7:15 a.m., EST, Oct. 3 by an Atlas launch vehicle.

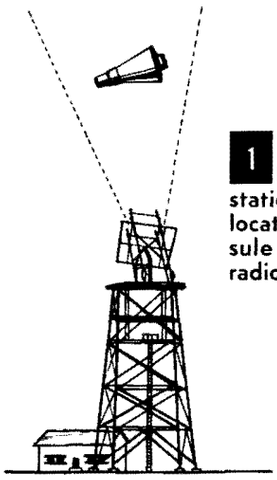
JOHN MENGEL, assistant director for tracking and data systems; Dr. Harry Goett, Goddard director, and Ozro Covington, deputy to Mengel, direct Goddard's world wide network of tracking stations.

OVERALL PICTURE of computer operations during the critical phases of the fifth and sixth orbits. In this area are the four plot boards, digital display, network status boards, network and output status consoles and consoles of the A and B 7090 computers.

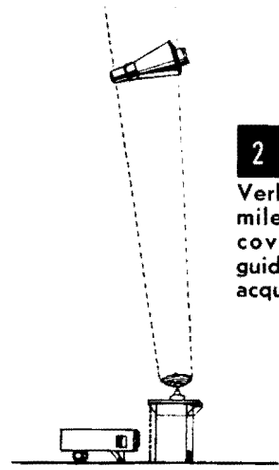
JIM STOKES, computer monitor, and representatives Dunseith, McCreary and Wells of the Manned Spacecraft Center, Houston, check flight progress.

ED WILLIS and Sid Lechter of the data support office prepare for lift-off.

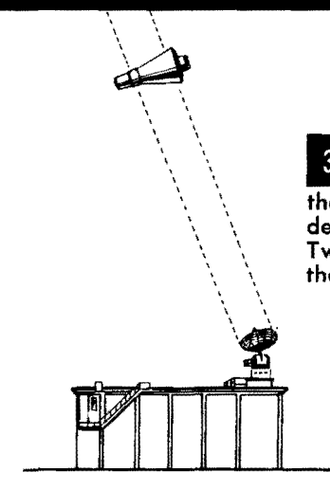
MERCURY STATION T



1 **Ears** of the tracking station, the acquisition aid locates the orbiting capsule by listening for its radio signal.



2 **Long-range eye**, the Verlort radar, can see 700 miles. Its narrow beam, covering only 2½°, is guided by the wide-beam acquisition aid.



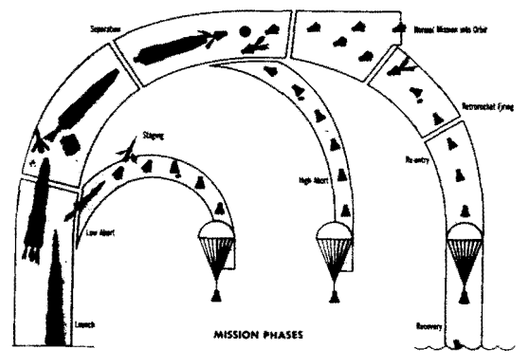
3 **Pinpoi**
the capsule
degree at 5C
Twelve-foot
the capsule a

PAUL WILLIAMS, Leon Woldorff and Ernie Hairston, all of the special projects branch, operate the "C" computer during the mission.

MISSION

A Mercury mission encompasses several sequential phases. These phases may be defined as:

Prelaunch — approximately a four-week checkout from the start of launch vehicles check to the moment of liftoff. During this period, checks and preparations are made to ensure that all elements and components of the launch vehicle, spacecraft and the over-all tracking communications and computational system are ready to operate at an acceptable level.



MISSION PHASES

Launch — extends from launch vehi
either abort or orbit. Shortly after sustain
IBM 7090 computers make a GO NO-GO
trol Center at Cape Canaveral. The Cap
mission or abort signifies the end of the lau

Abort — generally, a premature ter
begins with the decision to abort the missio
tower firing or retrorocket firing. There ar
if the booster/spacecraft fails to attain th
following sustainer engine cutoff, an abort
trol Center on the basis of the computer's
any time during powered flight (low-level or
cutoff is decided at Cape Canaveral. Th
to supply latitude and longitude of impa

Orbit — begins at the announcemen
an acceptible, sustained orbital flight and e
The computer determines present position,
point.

Re-entry — extends from retrorocke
re-entry phase the computer defines preser
impact point.

Recovery — extends from the time of
is recovered.

CAL PACKARD, flight director; James Donegan, operations director; Jerry Emity, computer operator and Jim Stokes, computer monitor, turn intent ears to flight developments.

SPECIAL PROJECTS branch personnel Beverly Kane, Chester Eddington and John Morton, perform computer operations.

RACKING FUNCTIONS

nt radar spots
within half a
)0-mile range.
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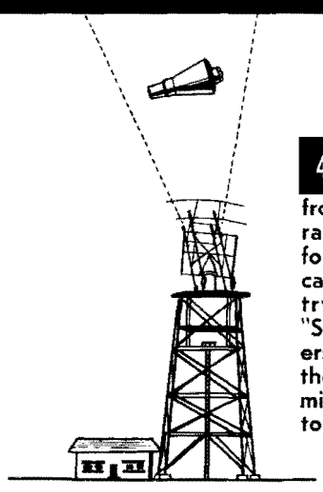
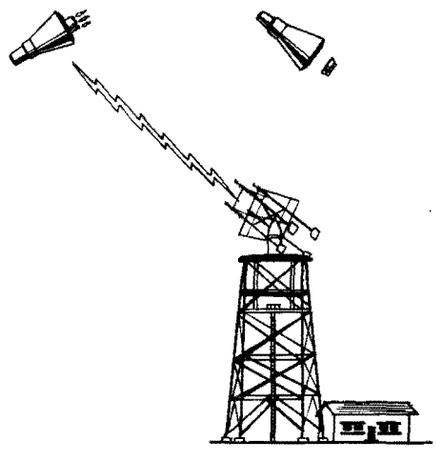
utomatically.



4 Communications from the astronaut and all radio signals bearing information about man and capsule enter this telemetry and voice antenna. "Slaved" to radar receivers, it remains focused on the capsule during its six-minute pass from horizon to horizon.



5 Command antenna shoots signals to fire capsule's retrorockets and to bring spacecraft back to earth. An "alarm clock" in the capsule also fires the rockets as a safety measure. In an emergency the astronaut himself can trigger the rockets.

MINUTES AFTER lift-off, Goddard support was in full swing. In the rear row, left to right, are Dr. Harry Goett, Goddard director; Ozro Covington, deputy assistant director for tracking and data systems; and an unidentified Army television technician. Second row, are Herbert Stotler, site director, data support office; Walter Adams, preflight director, data operations branch, and Monte Dellinger, IBM systems manager (back to camera). Front row, are Donald Roberts, IBM, and Sid Lechter, Cadfist director, data support office.

PHASES

icle liftoff until the flight passes into
er engine cutoff the Mercury project's
recommendation to the Mercury Con-
e Canaveral decision to continue the
nch phase.

mination of the launch phase which
and extends until the time of escape
e several levels of abort. For example,
e proper velocity or flight path angle
is commanded by the Mercury Con-
recommendation. A launch abort at
middle-level) prior to sustainer engine
e computer function in this phase is
ct for different conditions of abort.

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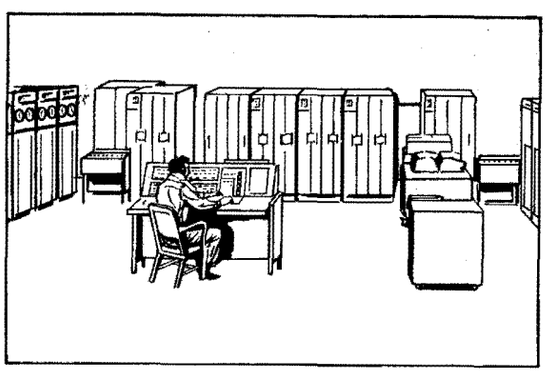
xtends until the retrorockets are fired.
time to fire retrorockets and impact

firing until spacecraft landing. In the
t position, time to impact and refined

pacecraft impact until the astronaut



The Computing and Communications Center at Goddard provides the required computing operations during a mission and serves as the communications link between the remote stations and the Mercury Control Center. Operating in parallel, two IBM 7090 computers installed at Goddard determine powered flight trajectory parameters, and the smoothed present position of the spacecraft. They continuously predict future spacecraft position and provide constant acquisition data for all sites. The computers also calculate and transmit to Cape Canaveral the quantities needed for display purposes.

JONES ATKINS, Supervisor of facilities control area, communications branch, monitors an in coming circuit from a tracking station.

JAMES McDOWELL, manned satellite communications director, checks status board.

GEORGE CASSELLS, communications network monitor, verifies proper operation of the switching system.

WORLD WIDE SUPPORT

Goddard personnel were scattered about the globe to provide technical support for the MA-8 mission.

California

Julius T. Thompson, Walter Adams, Ralph R. Conrad, Edward Ross

Canaveral

Robert D. Miller, Sharon L. Henderson, John T. Koslosky, Virgil F. Gardner, William Dewell, Dale W. Call, Irving Salzberg, Lyle Bonney

Bermuda

James C. Jackson, George Harris, Jr., Howard Clark, Thomas Carson

Aboard Ship

Watertown

Carl Parker

Huntsville

William Bryant

JOE KENDALL and Chuck McTavish of the special projects branch perform ASR operations.

COMMUNICATIONS SUPPORT group prior to launch includes the team efforts of Goddard and Bendix personnel.

ARMY SIGNAL Corps support provided closed circuit color television coverage of Goddard's computer room and control center. Standing are William Healy, control center design office, and Major Robert Vaughn and SFC Edmond DeLage of the Signal Corps. Seated are SFC Lander Carter and Jerry Barsky of the data operations branch.

Dr. Hess Discusses Properties Of The Artificial Radiation Belt

Dr. Wilmot N. Hess

Scientists from the Washington area heard Dr. W. N. Hess last Friday discuss the artificial radiation belt. Dr. Hess is chief of Goddard's theoretical division. He spoke at the first session of the Center's 1962-63 colloquium series. From his talk came answers to these questions.

Q. How was the new radiation belt formed?

A. The artificial radiation belt was formed by the July 9 high altitude nuclear explosion over Johnson Island in the Central Pacific. This was a 1.4 megaton bomb. As a result of the explosion, a large number of electrons was injected from fission product decay into the magnetic field and have formed a new trapped radiation belt.

Q. Is the belt large?

A. The belt extends below the old natural Van Allen radiation belt but merges with it at high altitudes, and high particle fluxes are expected up past 1 earth radii altitude.

Q. Where did we get this information?

A. Particle detectors on the Injun satellite, the Telstar satellite, the Traac satellite, and the Ariel satellite have provided numbers which can be used to determine the nature and extent of the new belt.

Q. What else did these satellites tell us?

A. The different detectors on these four satellites count electrons in different energy ranges. By comparison of their count rates, we have determined that the electrons have a fission energy spectrum. We also know quite well the spacial extent of the new artificially trapped electrons. Fluxes of greater than 10^9 electron/cm^2—sec are encountered at several thousand kilometers altitude near the equator.

Q. Can the damaging effects be determined?

A. By using the flux map determined from the satellite observations, the total number of electrons/cm^2 striking different satellites has been determined. From this can be inferred the expected solar cell degradation of these satellites. This process gives results which agree moderately well with the solar cell degradation experimentally measured on Traac and Transit IVB and Ariel and Telstar.

Q. Is the new belt fading away?

A. The lifetime of the particles in the intense part of the new belt is expected to be several years. At low altitudes, considerable decay of the fluxes has already taken place. Calculations indicate the particles are being lost from the belt primarily by coulomb scattering. Synchrotron radiation observed from the new trapped electrons shows a fairly rapid decay, but the synchrotron radiation is due to quite low altitude electrons. Because of this, the synchrotron radiation decay information is not representative of the decay of the electron belt as a whole.

Q. How might the belt affect the design of future spacecraft?

A. People will probably have to change some of the design features of power supplies on many future satellites. The damage to the solar cells by the new radiation belt is serious enough that current designs of power supplies are not adequate. In many cases, changing to "n-on-p" type solar cells will help a great deal. Also, increasing the total power output over the average power used will materially increase the satellite lifetime. All people involved in designs of power supplies or sensors for future vehicles should consider problems of this kind.

GSFC COLLOQUIUM SEASON UNDERWAY

"First Results of the Topside Sounder Program" will be the subject of the second in the current series of Goddard colloquium lectures at 2:45 p.m. Friday in the Building 3 auditorium. Appearing on the program will be John Jackson, Leo Blumle, and Richard Fitzenreiter all of the planetary ionospheres branch.

The colloquium program began a new year of activity last Friday when Dr. Wilmot Hess, chief of the theoretical division, spoke on the new radiation belt.

Colloquium talks are given weekly to develop interdisciplinary discussions in various fields of space sciences, said Robert Bourdeau, head of the planetary ionospheres branch and chairman of the colloquium committee.

The selection committee asks experts from Goddard and elsewhere to present programs on astronomy, energetic particles, ionospheric physics, solar physics, and aeronomy and meteorology.

While the space sciences, theoretical, and aeronomy and meteorology divisions supervise the colloquium, attendance is open to others at Goddard and outsiders who are interested in and can benefit by the presentations.

Previous colloquia have featured well known scientists such as Professor Marcel Nicolet of Belgium and Nobel prize winner Dr. Harold Urey.

In addition to Mr. Bourdeau, committee members are Dr. Paul Nakada of the theoretical division and Dr. Rudolf Hanel of the aeronomy and meteorology division.

EXPLORER XIV

(Continued from Page 1)

Additional experiments are a proton analyzer device by Dr. Michael Bader of Ames Research Center, a trapped particle radiation device by Dr. Brian O'Brien of the State University of Iowa, and a magnetometer experiment by Dr. Lawrence Cahill of the University of New Hampshire.

The New Belt

Instruments on Explorer XIV will not be able to precisely measure the artificial radiation belt created by the nuclear explosion because they were designed and built prior to its creation. But the satellite will provide at least the first confirming look at the higher reaches of the belt. This will allow comparison with measurements obtained from Telstar. The results of this comparison could materially affect the design of the special satellite being prepared to investigate the enhanced radiation belt. The lifetime of Explorer XIV may vary from a month to a year. Its anticipated elliptical orbit will keep it far out in space most of the time, away from the degrading effects of the new belt.

Cavity Study

The new satellite will fill in some of the gaps regarding the shape and size of the tear drop configuration cavity formed at the interface of the earth's magnetosphere and the solar plasma. The earlier satellite, Explorer XII, had helped map the shape of this cavity. Because of the relative direction of its orbit, Explorer XII measured the cavity mainly on the leading edge of the tear drop shape. Explorer XIV will pick up where XII left off by measuring the shape of the cavity further back in the tear drop's trailing direction. This will be possible because of the greater apogee of Explorer XIV (16 earth radii vs 13 for Explorer XII) and the direction of its apogee with respect to the sun.

At Goddard

Students Abound

A record 155 Goddard personnel are registered in colleges and universities for the 1962-63 school year, James Reese, employee development officer, announced. This compares with 82 who were enrolled in 1961.

The participants in the study program are taking 201 courses, compared to 109 a year ago.

Here is a breakdown for 1962 by institutions, number of personnel and courses:

University	No. of Participants	No. of courses
Maryland	91	113
Catholic	23	32
American	9	12
Johns Hopkins	5	7
Georgetown	5	9
George Washington	19	25
Howard	2	2
Drexel	1	1
	155	201

Purpose of the program is to enable employees to take academic courses which will help them perform their present or projected duties more effectively.

GREENBELT HAD UNUSUAL START 25 YEARS AGO

Goddard is a relative newcomer to the Greenbelt community, but it's certainly in keeping with the experimental, progressive spirit that attended Greenbelt's founding and its success over the years.

Planned Community

The concept of Greenbelt is that of a "garden town". A network of such model communities across the nation were planned by the Resettlement Administration created by President Roosevelt in 1935. They were to be built in suburban areas adjacent to densely populated urban centers. The "garden towns" had several purposes: (1) provide useful work for men on unemployment relief; (2) show the soundness of "garden city" principles; and (3) provide low-rent housing in healthful surroundings for families of modest incomes.

The Green Belts

Thus inspired, the Federal government sought large tracts of land which, under single ownership, could be developed as planned communities, protected by encircling green belts. Such a green belt would provide small gardens and farm tracts for residents while protecting the towns from the encroachments of unplanned neighboring developments. Two other sites selected were Greenhills, Ohio and Greendale, Wisconsin, located outside of Cincinnati and Milwaukee.

Government Departs

Under its council-manager local government (the first in Maryland) Greenbelt has grown steadily since 1937 when the 885 families were selected for the new homes from 9000 who applied.

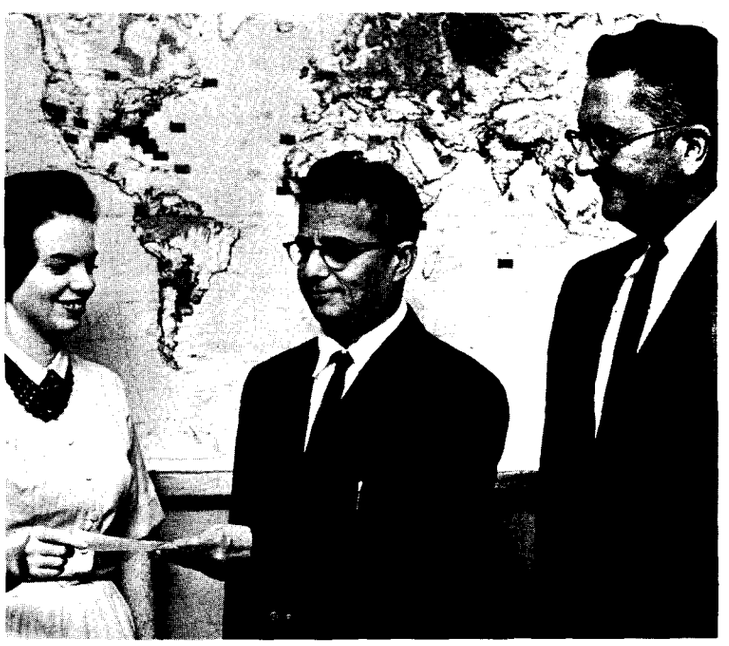
The Federal government relinquished ownership through a complicated series of dedications and sales ending in 1954.

Co-op Concept

Much of the city, its homes and businesses, has been owned on the cooperative basis, including the first cooperative movie theatre in the United States. City planning continues, the many clubs and organizations prosper, and community spirit is high.

Goddard Participates

Goddard helped Greenbelt celebrate its 25th anniversary this month with a satellite display on Oct. 7 and will provide a tour through the Center on Oct. 14.



Dr. S. L. Malurkar is a noted physicist from India, currently working with the Center under a National Academy of Sciences-NASA postdoctoral fellowship. Above, with Dr. Harry Goett, Goddard director, he is handing his United Givers Fund contribution to Miss Judith Holland of the theoretical division. Research associates like Dr. Malurkar are not Goddard employees and are therefore never solicited for UGF contributions. However, Dr. Malurkar volunteered last year and this year with a substantial contribution. He believes that a social responsibility rests upon us to help care for the less fortunate with whom we live. Another foreign contributor is Dr. Bruno Ratti who left recently to return to Italy.

"WHO, ME?"

Posters reminded each employee to ask that question as Goddard's UGF campaign was officially launched on Oct. 1 by Dr. Harry J. Goett, Director.

He urged the support of the assistant directors and division chiefs. Dr. Goett expressed his personal interest and emphasized the benefit of personal support and involvement of supervisory personnel.

With a goal of $48,500, campaign manager Hugh Easter said he is looking forward with great expectation towards achieving and surpassing Goddard's goal.

The effectiveness of the Goddard campaign depends on each individual. Total participation with "fair share" giving is the keystone to a successful campaign.

Recent Technical Publications Authored by Goddard Staff

Sherfey, J. M. and Johannsen, K., "Reliability and Redundancy Considerations in Selecting Spacecraft Batteries," NASA Technical Note D-1452, October 1962.

Rochelle, R. W., "Pulse Frequency Modulation," NASA Technical Note D-1421, October 1962.

COMING EVENTS

SEMINAR:

University of Md., Institute for Fluid Dynamics and Applied Mathematics, Oct. 1—Jan. 16, 1963.

North Carolina Section, Institute of Radio Engineers Seventh Annual Symposium, Greensboro, N. C., Oct. 13.

Joint Meeting of IRE, NASA and AEC, Detroit, Michigan, Oct. 15-18.

LECTURE:

Goddard colloquium lecture, Friday, Oct. 12, 2:45 p.m. Auditorium Bldg. #3 (GSFC colloquium lectures are scheduled for every Friday except Nov. 23.)

MISC:

New Employee Registration and/or opportunity to change registration for the Federal Employees Health Benefits Program, Oct. 1-15.

Greenbelt Anniversary, Oct. 7-14.

"Open House" for GSFC employees and their families, Oct. 13.

GSFC "Open House" for citizens of Greenbelt, Oct. 14.

To include items in the Coming Events column, please call ext. 4141 or 4142.