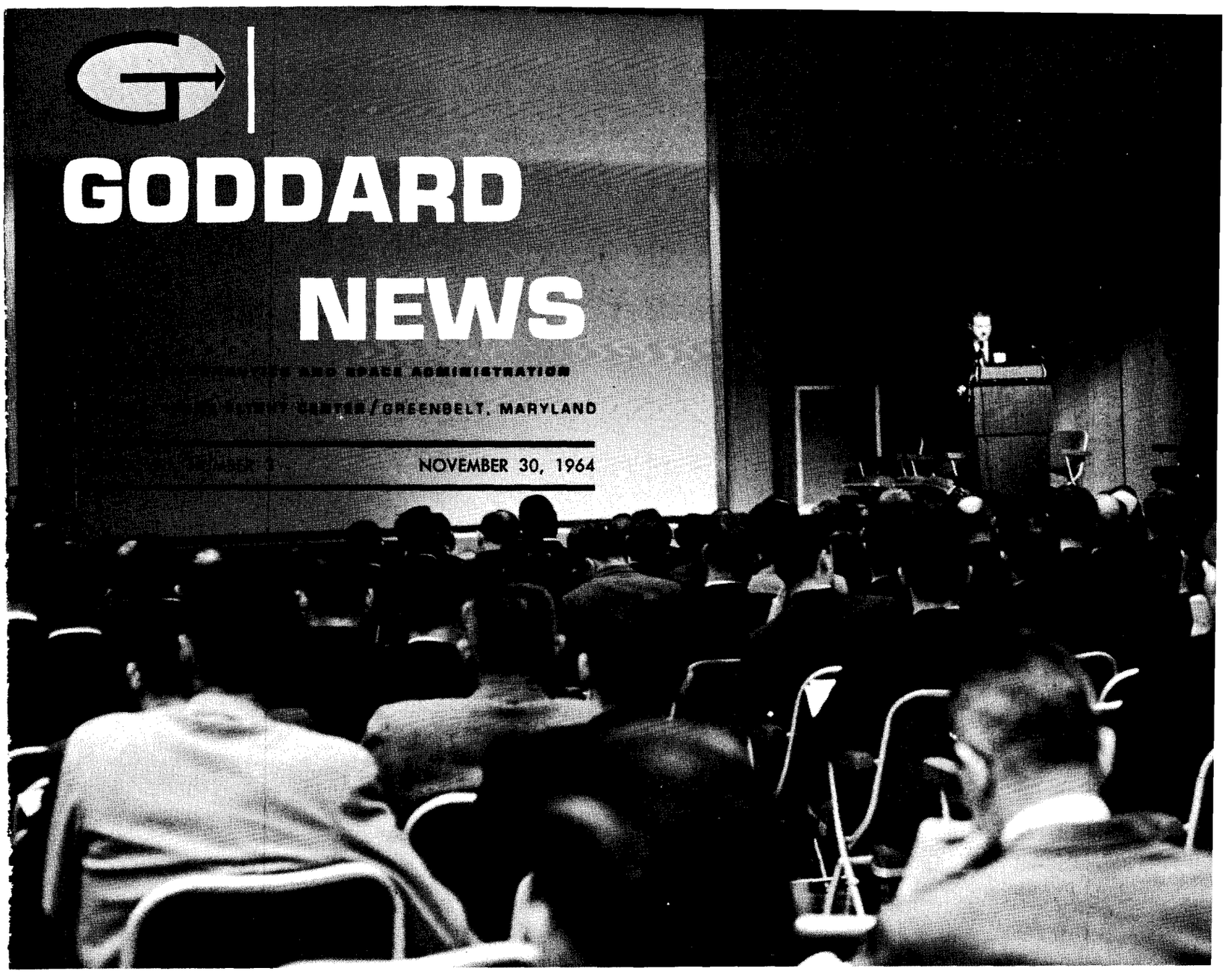
GODDARD NEWS

AND SPACE ADMINISTRATION

CENTER/GREENBELT, MARYLAND

NOVEMBER 30, 1964



*Held in Building 8 auditorium, the 2-day symposium comprised 4 sessions, 2 per day.*

# Symposium Attracts Top Scientists and Engineers: World's First on Short-Term Frequency Stability

Some 310 scientists and engineers specializing in microwave frequency-stability came to Goddard from across the country and also from England, Canada and Switzerland for the "Short Term Frequency Stability" symposium, November 23 and 24.

Jointly sponsored by Goddard and the Institute of Electrical and Electronics Engineers, the symposium was the first of its kind to study problems associated with the generation of stable frequencies in the microwave region for the control, guidance and tracking of launch vehicles and satellites. The ultimate objective was to develop a standardized definition and measurement technique.

In attendance were a number of distinguished scientists, including Prof. Norman F. Ramsey, Harvard University; Dr. Marcel J. E. Golay, Perkin-Elmer Corp.; Dr. William A. Edson, Electromagnetic Technology Corp.; Roger A. Sykes, Bell Telephone Laboratory; Prof. Campbell L. Searle and Prof. Malcom W. P. Strandberg, both of the Massachusetts Institute of Technology; Dr. James A. Mullen, Raytheon Research; Dr. Gernot M. R. Winkler and Dr. Frederick H. Reder, both of the U. S. Army Electronics Laboratory; Dr. George E. Hudson, NBS-Boulder Laboratory; Dr. Elie J. Baghdady, ADCOM, Inc., and Dr. Arthur D. McCoubrey, of Varian Associates.

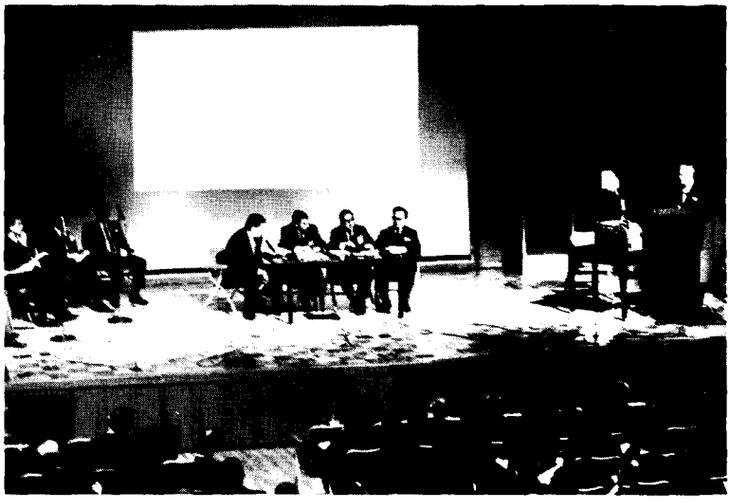
Dr. Harry J. Goett, Goddard's Director, opened the first session, which concentrated on papers outlining system requirements for signal sources exhibiting a high order of short-term frequency stability.

Goddard's Andrew R. Chi, Head, Timing Systems Section, Advanced Development Division (ADD), was both the symposium chairman and chairman of the program committee. The symposium secretary was Thomas E. McGunigal, Head, Signal Sources Section, ADD. Mr. Chi said, "We're delighted with the turnout and interest shown, and extremely hopeful that the technology discussed will lead toward accomplishment of our prime objective."

Goddard participants included John T. Mengel, Assistant Director for Tracking and Data Systems; Dr. Robert J. Coates, Chief, ADD; Chesley H. Looney, Jr., Assistant Chief, ADD; Merrick E. Shawe, Head, Space Data Control Branch; Dr. Friedrich O. Vonbun, Head, Systems Analysis Office; and Edmund J. Habib, Assistant Chief for Data Processing, Data Systems Division.

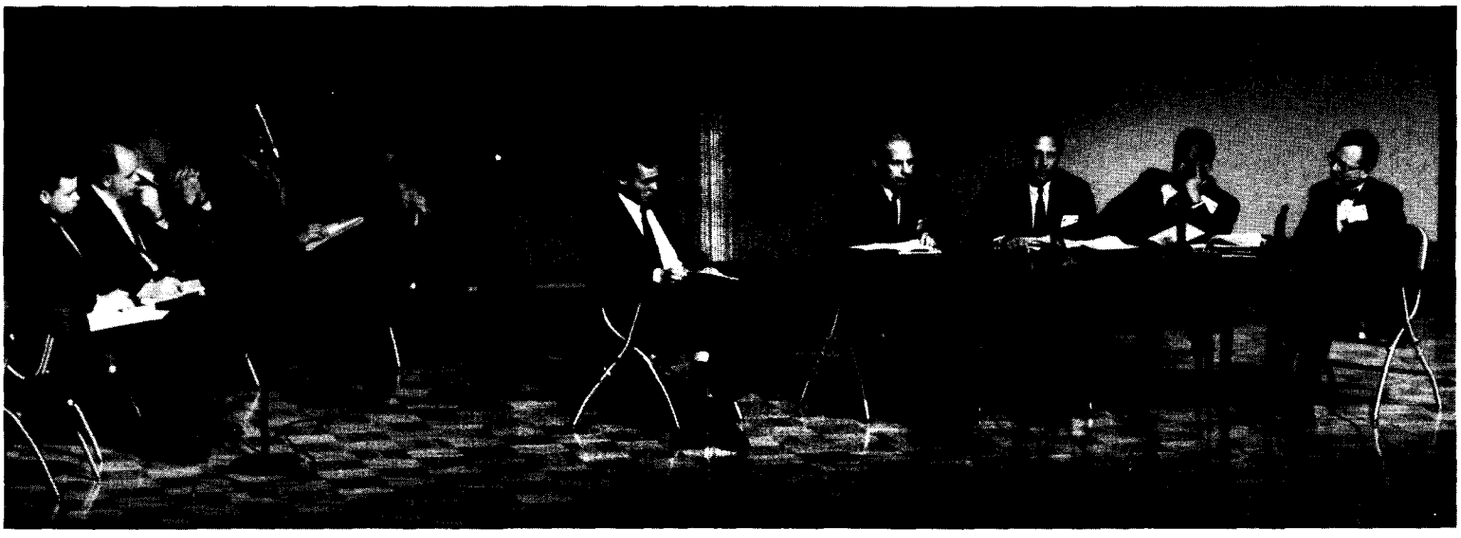
*(See Page 2)*

(From Page 1)



*SYMPOSIUM SESSION I: Chairman: Roger A. Sykes (at lectern), Bell Telephone Laboratories. Panel members at table: (from left) Dr. Elie J. Baghdady, ADCOM, Inc.; Edmund J. Habib, Goddard Data Systems Division; Dr. David B. Leeson, Hughes Aircraft Co.; and Gerald M. Hyde, Lincoln Laboratory, M.I.T. Authors are seated at left.*

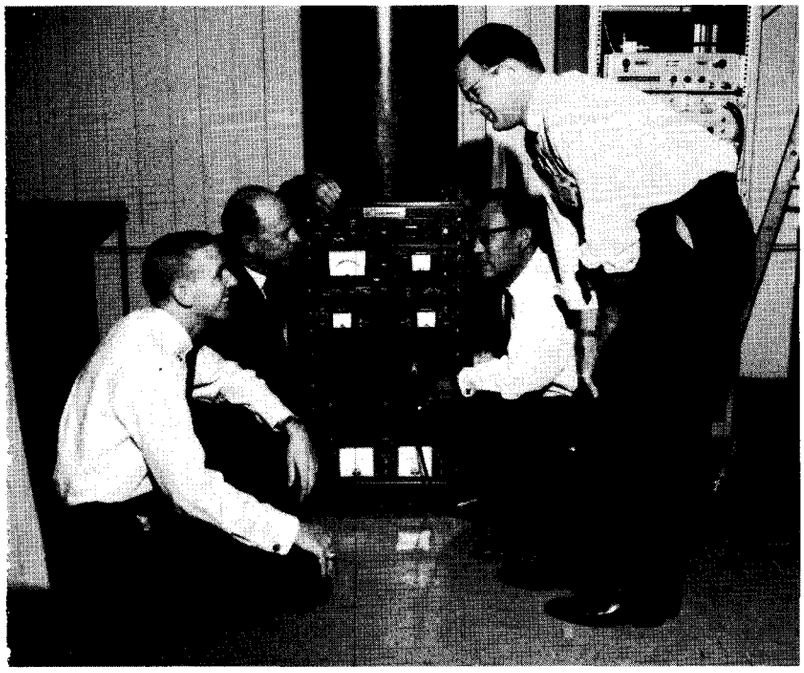
*SESSION II: Chairman: Dr. William A. Edson (right), Electromagnetic Technology Corp. Discussion panel: (from left) Prof. Malcom W. P. Strandberg, M.I.T.; Dr. James A. Mullen, Raytheon Research Division; and Dr. Marcel J. E. Golay, Consultant, Perkin-Elmer Corp.*



*SESSION IV: Chairman: Prof. Campbell L. Searle (center left), M.I.T. Discussion panel: (from left) Dr. George E. Hudson, Radio Standards Laboratory; Dr. Gernot M. R. Winkler, Institute of Exploratory Research; Benjamin Parzen, Parzen Research, Inc.; and Chesley H. Looney, Jr., Advanced Development Division, Goddard.*

*SYMPOSIUM OFFICIALS. Front row, from left: Dr. E. J. Baghdady, R. A. Sykes, Prof. N. F. Ramsey, Dr. M. J. E. Golay, Prof. M. W. P. Strandberg, and Chairman A. R. Chi. Back row, from left: Tom McGunigal, Dr. G. M. R. Winkler, Dr. F. H. Reder, Warren P. Smith, Dr. J. A. Mullen, C. P. Boyle, Dr. G. E. Hudson, Prof. C. L. Searle, and Dr. A. D. McCoubrey.*

# World's Most Stable Atomic Clocks Delivered to Goddard



Discussing the new hydrogen maser shown at center are Thomas E. McGunigal, Head, Signal Sources Section; Victor R. Simas, Head, R-F Systems Branch; Andrew R. Chi, Head, Timing Systems Section; and Merrick E. Shawe, Head, Space Data Control Branch.

The two hydrogen masers delivered to Goddard are the first commercial units of their type. They were developed in Beverly, Mass., by Varian Associates, a scientific firm with headquarters in Palo Alto, California.

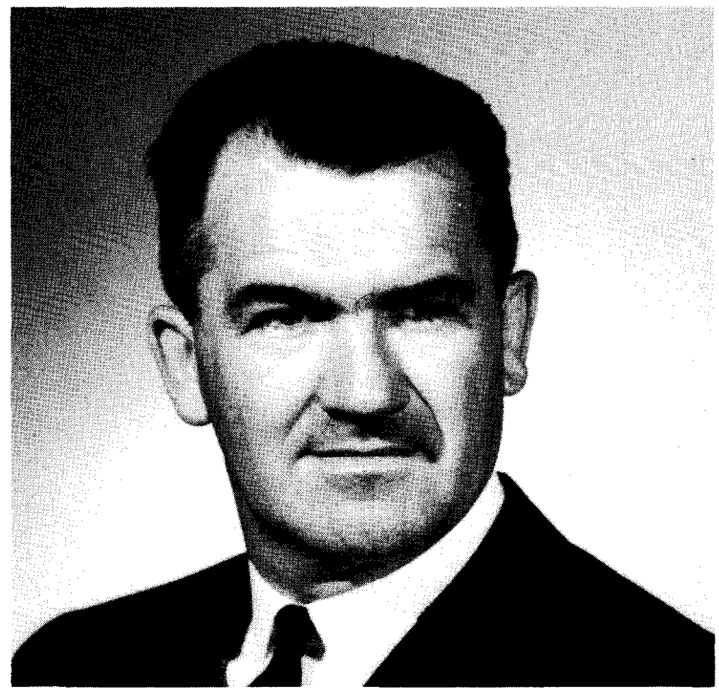
At Goddard the atomic clocks are being evaluated for space experiments—potential applications in the fields of high precision tracking of satellites and for testing the gravitational "Red Shift" experiment to a higher precision than has ever been attempted before.

The precision of Goddard's two molecular masers is such that the frequency of one will not change one part in 10 trillion, relative to the other. For comparison, one part in 10 trillion is equal to one second in a span of one million years, or it is the same as .01 of an inch of the distance to the moon.

The atomic hydrogen maser is the result of an invention by Norman F. Ramsey, Professor of Physics at Harvard University and one of America's foremost nuclear scientists. While at Goddard for the symposium on Short-Term Frequency Stability, Prof. Ramsey (in conversation with John T. Mengel) made a quick calculation and said: "The short-term stability of the hydrogen maser can be designed to be equal or better than that of the rubidium maser."

# Meet Our People

*This is another in a series of articles on Goddard personalities*



***Walter J. Carrion***

*Walter J. Carrion,* Associate Head, Optical Systems Branch, came to Goddard, May 1, 1961, from the Ballistic Research Laboratories (BRL), U.S. Army Ordnance Department, where he was Chief, Telescopic Instrumentation Section and member of the Scientific Staff.

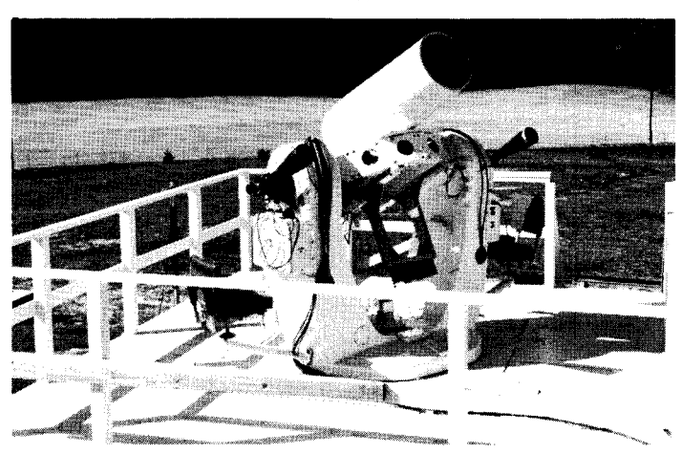
While there in 1958 he was nominated by the Ballistic Measurement Laboratory (BML) for the coveted Kent Award, and came in second in the final judging for the honor which BRL presents annually to top engineers and scientists whose accomplishments are judged the most outstanding of the year. This was the year that BML made the first precision measurements of the Russian Sputnik.

He has worked on Echo, the optical alignment of large radio antennas, Real-time Automatic Digital Optical Tracker (RADOT), and the S-66 laser tracking experiments. His current assignments include the development of new types of precision tracking instrumentation, and the planning of new facilities, such as the Goddard Optical Research Facility. He is also assigned as optical instrumentation consultant on the RT-2 telescope for Wallops Island Station, and on the Echo Project.

Mr. Carrion received his BAE degree from Catholic University, where also he was a graduate student as well as at Johns Hopkins University. While in Naval Aviation he held the rank of Lieutenant Commander.

He likes hunting, fishing, and is especially fond of training retrievers. Much of his spare time is spent working with his dogs.

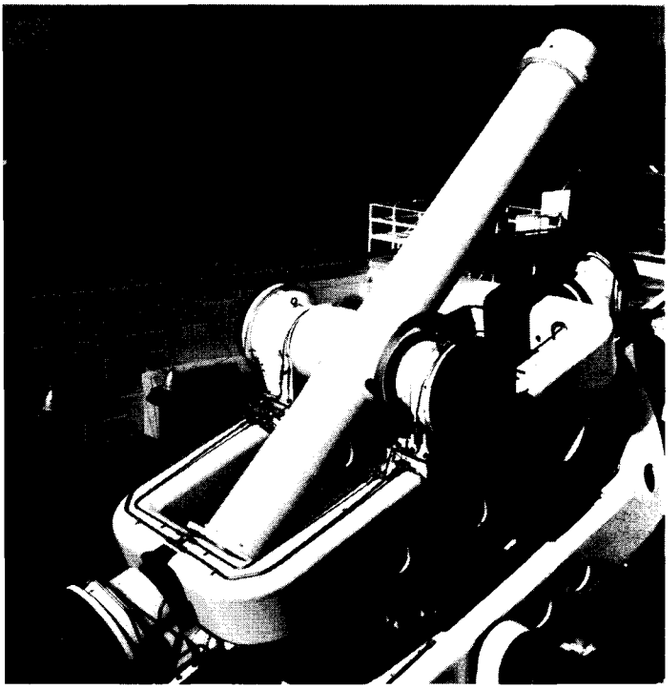
Mr. Carrion lives at 16 Amherst Avenue, Ellicott City, Md., with his wife, Helen and three sons: Michael, 13, Timothy, 11, and Patrick, 9.



***A converted Nike-Ajax tracking mount positions this 16" telescope to receive the reflected laser beam at the Goddard Optical Research Facility. It has a 290" focal length.***

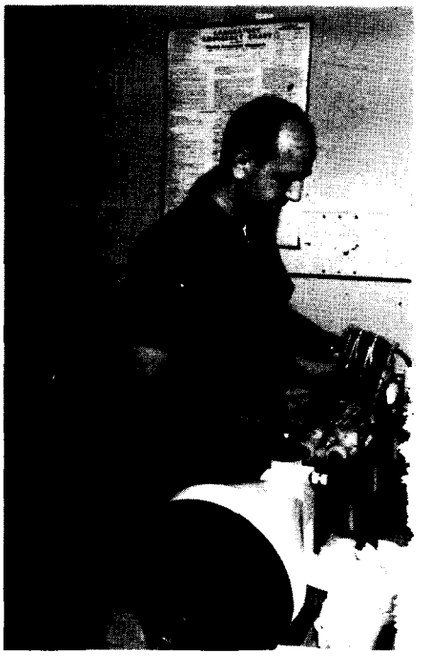
# GODDARD'S OPTICAL SY
# HOME OF THE LASER EXPE
## (Real-time Automatic L
## now being developed to t
## narrow laser beam

*Thomas S. Johnson (left) and Don A. Premo are at the Antenna-Position Programmer Control Console, which points the antenna at the predicated path of the satellite.*



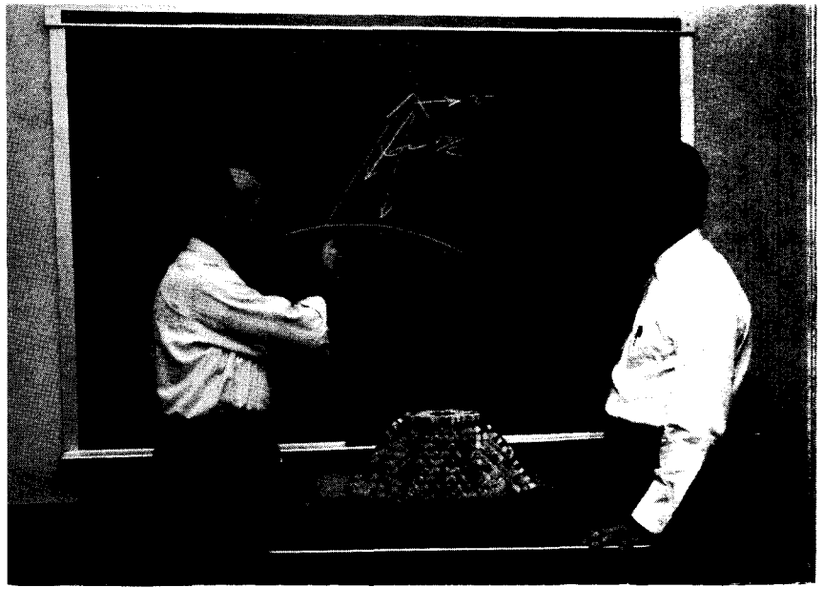
*New 24" telescope with a 2500" focal length will go onto this "Big Mount" at GORF and be operational sometime in 1965. At present it has a dummy load. The multi-mode mount is shown in equatorial position.*

*Howard Genatt, Station Manager, Goddard Optical Research Facility, at the finder—scope of the Branch's 16-inch equatorial telescope, used for research on image orthicons and other astronomical sensors.*



*Charles Peruso is assembling a joule ruby laser (used in the S- Project), which illuminates the sate lite's optical reflectors in the las tracking experiments.*

*Dr. Henry H. Plotkin (left), Head, Optical Systems Branch, and Walter J. Carrion, Associate Head, discuss use of Beacon Explorer-C optical reflectors (on table) in laser tracking experiments. A similar package has already been orbited on Explorer XXII.*



## LATEST NEW

Goddard scientists are expressing satisfaction with results obtained thus far through the use of LASER devices in the precision tracking of the Beacon-Explorer satellite, launched October 9 from Vandenberg AFB.

The LASER used by Goddard is a recently developed device in which light from a powerful flash lamp is focused into a synthetic ruby rod. This excites chromium atoms in the ruby to a state from which they tend to radiate their characteristic red light. In the LASER, the exact time and direction is controlled, to produce a very short powerful burst of light in a narrow pencil beam.

Dr. Henry H. Plotkin, Project Scientist, Optical Systems Branch, and his team of physicists-engineers have been directing their powerful LASER devices at special reflectors mounted atop the Beacon-Explorer as it travels through space. Although their techniques and equipment for aiming the light beam and receiving the reflected radiation are presently very new, experiments within the past month have shown a number of successful tracks.

Beginning October 11, 1964, 10 passes of the Beacon-Explorer have been tracked through spacecraft reflected radiation. Detection of the radiation returns was accomplished by an electronic photo-

# STEMS BRANCH:

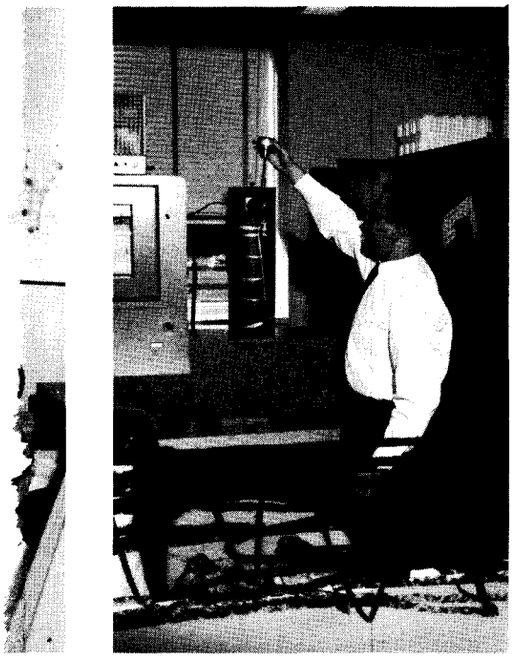
# RIMENTS AND NEW RADOT,

## Digital Optical Tracker)

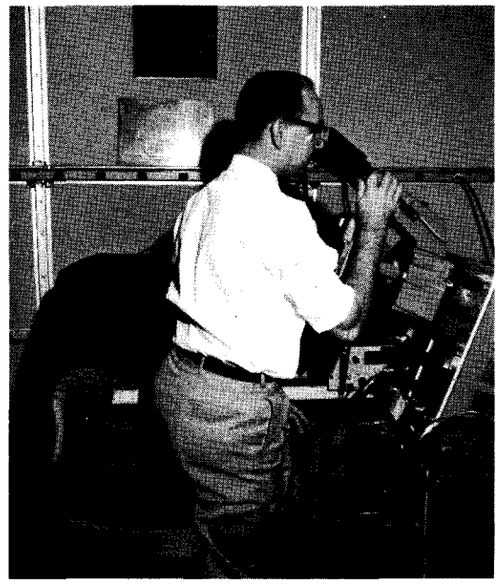
## rack the satellite with the

## for a full 24 hours.

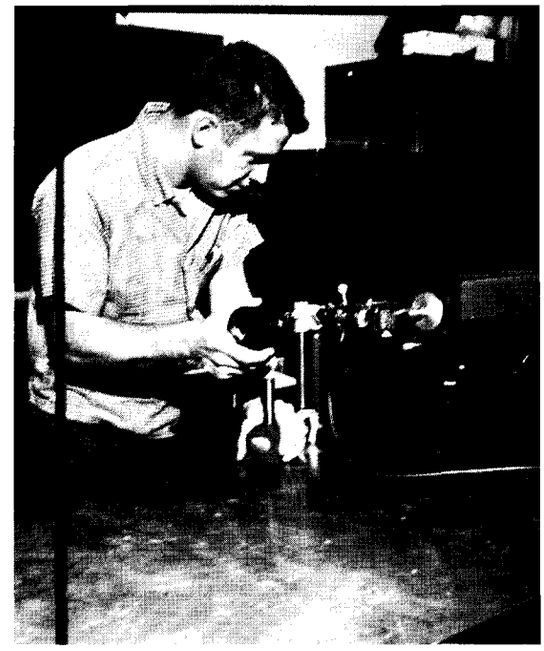
*Edward Hayes (left) and Louis O. Caudill, section head, prepare to insert Image-Orthicon sensor into the tracking head of digital TV system, which automatically reads-out a satellite's position relative to stars' positions in real-time.*



*Jack Degnan, co-op student, at the spectrophotometer, is mounting a gas cell to measure absorption and fluorescence spectra of gaseous samples.*



*John Moye makes evaluation of a photomultiplier to determine the one best used as laser receiving device. A Polaroid camera photographs the dark-current pulses to get statistical average of number and/or height (amplitude).*



*Paul Spadin tests the sensitivity of photomultipliers at the Helium-Neon laser wavelength to study the effects of atmospheric perturbations on the laser beam.*

## 'S ON LASER

detector after completion of a 1200 mile round trip by the LASER generated light pulse. Once detected, the optical "signals" were displayed and photographed on the face of an oscilloscope.

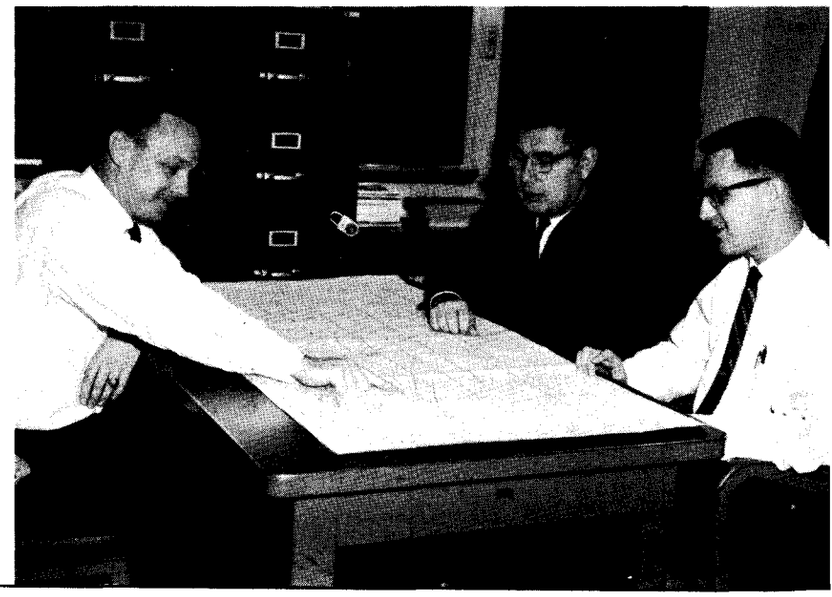
As is the case with many original investigations, many questions remain to be resolved. One perplexing Dr. Plotkin and his Goddard team at the moment is just why the LASER generated signal is smaller than was expected; not received consistently each time the satellite is illuminated.

Many more questions must be answered and techniques perfected before the Goddard LASER data can be used to refine Beacon-Explorer's orbit through purely optical means.

In making the announcement, Dr. Plotkin emphasized that Goddard's success was only a "beginning."

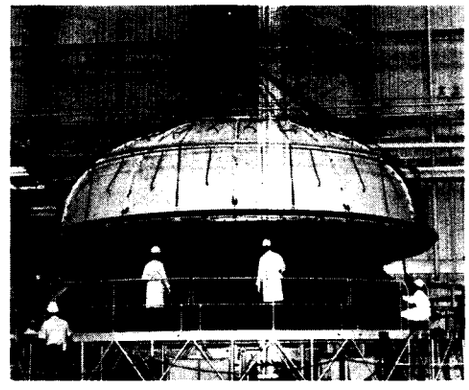
"Techniques being developed in these experiments must be perfected before LASER beams can be used to obtain refined satellite orbits, give us information about the shape of the earth, or for communicating between earth and space vehicles. In reaching these goals Goddard has embarked upon a program of systematic development in which the Beacon Explorer is an important tool," concluded Dr. Plotkin.

*Herbert L. Richards (left to right), Don Premo and Pete Minott are going over the PERT diagram being used for development of the Apollo Infrared Tracker System, which will acquire and generate angle-tracking information on the Apollo spacecraft as it re-enters earth's atmosphere upon return from a lunar mission.*



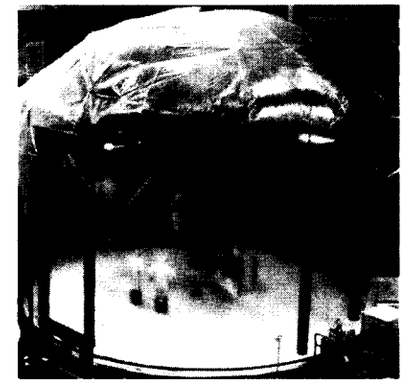
# WHAT'S NEWS AT OTHER CENTERS

## *What's Cooking?*



*The bulkheads of a Saturn launch vehicle must withstand unprecedented stress as the vehicle is launched. Before it can send these vehicles into space, NASA must find new ways to test new mechanical and engineering concepts of rocketry. This autoclave has been designed to check the fit of massive rocket sections.*

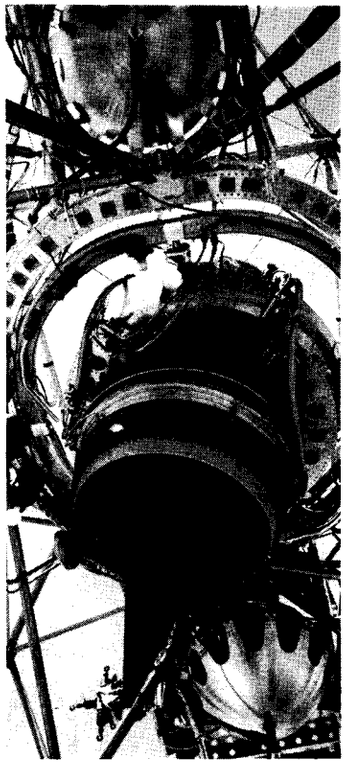
## *Hunting Trouble in Bubble*



*In this polyethelene bubble, conditions like those inside the fuel tank of a NASA Saturn S-II rocket have been simulated. Two men and a work platform may be seen through the poly film. The platform is being checked for cleanliness. It will be lowered into the Saturn's tank, enabling the platform operator to pick up tiny particles of metal or dirt that could mar the rocket's flight performance.*

*BIGGEST STRUCTURE AT THE CAPE. The Vertical Assembly Building, under construction at the Merritt Island Launch Area (MILA), Cape Kennedy, Fla., will be used to integrate and check out Saturns for Apollo missions.*

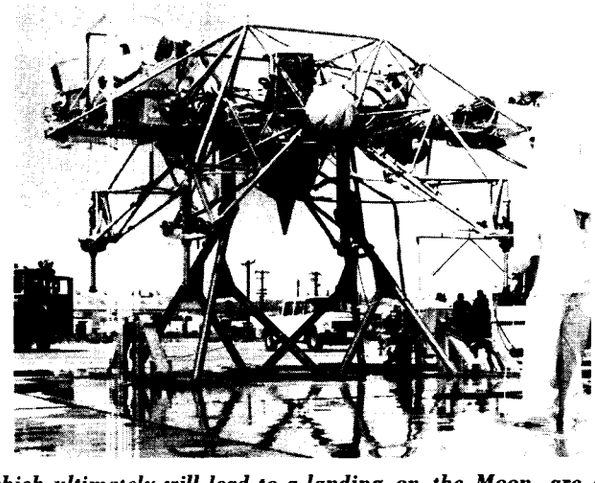
*STRESS AND STRAIN on astronauts is studied by Rita Rapp, physiologist in space medicine. She studies body changes under stress conditions. NASA astronauts fondly call her "The Vampire." She draws blood and makes other biochemical tests.*



## *'Way-Out' Snout*

*This snout-like device is what makes NASA's Lunar Landing Research Vehicle perform in the strange manner it does. It is a thrust motor mounted in gimbals which permit it to incline freely in any direction or remain level when its support is tipped. The apparatus at NASA's Flight Research Center, Edwards, Calif., is helping man to test—on Earth—conditions involved in a landing in the low-gravity lunar world.*

## *'Spider' With Eye On Moon*



*Rigorous tests, which ultimately will lead to a landing on the Moon, are conducted by NASA in such strange-looking contraptions as this spidery device. At NASA's Flight Research Center, Edwards, Calif., X-15 pilot Joe Walker is shown checking out electric flight control systems of the Lunar Landing Research Vehicle.*

# A NASA first— Two Satellites Launched Aboard One Scout Rocket

Two satellites—Explorers XXIV and XXV—were successfully launched November 21 from Vandenberg AFB, Calif., into the earth's upper atmosphere aboard a single Scout rocket.

It marked the first time NASA has shot aloft dual spacecrafts with a single booster.

The two-satellite payload, (consisting of an Air Density Explorer plus an Injun Explorer) was launched into an eccentric near-polar orbit to give scientists a better understanding of the relationships between radiation and atmospheric density.

Orbital elements, as computed by Goddard's Theory and Analysis Office headed by Dr. Joseph W. Siry, were:

*Explorer XXIV* (Air Density)

| | |
|---|---|
| Apogee: | 1,550 miles |
| Perigee: | 327 miles |
| Period: | 116 minutes |
| Inclination: | 81 degrees |

*Explorer XXV* (Injun)

| | |
|---|---|
| Apogee: | 1,548 miles |
| Perigee: | 326 miles |
| Period: | 116 minutes |
| Inclination: | 81 degrees |

At liftoff, 7:00 p.m. EST, the 72-foot Scout rocket roared from its pad, with a 105,000-pound thrust. About nine minutes after launch, a separation timer switched on to begin a sequence that ultimately inflated and separated the Air Density Explorer, and almost an hour later, separated the Injun Explorer from the fourth stage.

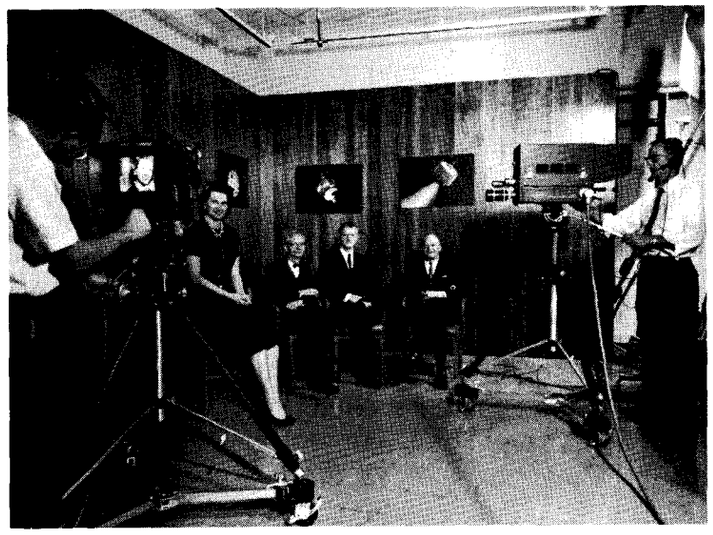
After one complete orbit, Goddard trackers—in the Office of Tracking and Data Systems headed by John T. Mengel—announced that preliminary data indicated the satellites were close to planned orbit.

## AGREEMENT NEGOTIATED BETWEEN GODDARD AND METAL TRADES COUNCIL

The first NASA agreement negotiated under Executive Order 10988 was recently approved by Mr. James E. Webb, Administrator, for the Goddard Space Flight Center and the Washington Area Metal Trades Council. The initiation of the agreement was observed at a meeting November 12 with Dr. Harry J. Goett, Center Director.

Participating (from left) were: Joseph Pometto, Ralph Jones, Charles MacCartee, Herbert Kahl-Winter and Brim Marcus of Goddard's Fabrication Division; Dr. Harry J. Goett, Director; Robert W. Hutchison, Personnel Director; Leopold Winkler, Chief of Technical Services; Dr. Michael J. Vaccaro, Assistant Director for Administration; and Joseph Burgess of Fabrication.

Dr. Goett noted that agreement orientation involving supervisors and employees would commence immediately.

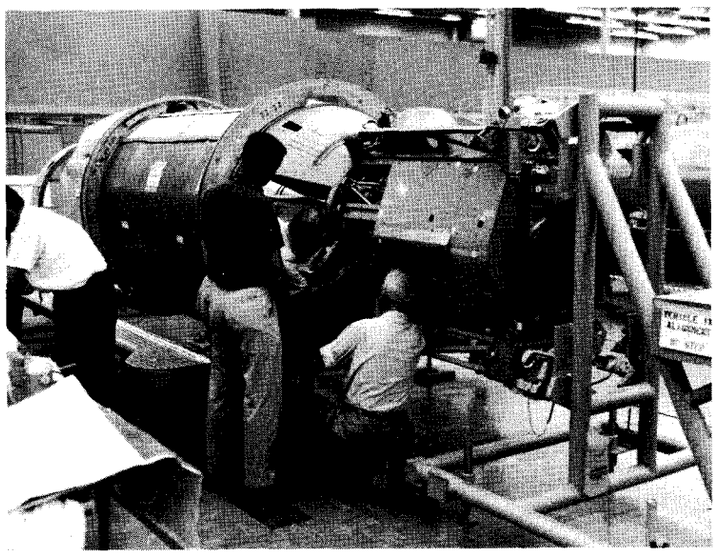


## GODDARD'S SCANDINAVIANS MAKE RELAY TEST-TAPE

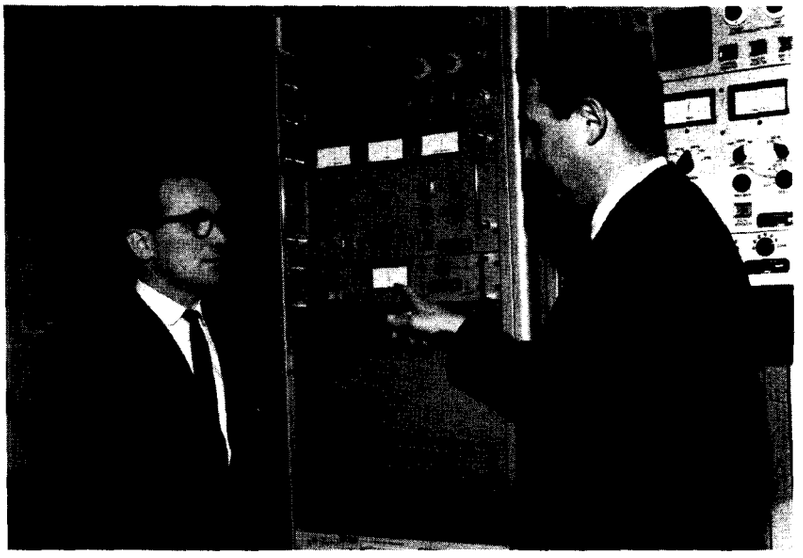
In the TV studio at Building 8, this star cast is making a television test-tape for transmission over RELAY from our ground station in Mojave Desert to the Scandinavian ground station in Gothenburg, Sweden.

Cameramen Bob Smith (left) and Keith Walters are "shooting" Mrs. Barbara May, SS&SA, who spoke to Scandinavian station personnel in English about Goddard.

In the background are (left to right) Hans Jorgensen, Otto E. Berg, and Kurt H. Sundstrom, who greeted the Scandinavian participants in tongues of their ancestors: respectively, Danish, Norwegian and Swedish.



GEMINI MANNED RENDEZVOUS, FLIGHT HARDWARE—Gemini Agena, shown here, will be one-half of man's first joining together of two vehicles on space orbit. The Agena will supply the major part of the rocket power and maneuvering capability for the Gemini man-in-space program. It will join with the Gemini spacecraft, containing two astronauts. After hookup of the two vehicles, the combined craft will conduct various space maneuvers. Here is the actual vehicle which will attempt to make the first space rendezvous. The new engine, capable of starting and stopping many times in space, is already installed, as is the control system, capable of handling 96 commands from the astronauts or ground stations.



# Tom Reid Appointed Station Director at Canberra

Thomas Reid (left), recently appointed Station Director of the Canberra, Australia, STADAN facility now under construction, is being shown telemetry receivers by Michael Logan, Network Engineering Branch, in Goddard's Building 12.

The Canberra station, located in Orroral Valley, will employ about 100 people when operational in October 1965. It will have an 85 foot parabolic reflector antenna and ten telemetry receivers of the type shown.

Mr. Reid is employed by the Commonwealth of Australia, Department of Supply. He previously lectured on Digital Computer Techniques and Communication Theory at the University of Adelaide in Australia. He will report to the Canberra site in February 1965.


# GODDARD NEWS

NOVEMBER 30, 1964

*"It is difficult to say what is impossible, for the dream of yesterday is the hope of today and the reality of tomorrow."*
—DR. ROBERT H. GODDARD

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Jerry Stark, *Editor* Shirley Deremer, *Inside Goddard*

Photography by Goddard's photographic branch

** Press date precedes publication date by approximately seven days.*


## Goddard Speech and Paper Presentations

**(Technical presentations approved as of November 30, 1964, for period through December 13, 1964. Requests for copies of speeches and papers should be made directly to the author.)**

***A. G. W. Cameron,*** University of California, December 3, 1964, Los Angeles, California, ***"The Atmospheres of the Planets."***

***A. G. W. Cameron,*** University of California, December 4, 1964, Riverside, California, ***"Neutron Stars and Celestial X-Ray Sources."***

***Paul A. Lantz,*** IEEE Professional Technical Group on Antennas & Propagation, December 8, 1964, Akron, Ohio, ***"NASA Space Data Acquisition Antennas."***

## Goddard Coming Events

- **December 3, 1964, 4 p.m., Goddard Institute for Space Studies, Watson Building, 612 W. 116th Street, New York, New York—Leon Mestel, University of Cambridge, England, and Goddard Institute for Space Studies, "Magnetism and Cosmogony."**

*(Found: a copy of the Patrick Air Force Base newspaper from which we extracted the following tongue-in-cheek article for our readers edification.)*

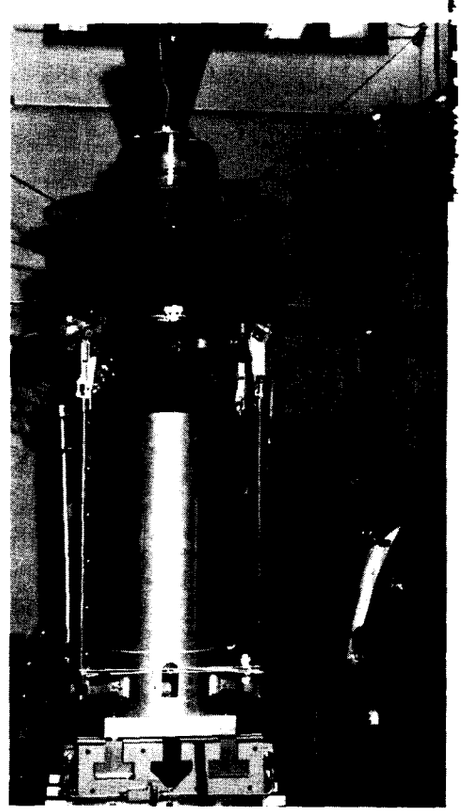
# *"Missile Guidance Explained?"*

"The missile knows where it is at all times. It knows this because it knows where it isn't. By subtracting where it is from where it isn't, or where it isn't from where it is (whichever is greater), it obtains a difference or deviation.

"The inertial guidance system uses deviations to generate corrective commands to drive the missile from a position where it is, to a position where it isn't; arriving at the position where it wasn't, it now is. Consequently the position where it is, is now the position where it wasn't, and it follows, the position where it was is now the position where it isn't.

"In the event that the position, where it now is, is not the position where it wasn't, the system has acquired a variation (variations are caused by external factors, and the discussion of these factors is not considered to be within the scope of this report), the variations being the difference between where the missile is and where the missile wasn't.

"If variation is considered to be a significant factor, it too may be corrected for by use of the MARK VI system; however, the missile must not know where it was."



***KENNETH M. CARR, Structural Dynamics Branch, T & E, puts an engineering model of the anchored IMP-D satellite through the transverse vibration test in Goddard's Building 7.***