**Who's Up Here? . . .**

***WHAT'S UP HERE? . . . Or what's up there? In any event, a look at page 4 will tell you what is up, and how it came out.***

N.A.S.A. HISTORICAL ARCHIVES
NO. X GS7C

# GODDARD NEWS

THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GODDARD SPACE FLIGHT CENTER

GREENBELT, MARYLAND

VOLUME VII, NUMBER 2 JUNE 1, 1964

**SPLASH! . . .**

## 'Wet' Sand—A Clue To the Lunar Landscape

Can you imagine a swimming pool filled with sand instead of $H_2O$? Theoretically, it would be possible to construct such a pool, *and* be able to swim in it!

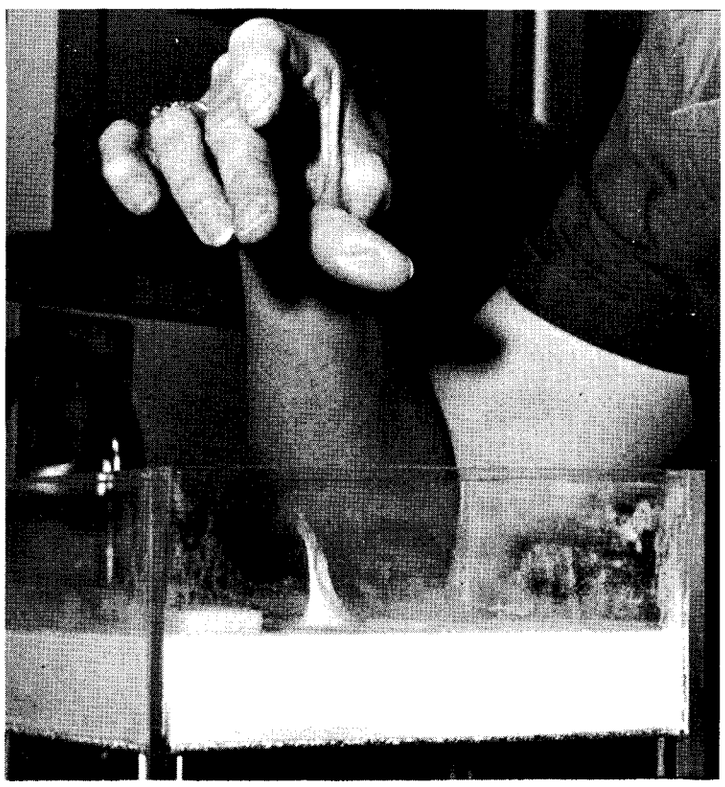
An animated model "sand box" is now being used in the laboratory area in building 4 which shows how a powdery silicate resembling fine white sand can be made to behave and feel like a fluid.

The display was built by fabrication division to specifications supplied by Standard Oil of New Jersey through Charles Boyle, public affairs officer, who was previously employed there. However, it is being used here by theoretical division personnel to study possible conditions on the lunar surface.

Here's how the device is constructed and how it works: It is a box made of clear plastic which has an upper and lower chamber. A sheet of porous sintered bronze separates the box into these two sections.

The top section is uncovered, and the lower section is closed on the bottom. A hose enters the lower chamber, and a flow of air can be introduced into it. This pressurized air then seeps through the sintered bronze partition and bubbles up through the powdered sub-

**(Cont'd. on p. 7)**



***Just like dropping money in a milk container—except for the fact that this coin was just dropped in a fine sandy material that has been fluidized in a Goddard lab.***

**LAUNCH TIME:**

# Model Rockets Blast Off

"Stand by . . . five . . . four . . . three . . . two . . . ignition. . . ."

These words—which seem to belong at Cape Kennedy—originated at Goddard's Optical Research Facility last Saturday. It was the second series of rocket launchings from the Center (the first was on May 9).

Heads snapped back to watch the graceful flights of more than a dozen rockets. Several seconds after launch, each rocket returned to earth by either parachute or gliding wing.

Model Rocketry has been introduced to the Center. The tiny rockets used stood six to 14 inches tall and weighed from 14 grams to three ounces and reached speeds up to 400 miles an hour. Yet they are so fragile they can be demolished by a small child stepping on them. (see p. 7, Feb. 24 issue).

The models are part of a program devised by the National Association of Rocketry, an organization dedicated to the safe and sane firing of miniature space vehicles.

The demonstrations were supervised by James Kukowski of Rockville, a newsman, who is a senior member of the NAR. Assisting were Dr. William B. Rich, NAR regional director and chief, speaker services, NASA Headquarters and Howard Galloway, Jr., Goddard space technologist. Mr. Kukowski and Dr. Rich have been active in model rocketry for several years.

The tiny rockets are powered by commercially packaged propellant and are constructed of paper and balsa wood. The safety record of the NAR is unmatched by any other scientific hobby or sport in the world. In over 2 million launchings by NAR members there has never been an injury inflicted. Abortive launchings produce nothing more than noise and a shower of confetti.

### Championship Meet At Wallops

The NAR program has so impressed NASA officials that the 6th National Model Rocket Championship meet will be held at Wallops Station, Virginia, August 19-22.

Fifty of the nation's top model rocketeers will compete there in 9 events. In addition, the contestants, ranging in age from 12 years to 60, will also be given tours, lectures and technical assistance by Wallops officials.

For more information on model rocketry, contact Goddard's Howard Galloway at (982) 4865.

### Goddard Coming Events

**Films:**

- **June 4 and 11, 12:30 p.m., Bldg. 8 Auditorium—"Celestial Mechanics and the Lunar Probe." *(This film describes the mechanics of guiding lunar probes.)***
- **June 4 and 11, 12:30 p.m., Bldg., 8 Auditorium—"Project Apollo Manned Flight to the Moon."**

### Goddard Speech and Paper Presentations

**(Technical presentations approved as of May 22, 1964 for period through June 14. Requests for copies of speeches and papers should be made directly to the author.)**

**SPEECHES**

***W. N. Hess,*** IEEE Photovoltaic Specialists Conference, June 2-3, Cleveland, Ohio, ***"The Energetic Particle Environment."***

***A. G. W. Cameron,*** IBM Thomas J. Watson Research Center, May 21, Yorktown Heights, N. Y., ***"Origin of Planetary Atmospheres."***

***Hong-Yee Chiu,*** University of Virginia, Department of Physics, May 22, Charlottesville, Va., ***"Neutron Stars."***

**PAPERS**

***B. T. Cunningham,*** IEEE Photovoltaic Specialists Conference, June 2-3, Cleveland, Ohio, ***"The Electrical Characteristics of Irradiated Silicon Solar Cells as a Function of Temperature."***

***Raymond C. Waddel,*** IEEE Photovoltaic Specialists Conference, June 2-3, Cleveland, Ohio, ***"Radiation Damage on Relay I and II."***

***H. T. Sargent, Jr.,*** Globecom VI, June 2-4, Philadelphia, Pa., ***"The 304 SCAMA Switchboard for the NASA Global Communications Network."***

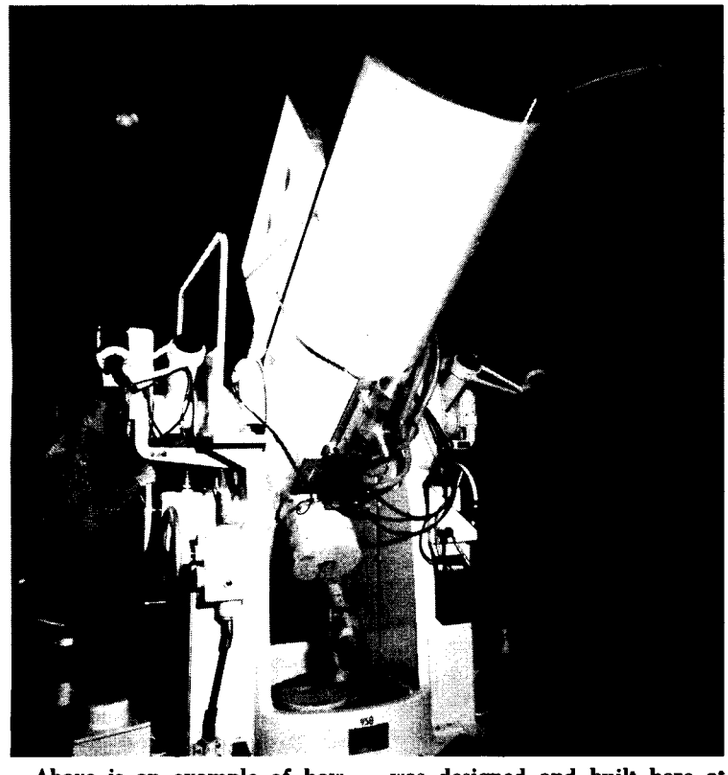
***J. N. Dupree,*** Globecom VI, June 2-4, Philadelphia, Pa., ***"Wideband Communications System for Satellite Data Transmission."***

***L. R. Stelter,*** Globecom VI, June 2-4, Philadelphia, Pa., ***"The NASCOM (NASA Communications) Network: Its Present State and Planned Evolution."***

***F. S. Humphrey,*** Globecom VI, June 2-4, Philadelphia, Pa., ***"Tapping Hardware-Software Potentials for High Reliability in the NASCOM Network Utilizing Dual Univac 490 Communications Processors."***

***T. P. Gorman & J. Purcell,*** National Telemetry Conference, June 2-4, Los Angeles, Calif., ***"Development of Optimum Frame Synchronization Codes for Goddard Space Flight Center PCM Telemetry Standards."***

# Goddard LASER Will 'Find' Satellite in Orbit



**Above is an example of how a LASER (*L*ight *A*mplification through the *S*imulated *E*mission of *R*adiation) device looks in action. This Goddard LASER is mounted beneath an 18-inch optical tracking telescope atop a 60-foot tower at Wallops Island, Va. (left).**

**This particular LASER device was designed and built here at the Center. It will be used in future experiments to track satellites carrying a specially-designed array of fused glass reflectors to bounce the LASER beam back to Earth. The telescope will be used to optically "find" the satellite so it can be hit by the intense light beam.**

# News About Space & Aeronautics

● This agency and the Smithsonian Astrophysical Observatory have put into full operation a seven-state midwestern network "to catch a falling star".

The network consists of 16 unmanned automatic camera stations and the "stars"—bright meteors—will be caught on film. Photos of the meteor trails will be used for scientific studies and to track and recover any resultant meteorites.

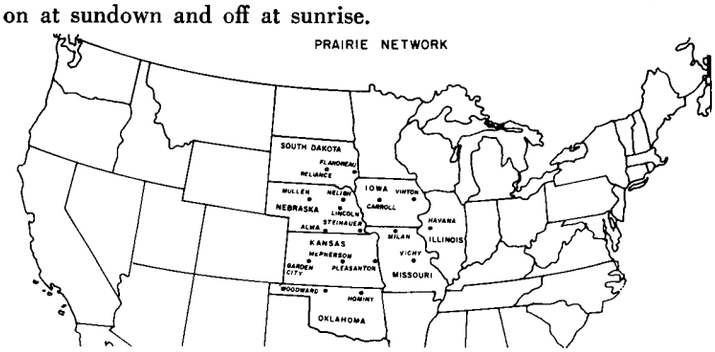
The project is called the Prairie Network. The camera stations were designed and constructed by Smithsonian engineers under a $240,000 grant from NASA. Films will be processed and examined at the network's field headquarters in Lincoln, Nebr. Headquarters of the observatory are in Cambridge, Mass.

When high-speed particles of varied sizes enter the Earth's atmosphere, trails of hot, glowing gases are produced. Large particles cause bright meteors, or fireballs, and may have enough mass for a portion of them to reach the Earth intact. The surviving mass is called a meteorite.

Of interest to NASA scientists are photographic measurements that will help determine how much mass a body loses when it enters the atmosphere at velocities comparable to those of reentering spacecraft.

The photographs also will be used to determine the origin of meteors. By calculating and extending the light trails backward into space, the scientist will be able to determine the particle's solar orbit or if it possibly came from the Moon.

Each station contains four wide-angle (80-degree) cameras aimed north, east, south, and west to effectively cover the entire sky. A light-sensitive photo-cell automatically turns the equipment on at sundown and off at sunrise.




● ● ●

● IMP I (Explorer XVIII), Goddard's interplanetary monitoring platform, survived sub-zero temperatures during a record eight hours in the Earth's shadow and resumed normal operation early last month.

During its dark journey, IMP was subjected to the longest chilling flight in the Earth's shadow ever experienced by a satellite.

Paul Butler, IMP project manager for Goddard, reported that temperatures on IMP's outer surface fell to more than 400 degrees below zero.

IMP remained in Earth shadow so long because of its highly eccentric orbit (unlike that of most low flying satellites).

When its orbital high point is reached, IMP slows down and appears to "hang" in space. May 6, at close to apogee, it entered the Earth's shadow for its long stay—a rare event that can occur only once a year.

The satellite emerged into sunlight shortly after 7 p.m., Wednesday. At 3:38 a.m. Thursday its transmitter signal was picked up by the NASA tracking station at Santiago, Chile. IMP was working again and its signal came in loud and clear.

# *Impetus*

**Editor's Note: This column of thoughts from various quotable sources will run whenever ideas are available which fit this definition—"comments which give impetus to the creative mind; which stretch and exercise the intellect." Publication does not necessarily imply endorsement.**

*Impetus* for this issue may not be extremely challenging, but it is bound to make anyone who writes—from scientist to secretary—reflect and perhaps smile a bit about the terrible typo which can humble the mighty (and often does so).

The Typographical error is a slippery thing and sly;
You can hunt it 'til you are dizzy, but it somehow will get by
Till the forms are off the presses, it is strange how still it keeps;
It shrinks down in a corner, and it never stirs or peeps.
That typographic error, too small for human eyes,
Till the ink is on the paper, when it grows to mountain size.
The boss, he stares with horror, then he grabs his hair and groans;
The copy reader drops his head upon his hands and moans.
The remainder of the issue may be clean as clean can be—
But that typographical error is the only thing you see.—ANON.

***Frank Cuzzolina (right) of Goddard's T & E division and a contract employee examine the upper optics of one of the 127 optical modules which make up the solar simulator in the lid of the Space Environment Simulator (SES). The 127 boxes which resemble miniature skyscrapers are the electronics for each of the optical modules.***

**GODDARD NEWS**

*"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

The Goddard News is a bi-weekly publication of the National Aeronautics and Space Administration's Goddard Space Flight Center, Greenbelt, Md., suburban Washington, D. C.

Phone—Ext. 4141 or 4142

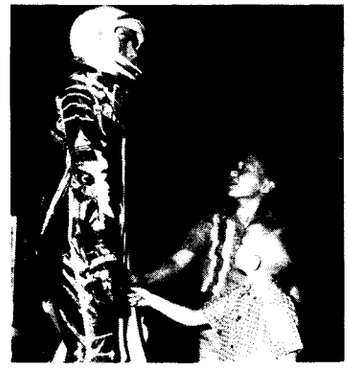
Bruce Brough, *Editor* Shirley Deremer, *Inside Goddard*

THIS IS UP!

*William O'Leary (right) office of public affairs, looks on as a scale model homo sapiens holds a scale model of Echo II to the delight of onlookers. In the background is the Echo cannister with folded balloon visable.*

# Goddard Open Hou

*"Well, I just don't know. . . ." Whether his expression is disbelief or dismay, at least he's interested!*



*The sign at the astronaut's neck says "DON'T TOUCH." The boys obviously have to see if there is a thumb in there anyway.*

The Center's Open House on May 23 was the best attended to date, with more than 4,200 visitors. This compares with a little more than 3,000 last year.

As in the past, youngsters were amazed and enthusiastic about what they saw. Senior citizens who saw the first automobiles at the turn of the century were even more amazed to learn what is being done in space.

Outstanding displays and more audience participation than in the past marked this Open House. Visitors had limited access to the lab area of building 7 for a closer look at test and evaluation equipment. Lester Tester, the jovial 8-foot-tall reverse physchologist for the division answered questions from a vantage point outside building 10.

IMP, which has been much in the news lately, was given a great degree of exposure at Open House. Paul Butler, the project manager, cooperated in the opening of the IMP electronics integration lab in addition to an outdoor exhibit featuring the satellite on a spin table.

The photographic branch put together a set of excerpts from movies and slide presentations which was shown throughout the day on schedule. The closed circuit TV system was also in use. For demonstration purposes, children were able to "see themselves on TV"—a process

*T&E's own Lester Tester, the 8-foot tall reverse psychologist, made a bi he gives counsel to a group of visitors. He was prevailed upon to give*

# se = Record Turnout, Informed Community . . .

which produced no end of grotesque facial expressions.

One after the other, crowds averaging 300 attended the Spacemobile lectures in the building 8 auditorium. A new device developed here at Goddard for teaching the principles of telemetry was used and proved to be a highlight of each lecture presentation.

Fabrication division had a dramatic display of arc welding in addition to their popular optics display. Interesting pieces of work were in place on some of the lathes for the visitors' benefit.

A manned space flight display in the high bay area of building 5 attracted a great deal of attention. There were also two six-foot models of Echo there.

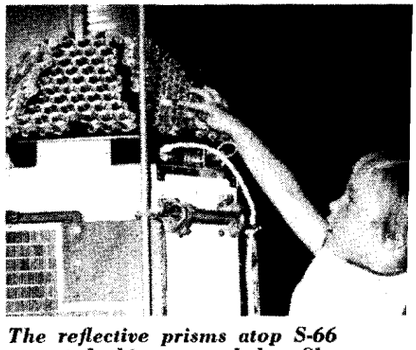
The satellite display room in building 1 was open, and stocked with some new satellites, including an Echo II canister with a transparent section, exposing the folded mylar balloon.

TIROS Technical Control (TTC) was open, as well as these other building 3 sites: Satellite Operations Center, the computer room, SCAMA, and the communications center.

The cafeteria handled the large crowd with dispatch, and Open House staff members stated that "fine cooperation from all involved made this year's event the success it was."

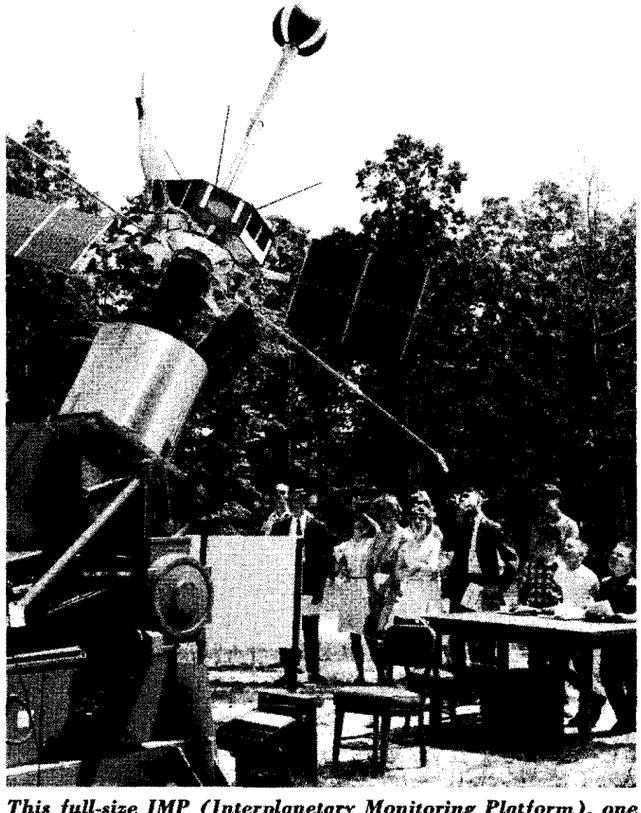
*Both old and young found the displays fascinating. Here Gerald Longanecker, systems integation branch, demonstrates the action of the solar paddles on IMP. The boy is holding some literature distributed during Open House.*

*Tape is more useful for fun than for work: So this young visitor seems to think. Maybe he's right!*



*The reflective prisms atop S-66 attracted this young lady. She has yet to learn that all that sparkles is not necessarily a girl's best friend.*

*hit with everyone at Open House. Here rrect answers for the occasion—and did.*



*This full-size IMP (Interplanetary Monitoring Platform), one of the most useful and informative of the recent scientific satellites managed by Goddard, was on display outside mounted on a spin table. It was one of the most popular displays.*

*"Candid Camera" could well be the title of this photo. These grotesque expressions are the result of hamming for the closed circuit television. When one looks in a mirror, why look normal? In addition, the television was color, adding to the fun.*

# A 'Swingin'' Horseshoe Will Toast Birds Evenly...

When in orbit, a satellite spins, moves along an orbital path, and exposes different surfaces to the Sun.

Now, a huge steel horseshoe is being installed in the large space environmental simulator (SES) in building 10 to make sure test satellites receive the same treatment.

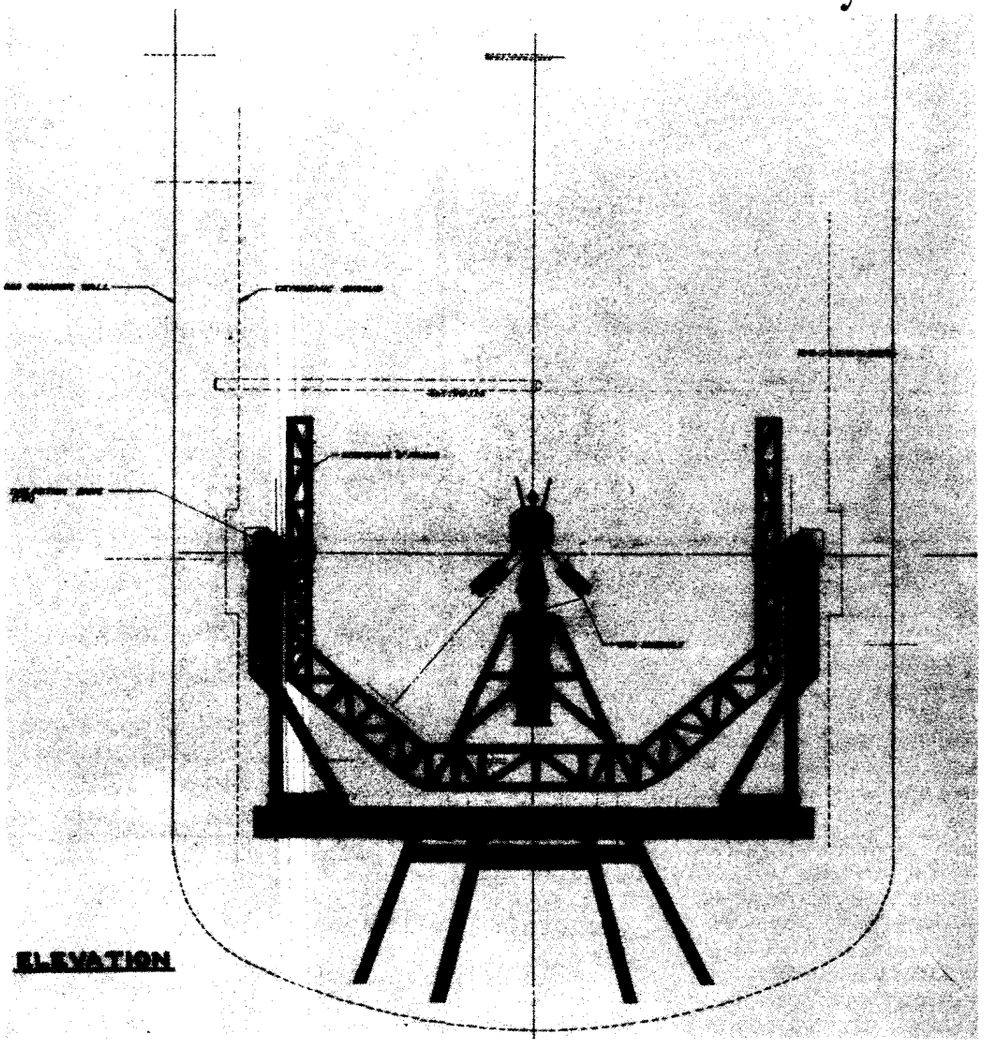
The steel U-frame (see diagram) is called the spacecraft positioner. It will move the test satellite to various positions so that its sides as well as its top will be exposed to the "sunlight" from the chamber's solar simulator.

As shown, the U-shaped arrangement pivots from the tips of the "horseshoe." It can move 360°—a full circle—on this axis.

Power to the positioner is supplied by two direct-drive torque motors, one mounted at each pivot point.

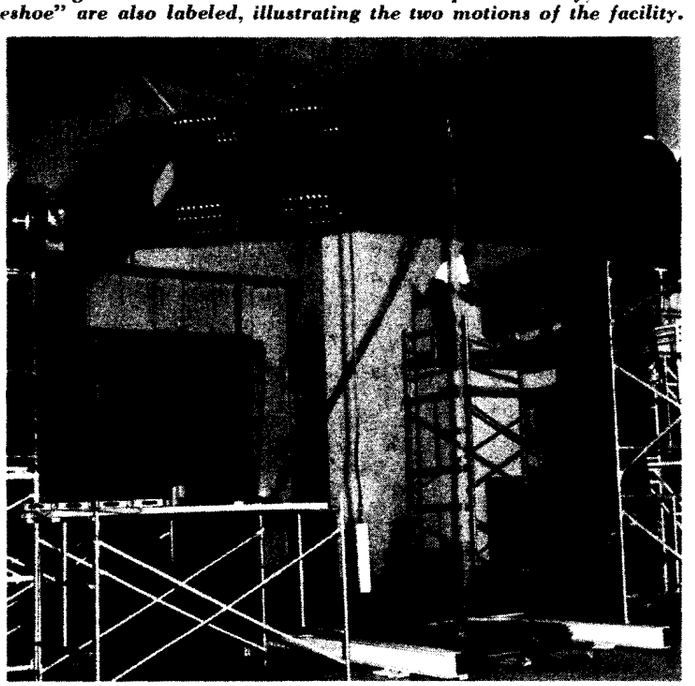
The combined movement of the positioner on its axis *and* the spinning of the satellite can accomplish desired orientation during pre-launch testing. The positioner will fully accommodate all Scout and Delta class spacecraft, and Agena class satellites up to 1500 pounds. It can perform limited tests with spacecraft up to 4,000 pounds.

Project manager for the SES spacecraft positioner is Don Stanfill of the engineering design branch, test and evaluation division.




*This front elevation drawing of the spacecraft positioner shows how it fits into the space environment simulator in building 10. A satellite is shown on the spin assembly, and the drive hubs of the "big horseshoe" are also labeled, illustrating the two motions of the facility.*

*The man in the left foreground gives a perspective on the size of the positioner. It is in building 10.*



*Here the "horseshoe" is raised parallel to the floor during tests prior to placement inside the SES chamber.*

# 'Wet' Sand (from p. 1)

stance in the upper chamber.

Result? The powdered silica gel behaves like a liquid. It flows, and light objects will float on top of it. It can be poured and even feels "wet" when you put your finger in it. Throw a coin into the fluidized granules and it will "splash" and produce concentric rings. It seeks a level as does water.

Now, as interesting as it seems, what possible application can this fluidizing process have to space research? Mrs. Winifred Cameron, theoretical division, gives this explanation:

"A mixing of gas and solid particles in which a gas flows steadily through the mass and supports the particles is called a fluidized bed because of the similarity in behavior of the substance to that of a fluid. For instance, it moves largely under gravitative forces, follows the path of least resistance, seeks the lowest level, thus flows in the topographical lows and around obstacles.

"Therefore its path is often sinuous or meandering as the beds of rivers. It is also capable of great carrying power.

"Thus a substance composed mostly of gas and dust, may carry tremendous boulders weighing many tons. Industry utilizes this remarkable property for the transportation of materials, by fluidizing a bed of sand, for example.

"Fluidized dust phenomena are common in nature. Fissures and vents may erupt ash flows. Ash flows behave much like rivers, and they carry, *in suspension,* a lot of rocky debris. When the gas becomes depleted, the boulders and rocks are no longer sustained and then they may roll and scrape along the ground, capable of significant erosion, mostly by abrasion.

"In many cases, small ash flows have eroded furrows or channels. The largest one of which we know is in Japan and is several miles long, a mile wide and over a hundred feet deep at the deepest. Its form is somewhat sinuous.

"Larger events deposit smooth, flat, featheredged plains. There are many of these on Earth.

"The Moon seems to exhibit these phenomena also. The characteristics of the terrestrial ash flow fields, often called welded tuffs, are strikingly similar to those of the lunar "seas", commonly called maria. These are the dark, smooth, flat plains of low elevation of the Moon's surface.

"Likewise, the lunar sinuous rilles have characteristics very similar to the channels dug by terrestrial ash flows. Lavas sometimes erode channels, but we do not know of any on the scale of the lunar sinuous rilles.

"We think that it would not be surprising to find these phenomena on the Moon because we believe that the Moon shows evidence that it has been differentiated, which may be of the acidic type. Ash flows are common manifestations of acidic igneous activity on Earth and therefore may be expected on the Moon.

"We have found that the lunar environment is actually more favorable to the fluidization mechanism because the viscosity of the gas is not reduced by lowering the density. The lower gravity reduces the pressure to be sustained and therefore less gas would be required to produce a given deposit on the Moon than on Earth. At the interface between the fluidized mixture and the lunar surface vacuum, the formulas fail, but this is only in the upper few inches of a deposit which may total hundreds of feet."

Mrs. Cameron and Dr. John O'Keefe, assistant chief of the theoretical division, are extremely interested in exploring further the properties and reactions of fluidized solid particles. Now they can do so right here at the Center. They hope to experiment with the "sand box" in a simulated lunar environment soon.

Perhaps it isn't practical to swim in fluidized sand, but the little plastic box in building 4 may give some clues to the lunar surface, an island in the new ocean which we must sail.

***Winifred Cameron and Dr. John O'Keefe, theoretical division, pour the fluidized sand from side to side. Notice the bubbles at the shallow end of the box from air pressure.***

**WORK AWARDED:**

# Institute Scientist Studies 'Heavy' Stars

*news from the Institute*

**Goddard Institute for Space Studies**
**475 Riverside Drive, New York, N.Y.**

Dr. Hong-yee Chiu, research scientist at the Goddard Institute for Space Studies, has been awarded NASA's Distinguished Service Certificate for his contributions to the space program. The certificate carries a cash award of $500.

A pioneer in the field of neutrino astrophysics, Dr. Chiu was cited for his research accomplishments in that area, and for his work on neutron stars and supermassive objects.

Neutrino astrophysics is concerned with the role of neutrino emission in the evolution of a star. A neutrino is a type of particle, possessing neither mass nor charge, which is emitted in certain interior nuclear interactions known as weak interactions.

In an extensive series of papers between 1960 and 1963, Dr. Chiu developed evidence that neutrinos play a dominate role in the advanced stages of stellar evolution, even though they have no mass and no charge. His investigations show that late in the life of a star, neutrinos are created in great numbers out of photons, and thereafter play a major part in the release of energy from the star's interior.

In fact, it appears that the energy carried off by these particles in the last thousand years of a star's life is equivalent to all the energy released by electromagnetic radiation in the star's entire previous history of billions of years.

More recently, Dr. Chiu has begun investigations in the field of neutron stars and supermassive objects. This work has been stimulated by the discovery of extremely bright radio sources.

It is difficult to understand how such objects could develop

**(Cont'd. on p. 8)**

# 'Heavy' Stars (from p. 7)

according to the laws of nature. If they exist, their gravitational fields are so strong that the effects of general relativity should become very important in their structure. These discoveries have brought astronomy to the frontiers of our knowledge of physics, and may give us in particular an understanding of general relativity in relation to gravity.

Dr. Chiu has been actively investigating the properties of neutron stars. These are stars that are believed to be composed entirely of closely packed neutrons, weighing from 10 to 100 billion tons per cubic inch. It has been calculated that such neutron stars must be from 5 to 10 miles in diameter, but with a weight comparable to that of the entire Sun.

They are particularly interesting for the space program because they may exist very close to our solar system, and yet be virtually undetectable in visible light from the Earth because they give off light at a very weak level.

According to Dr. Chiu's calculations, there are probably a hundred neutron stars within a 100-light-year distance from the Sun.

In 1963, Dr. Chiu made the important prediction that newly-formed neutron stars may be intense X-ray sources. Shortly afterward, Herbert Friedman and his group from the Naval Research Laboratory launched a rocket carrying an X-ray detector above the atmosphere. The results suggest that the sources observed by Dr. Chiu may indeed be neutron stars.

Dr. Chiu, who is an adjunct professor at Columbia University, has published 16 papers in the two and one half years he has been with the Goddard Institute. Five more have been accepted for publication in various journals and international conference proceedings.

He has completed the manuscript of a book, "The Physics of Stellar Interiors," to be published in the fall, and is working on another book, "Cosmic Neutrinos," in collaboration with Prof. Hubert Reeves of the University of Montreal.

### Achievements

Born in Shanghai, China, in 1932, Dr. Chiu studied physics at National Taiwan University and at Oklahoma State University, receiving his bachelor's degree in 1956. He obtained his Ph.D. at Cornell University in 1959. Subsequently, he was associated with the Institute for Advanced Study, Yale University, Brandeis University and the University of Colorado. Dr. Chiu joined the permanent scientific staff of the Goddard Institute last August after two and one-half years as a National Academy of Science - National Research Council Research Associate, first at this Center's theoretical division and then at the Goddard Institute.

*Dr. Robert Jastrow (right) director of the Goddard Institute for Space Studies, congratulates Dr. Hong-yee Chiu after presentation of the Distinguished Service Award.*

# University—Goddard Teams Organize for Summer Workshop

Goddard's third annual Summer Workshop, beginning June 15, will bring together approximately 20 academic personnel from eleven universities and an equal number of Goddard scientists to study three projects: Space Optics, Radiation Sensors and Solar Simulation; Heat Transfer and Cryogenic Pumping in Vacuum Technology; and Magnetic Environment Simulation.

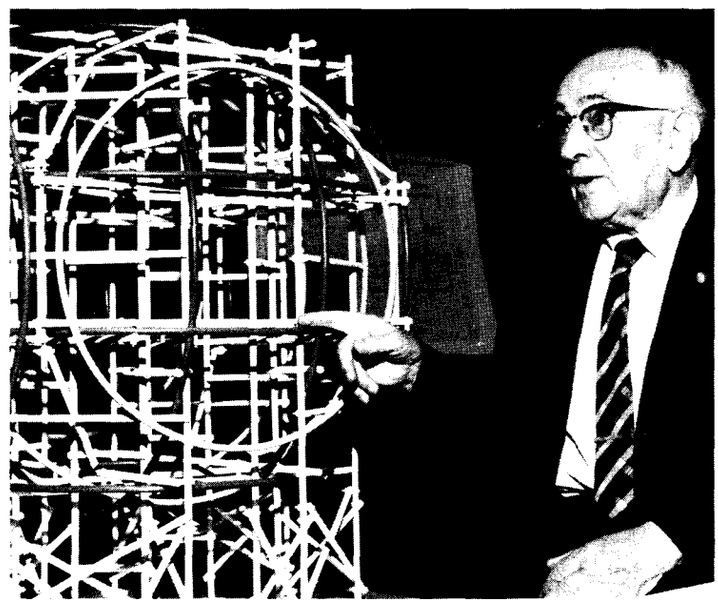
Three high school students especially selected by the National Science Foundation will also take part in the program with each assigned to one of the study areas, according to Dr. Elias Klein, director of the workshop.

The Summer Workshop program has had three major objectives since its inception three years ago. First, it serves to reintroduce members of the permanent staff to an academic viewpoint and thus serves as a "refresher course" to them.

Secondly, it gives university people an insight into the type of problems faced by a space research center. Their understanding of this phase of the science may lead to curriculum changes or research projects that will benefit the space effort.

Thirdly, the workshop works on current problems, and may either solve some problems or determine approaches that will lead to solutions.

For example, the basic design for the magnetic fields components test facility now under construction at the magnetic test site a mile east of Goddard was delineated by the first and second annual workshops.



*Dr. Elias Klein, director of the third annual Summer Workshop, was one of the original proponents of the idea. He is shown here with a model of the magnetic fields components test facility—a direct result of the work of the first two workshops. This model was constructed by the facility's contractor, Spectra-Physics, Inc. That firm has started construction of the full-scale facility near Goddard.*

### Other Participants

Three top-level part-time consultants will also be participating in this year's workshop. They are: Dr. Daniel Alpert of the University of Illinois, who has made many outstanding contributions to the work in gaseous and physical electronics and in their applications to high vacuum measurements; Dr. Irvine C. Gardner, past division chief, optics and meteorology, National Bureau of Standards, who is an authority on testing and use of optical instruments; and Dr. John D. Simons, an independent consultant in vacuum science and technology who has made important contributions to the development of high vacuum systems and gage calibration.

Ten of the academic participants have earned Ph.D. degrees in their fields of study. The balance are graduate students pursuing their Ph.D's.