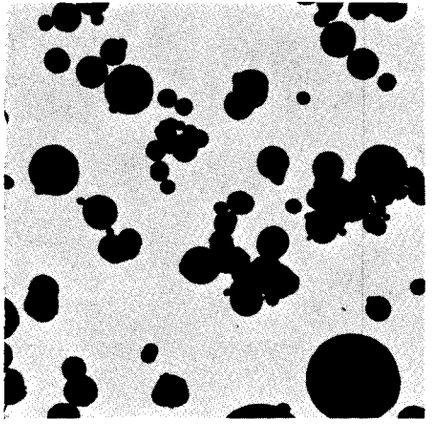


These are not ink spots, but tiny dust particles in the one micron size range as used in the dust particle accelerator. This photo, 8" x 10" before reduction for printing in the GODDARD NEWS, was magnified 11,000 times.

GODDARD NEWS

GODDARD SPACE FLIGHT CENTER / GREENBELT, MARYLAND

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

VOLUME VI, NUMBER 8 MARCH 9, 1964

WITH TWO MILLION-VOLT KICK:

Superdust is 'Faster Than a Speeding Bullet!'

There are only two in the world, and one is here at Goddard! What are we talking about? An electrostatic dust particle accelerator, with two million volts of push.

The accelerator requires about 200 square feet of floor space. It can boost the speed of a single 1 micron dust particle to low meteorite velocity—approximately 10 times the speed of a bullet from an Army rifle. A 1 micron piece of dust would compare in size with some tobacco smoke particles.

The machine is actually an ion accelerator with modifications. "We have installed a modification invented by STL (Space Technology Laboratories) and installed on their machine, the only other one in existence," explained Otto E. Berg, astrophysics branch. "The modifications convert it to a dust particle accelerator."

Berg has been especially interested in the study of meteors since his pre-NASA days at NRL. He and other members of the astrochemistry section will use the meteorite simulator to study the physics of high velocity (hypervelocity) impact.

Impact at tremendous speed produces such side effects as ionization, light and heat.

The equipment will also be used to calibrate the meteoroid sensors to be flown on some of the early Orbiting Geophysical Observatories (OGO's). This first "operational" use of the meteoroid simulator will indicate to Goddard project people how the sensors will respond to cosmic dust.

The accelerator, now in use in building 4, may be only the first step. Under serious consideration is a larger dust particle accelerator that will use the current machine as an injector. Thus, the particles will enter the proposed accelerator at hypervelocity, and be given a series of high voltage "kicks" which would add up to *20 million volts* in the larger machine.

Wesley Alexander, Harry Burton and Otto Berg (from left), all members of the astrophysics branch, prepare the two million-volt accelerator for another experiment.

The proposed simulator, with 10 times the voltage of the current item, will have to be housed in a room about 170 feet long, compared to 20 feet for the present two million volt version.

But, even before the bigger model comes to pass, we have at the Center an item that has just one other earthly equal. Our present accelerator has many unusual points. It can measure velocity directly by recording the time of flight of a particle between two tubes. It can fire more than 100 times per minute.

Scientists and layman alike are amazed to learn that the accelerator fires a *single* particle at a time. The question arises: "How do you get a single particle in there?"

As Berg described it, there is an electrical field above a "bucket." The "bucket" contains about a teaspoon-full of the tiny particles. The particles are "excited" by the electric field, and begin to bounce around. A few get through a "maze" made up of a series of tiny holes. They (or usually "it") are then charged to a high degree and fired down the tube toward the target.

Probability assures that *usually* only one particle gets through the maze and into the accelerator. Naturally, sometimes more than one do get in —and sometimes none. Scientists can measure when they get either of these extremes, and the results are not used.

But, most of the time, the two million volt electrostatic dust particle accelerator functions as a single particle machine. Later, perhaps, it will be just the "booster" for a huge meteoroid simulator with ten times the voltage.

Italian-American Satellite Program Moves Ahead

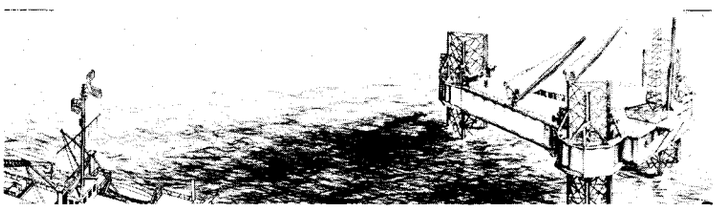
Another phase of Italian-American cooperation on the San Marco project has been scheduled, this one involving Goddard sounding rockets.

San Marco is a joint international program which seeks to launch the first Italian-built satellite sometime in 1965. The launch vehicle will be NASA's Scout, and the shot will take place from a floatable "Texas tower" in the Indian Ocean near the Equator.

A series of Nike-Apache sounding rockets, supplied by Goddard, will be used by the Italians soon. One launch from the Indian Ocean complex will check the compatibility of the ground station equipment being installed there with rocket telemetry equipment similar to that to be used aboard the satellite.

Other rockets will carry some related experiments.

The sounding rocket branch, headed by Karl R. Medrow, has provided vehicles and technical assistance for the project. The preliminary work here has been completed and the hardware is now in Rome for further wiring and assembly before being shipped to the launch site.



Here is an artist's drawing of the Indian Ocean complex.

Patent Awards Are Given; Uncle Sam Saves Millions

Three Goddard men, Robert C. Baumann, Leopold Winkler and Pleasant T. Cole, received patent awards February 27 totaling $3000.

Robert C. Baumann, chief, spacecraft integration and sounding rocket division, and Leopold Winkler, chief, office of technical services, were presented a joint patent award of $2000 (to be divided equally) for their "spin adjusting mechanism." This is a compact mechanism to accurately increase or decrease satellite spin rate. It is applicable to almost every space vehicle.

The invention was conceived in August, 1958, while both men were employed at the Naval Research Laboratory. It was first used on Vanguard (SLV-3) which was launched in September 1958 by the Navy.

The satellite did not achieve a successful orbit. The first successful satellite incorporating their new technique, Vanguard II, was launched and orbited on February 17, 1959 by NASA.

This invention is currently being used or considered for use on many satellites and sounding rockets. For example the S-16 (OSO), Syncom B and the Aerobee sounding rockets have incorporated this invention. It will probably be used on the S-17 (OSO), Nimbus and the OGO spacecraft. The Mercury capsule contained a similar system for rotating the capsule.

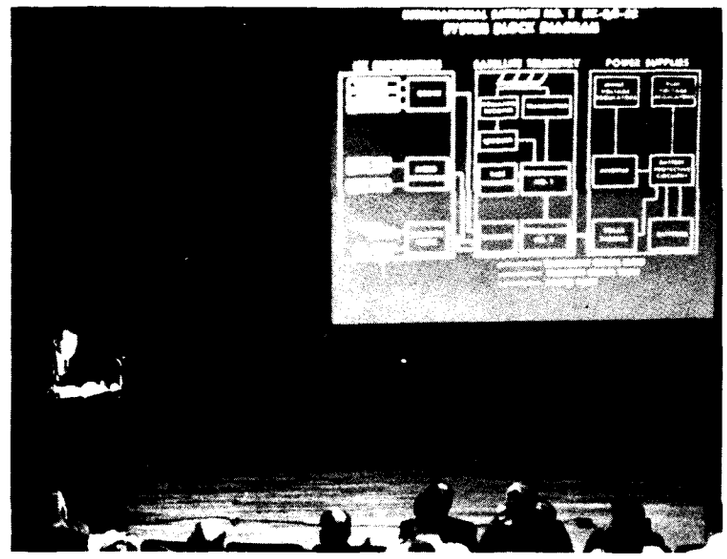
It is impossible to say exactly how much this system will save the Government. Dr. John W. Townsend, assistant director for space sciences and satellite applications, believes that "the claims in this patent are so broad in scope and so basic that if the patent were owned outside of the government, we would be involved with a *multi*-million dollar lawsuit. . . ."

Pleasant T. Cole, spacecraft technology division, received a patent award of $1000 for a "system for recording and reproducing pulse code modulated data." This invention pertains to a system of data storage and retrieval to be used in connection with S-57, OGO and other satellites. It is basically a new application of magnetic recording.

The invention relates to an improved magnetic tape pulse code modulation (PCM) data recording and reproducing system capable of achieving a large packing density on magnetic tape, thus reducing weight requirements.

The novel feature of this invention is the utilization of a playback head having a gap width equal to approximately one-half wavelength of the fundamental pulse repetition frequency of the PCM recorded data signal.

Awards were presented by Dr. Hugh Dryden, deputy administrator, at a ceremony in the administrator's conference room at NASA headquarters.



Emil Hymowitz, project manager of UK-2 for Goddard, is shown addressing the systems integration branch on that satellite's mission. His presentation last month in the building 3 auditorium was followed by the premier showing of the UK-2 film.

Leopold Winkler (left) and Robert C. Baumann are examining a model of their invention at the award ceremony at Headquarters.

Pleasant T. Cole is receiving his patent award from NASA deputy administrator Dr. Hugh Dryden with a handshake.

Recent Technical Publications Authored by Goddard Staff

M. E. Pittman and D. L. Waidelich, "Three- and Four-Coil Systems for Homogeneous Magnetic Fields," NASA Technical Note D-2095, February 1964.

W. H. Hord, "The Environmental Test Program for Ariel I, the International Ionosphere Satellite," NASA Technical Note D-2099, February 1964.

J. P. Heppner, "The World Magnetic Survey," NASA Technical Note D-2109, February 1964.

W. R. Cherry and L. W. Slifer, Jr., "Solar Cell Radiation Damage Studies with 1 Mev Electrons and 4.6 Mev Protons," NASA Technical Note D-2098, February 1964.

C. A. Wagner, "The Drift of a 24 Hour Equatorial Satellite Due to an Earth Gravity Field Through 4th Order," NASA Technical Note D-2103, February 1964.

J. H. Conn, "Vibration Isolation of Satellite Tape Recorders," NASA Technical Memorandum X-942, February 1964.

P. A. Studer, "Development of a Brushless D. C. Motor for Satellite Application," NASA Technical Note D-2108, February 1964.

E. M. Darling, Jr., "Geographical Grid for Nimbus Cloud Pictures," NASA Technical Note D-2136, February 1964.

K. W. Ogilvire, N. McIlwraith, H. J. Zwally and T. D. Wilkerson, "A Detector-Analyzer for Studying Planetary Plasma," NASA Technical Note D-2111, February 1964.

G. P. Newton, D. T. Pelz, G. E. Miller and R. Horowitz, "Response of Modified Redhead Magnetron and Bayard-Alpert Vacuum Gauges aboard Explorer XVII," NASA Technical Note D-2146.

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.

The Goddard organization existed before this Greenbelt Center was dedicated, but only as a dispersed entity. Then came the dedication of the Center, and the slow but steady gathering of personnel here.

On March 16, we will celebrate the third anniversary of that dedication. Those who have been on board since the beginning can sit back and marvel at how far we have come. The newer members of the team should realize that this large, campus-like complex of buildings has become what it is in less time than it takes a student to go through college.

Goddard never will be "all here." There is still the Goddard Institute for Space Studies in New York City. It will remain there, near the center of the academic community with which it works. And, naturally, the field projects branch will continue to work at Cape Kennedy and the Pacific Missile Range.

Here at Greenbelt, building is continuing, and we will continue to grow. But now that the initial three-year period is ending, some of the "finishing touches" will become evident.

For example, the mall stretching from building 8 to the gatehouse will not continue in its present condition. Tasteful landscaping is on the planning boards, and the trees and shrubs to be used are already growing in our own nursery area on the nearby Agricultural Research Center.

It's been a busy three years since dedication. We're still a young Center, and who knows what amazing steps are still to be taken. In retrospect, what has already taken place is enough to set a precedent: It's up to all of us to live up to it.—*The Editor*

Goddard Speech and Paper Presentations

(Technical presentations approved as of March 2, for period of March 9 through March 27. Requests for copies of speeches and papers should be made directly to the author.)

(SPEECHES)

Paul D. Lowman, Scientific Research Society of America, Fort Detrick, Maryland, March 9, 1964, ***"Scientific Benefits of Manned Lunar Exploration."***

J. A. O'Keefe, Scientific Research Society of America, March 9, 1964, Frederick, Maryland, ***"Tektites and the Moon."***

J. A. O'Keefe, Space Studies Seminar, University of Kentucky, March 10, 1964, Lexington, Kentucky, ***"Geochemical Problems Related to the Moon."***

J. A. O'Keefe, Cedar Rapids Section of the IEEE, Cedar Rapids, Iowa, March 11, 1964, ***"Space Phenomena."***

Bertram Donn, National Capital Astronomers, March 7, 1964, Washington, D. C., ***"Comets as Probes of Space and Time."***

William W. Wolman, Canaveral Reliability and Quality Control Club, March 19, 1964, Patrick Air Force Base, Florida, ***"Reliability Analysis for Space Systems."***

(PAPERS)

William W. Wolman, 20th Annual Quality Control Conference, March 26, 1964, Rochester, New York, ***"Reliability Program Elements for Satellite Systems."***

Thomas D. Clem and J. C. Schaffert, Electronic Timing Symposium, Harry Diamond Labs., March 18, 19, 1964, Washington, D. C., ***"A Solid State Satellite Separation Sequence Timer."***

J. A. Kane, COSPAR Meeting, European Preparatory Commission for Space Research, March 19-26, 1964, Alpbach, Austria, ***"NASA Experiments in the Polar D Region."***

Andrew B. Malinowski and John W. Adolphsen, International IEEE Convention, March 23-27, 1964, New York, New York, ***"Telemetry Encoder for International Satellite S-52/UK-2."***

News About Space & Aeronautics

● Ten Agena launches are scheduled this year. The first two of these launches occurred in January—Ranger 6 and Echo II, which placed a 135-foot communications balloon in orbit.

• • •

● To date, seven nations have installed equipment to receive weather forecasting photos from weather satellites.

The equipment, called Automatic Picture Transmission, is incorporated in the meteorological satellite TIROS VIII, launched by NASA last Dec. 21.

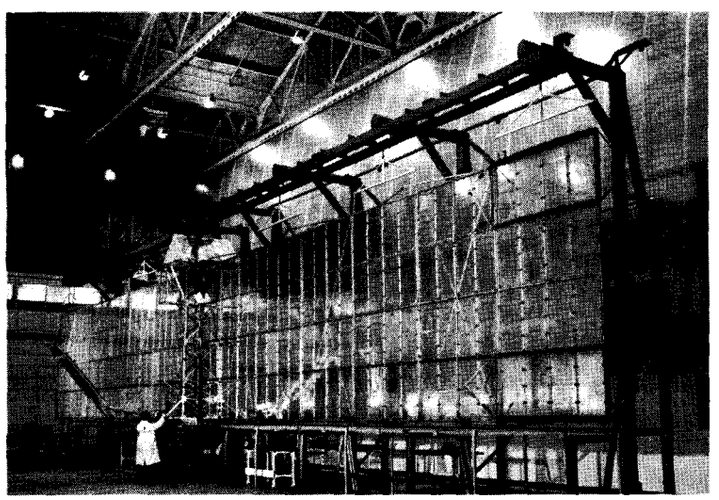
The APT subsystem is in use in France, England, Australia, Canada, India, Denmark and Hong Kong. The relatively inexpensive APT enables weather men to observe cloud-cover photos of their area as the image forms on a facsimile machine in their stations.

• • •

● The Nimbus meteorological satellite, scheduled to succeed the highly successful TIROS, is designed to received weather data from the entire world at least twice daily by means of a sophisticated combination of TV cameras and infrared sensors.

• • •

● Below is a photo of a dynamic test model of the meteoroid detection satellite being developed for the NASA-Marshall Space Flight Center, Huntsville, by Fairchild Stratos, Hagerstown, Md. It will be launched on Saturn I vehicles (SA-8 and SA-9). The panels will unfold in space to form a wing measuring 15 by 96 feet. Electronic detectors will detect the size and frequency of meteoroids, gaining information to be used in the design of spacecraft which will be exposed to the space environment for long periods. Goddard is in charge of all ground support (tracking, telemetry, and command) for the upcoming Marshall satellite.



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

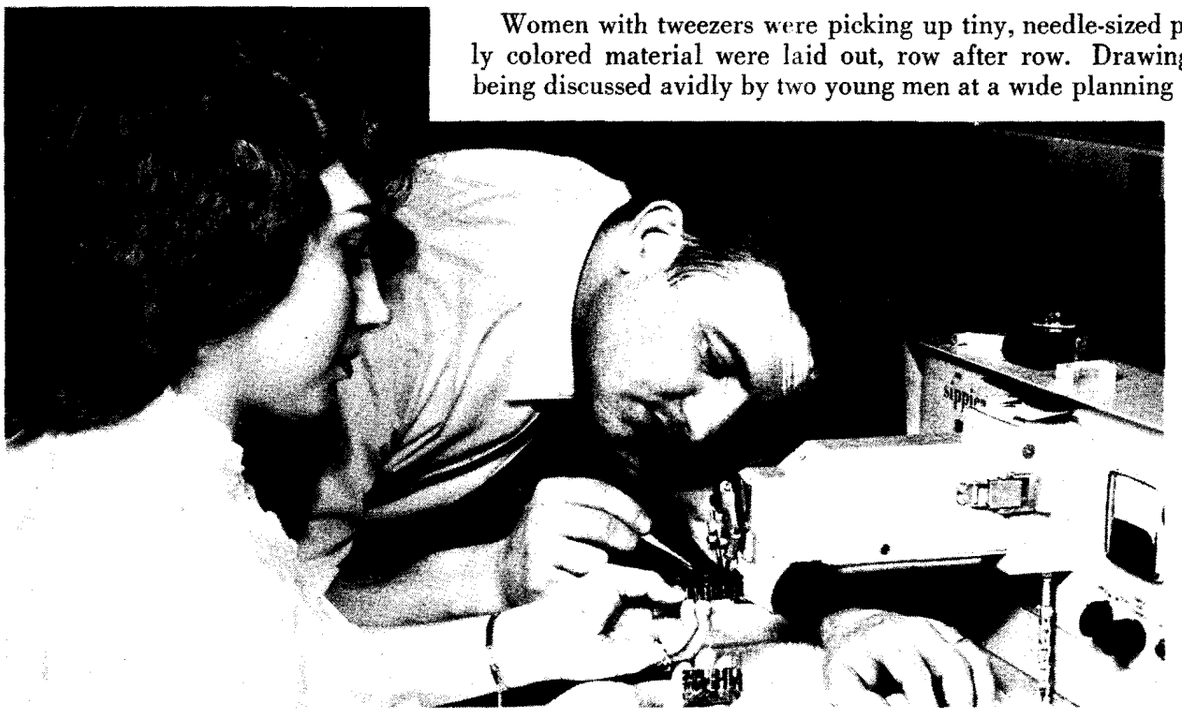
The Goddard News is a bi-weekly publication of the National Aeronautics and Space Administration's Goddard Space Flight Center, Greenbelt, Md., suburban Washington, D. C.

Phone—Ext. 4141 or 4142

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

Tweezers and Spools Aren't Limited to Knitting Mills—

Women with tweezers were picking up tiny, needle-sized pieces of wire. Spools of brightly colored material were laid out, row after row. Drawings with unusual patterns were being discussed avidly by two young men at a wide planning desk.



Mary Center (left) and John Etzel are examining a tiny welded module to be used in an experiment on OGO. It will become part of a dust particle experiment on that satellite.

This could be a description of a knitting factory if it were to stop with these three items. Instead, it is a first impression of Goddard's electronics processing area in the fabrication division.

Emile Zugby, head of the operation, pointed out that the rolls are wire, and that the only fabric he was concerned with was the strong weave of teamwork between his shop and the rest of the Center.

Technical services are performed here for project scientists that range from layout of electronic circuits to their fabrication. Some of the highly miniaturized work needs the delicate touch that only a woman technician can give.

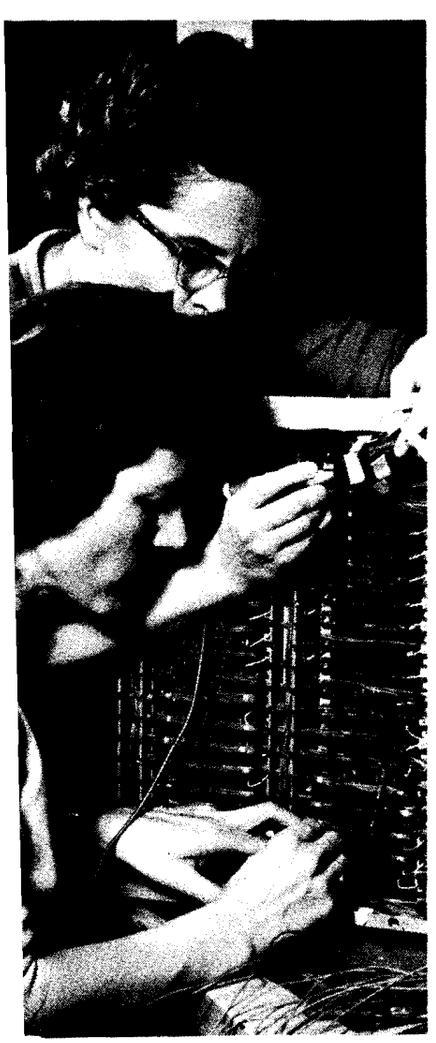
Coils are wound from hair-thin wire. Printed circuit boards are designed, sent to the plating shop for camera work, and etching, then assembled and soldered back in Zugby's area.

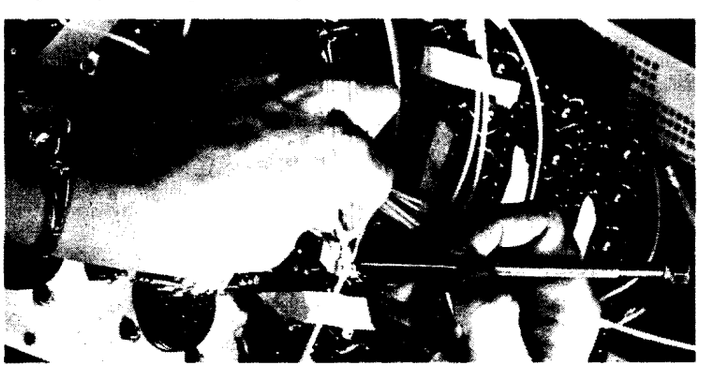
What happens if an engineer needs a coil or transformer which is no longer being manufactured? The electronic processing area will duplicate it.

The men and women in the area make cables to specifications, and fabricate harnesses for equipment consoles. And, being part of the engineering office headed by Abraham Piltch, Zugby's area is involved in a great deal of developmental work.

They have great capability for seeing a job through from rough drawing to completion. For ex-

Annette Horton (standing) and May Blevins are wiring an encoder drawer for data handling equipment.



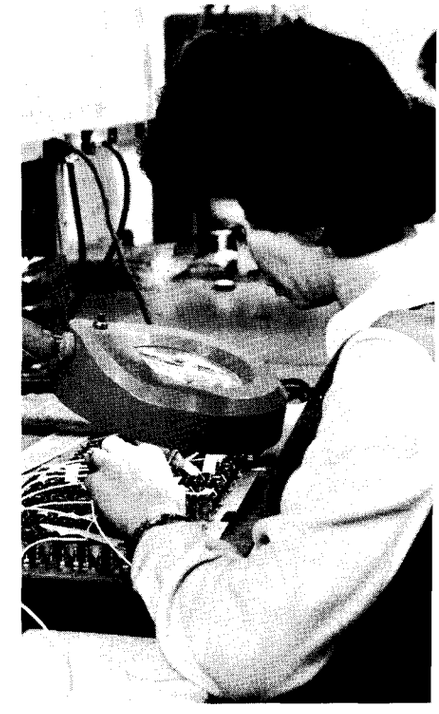


The rings and watch dramatize the fact that some delicate, painstaking close work is best accomplished by women. Soldering and welding of tiny components require a special touch combined with infinite patience.

Mary Center (left) and Virginia Deener are examining one of the minute welded modules for the dust particle experiment on Goddard's OGO. Tweezers and miscroscopes abound in the area.

Electronics Processing Area Also Weaves Wonders

Charles Limparis works, as shown, designing layouts for welded module packages. His finished drawings are photographically reduced to proper size elsewhere, then returned for wiring, etc.



Kathy Sawyer works on the wiring of a universal tester for the OGO project. Her work space is equipped with a magnifying fixture, as are most others in the area.

The only man in this overall view of the soldering area is Emile Zugby, who is in charge of the electronics processing team. Numerous projects are underway at any given time.

ample, they make complete ground control consoles. First the layout is drawn up. Then the chassis are assembled and wired. Each individual chassis is then placed in the console and they are all inter-connected. All necessary cabling and harnessing is done right on the spot.

Naturally, due to the great detail involved and the small number of craftsmen in the area, most work is prototype. Any mass manufacturing would have to be done under contract after the Goddard-made item was finished and tested.

However, in some instances, the group does produce flight hardware. If only a limited number of a specific item is needed, they can and will do the job.

They have recently modified flight models of Echo beacons. In addition, Zugby's men designed and fabricated resistance welded circuit modules for a dust detector from circuitry designed by Wesley Alexander, astrophysics branch. The detector will be aboard the polar orbiting geophysical laboratory (OGO).

The women who do the fine work can't "get in a rut," since new types of work "keep coming in," according to Zugby.

Minute wires, tiny transistors, modules for assembly by resistance welding—all are in a days work for the electronic processing area.

This prototype coil being wound by Betty Reynolds will be part of a low-frequency radiation detector. Emile Zugby checks the job, which utilizes hair-thin wire which is guided into place by hand. The winding mount was created in-house using a hand drill for motor power.

Space-minded Students May Find a Home at N. Y. Summer Institute

news from the Institute

This summer a group of space-minded college students will cram a year's course in physics, astronomy and the earth sciences into five weeks of intensive day-and-night effort.

The program is Columbia University's annual Summer Institute in Space Physics, directed by Robert Jastrow, director of this Center's Goddard Institute for Space Studies and adjunct professor of geophysics at Columbia.

Columbia recently announced the opening of competition to attend the NASA-sponsored program this summer. Forty-five will be accepted.

The program is directed toward undergraduates at the junior and senior level with a background of three years in mathematics and the physical sciences.

"We feel that this undergraduate group is the most important one to reach," says Dr. Jastrow.

"Graduate students, especially those in physics, usually commit themselves to a field of research shortly after they enter graduate school. After they are committed, it is difficult to interest them in astronomy and the earth sciences.

"Undergraduates are the best potential source of talent for space science in future years. However, astronomy and the earth sciences are usually neglected in the undergraduate physics curriculum.

"The Summer Institute adds to the basic training of these college students and at the same time opens their eyes to the fascination of large areas of research in geophysics and astronomy of which they were entirely ignorant," Dr. Jastrow explains.

From July 6 to August 7, the carefully selected group of physics majors will spend most of their waking hours working with six prominent scientists from Columbia and the Goddard Institute for Space Studies. They will study radiative transfer, turbulent convection, plasma physics, magnetohydrodynamics, nucleosynthesis, stellar evolution and radio astronomy.

Their basic theoretical knowledge will be applied to the atmospheres of the Earth, Mars and Venus, the formation of the elements, the evolution of the stars and galaxies, and structure of the moon and planets.

This year, for the first time, a separate program has been added for engineering students, paralleling the physics program. They will take courses in rocket propulsion, guidance and control, scientific satellites, communications, and manned spaceflight as well as basic theory.

At the conclusion of the course, students who have completed the requirements will be taken on a field trip to space research centers.

The trip will include visits to the George C. Marshall Space Center in Huntsville, Alabama, for a tour of projects in propulsion, rocket and spacecraft guidance and control, and spacecraft development; to Cape Kennedy, for an inspection of the rocket and spacecraft technology, and to Goddard for an examination of the work in progress here on scientific satellites.

Participation in the Summer Institute is limited to winners of grants, and the competition is extremely sharp. Last year, all winners had "A" records in science.

In addition to being academically talented, the students also have been unusually well-rounded and show a variety of interests outside science. Many have been active in sports. One 1963 scholarship winner was a star center on the Duke basketball team, and another was an intramural wrestling champion at his college.

Columbia's experience with the first two years of the program shows that it has been successful in arousing the interest of exceptionally good students to the fields of scientific research which have a bearing on the space program.

Of the original group, at least 20 have returned to New York to work at the Goddard Institute or Columbia, or have continued graduate study in the field elsewhere.

The grant winners come from all over the country. Last year, 18 states and 30 colleges and universities were represented.

In addition to the U. S. students, the NASA Office of International Programs awards 10 to 14 scholarships to foreign students.

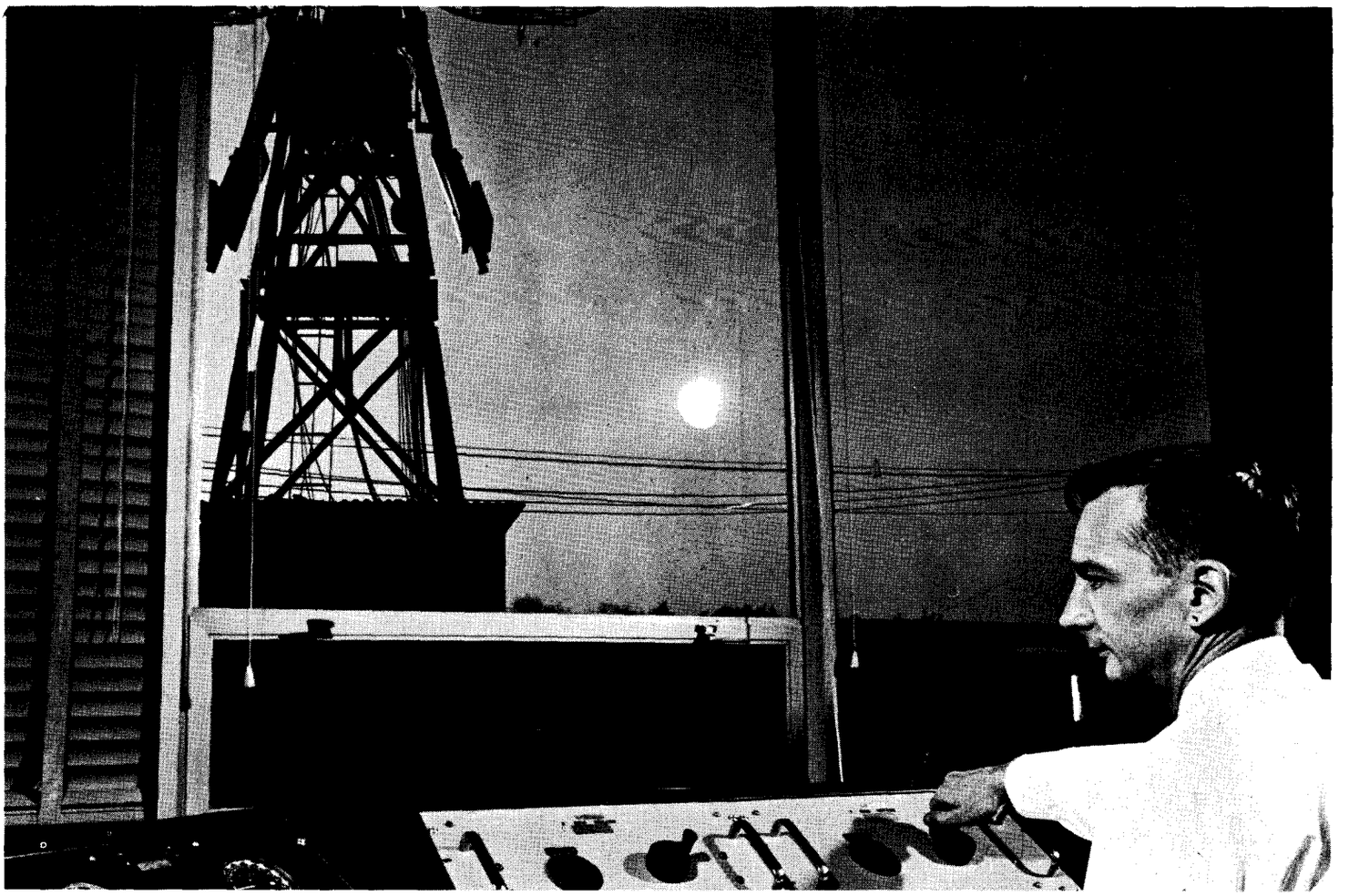
Last year, 14 applicants were accepted, including 4 from Canada, 1 from Mexico, 1 from Pakistan, 2 from the United Kingdom, 2 from France, 1 from Sweden, 1 from Germany, 1 from Belgium and 1 from the Netherlands.

Applications should be received by the director of Columbia's Summer Institute by March 18. Later applications cannot be guaranteed consideration. Awards will be announced about March 25.

Goddard's Dr. Robert Jastrow (right), head of this Center's Institute for Space Studies in New York City, discusses the Columbia University Summer Institute in Space Physics with the director of Columbia's Summer Session, Prof. William Owens. Dr. Jastrow has directed the NASA-sponsored program since its beginning in 1962.

Astronaut Alan Shepard toured Goddard last month. In addition to the manned spacecraft tracking network facilities, he saw this model of TIROS, NASA's workhorse weather satellite. Joe Parisi, RCA contract employee (left) is shown discussing TIROS with Shepard and John T. Mengel, assistant director for tracking and data systems.

The Antenna Control Building—Hydraulic Power Under the Tower



George Winston, control section head, adjusts the antenna position from the console inside the control building.

Nearly everyone at the Center has seen our large water tower, but few have noticed the small building resting in its shadow. In fact, the antenna control building is almost underneath the tower.

What is it for, and why is it in such an unusual spot? For one thing, the antenna (located near the building) can use the water tower for alignment and calibration. A transmitter is hung on the tower for this purpose. When being so used, the water tower actually serves as a substitute satellite.

The antenna control building has two distinct functions, according to Tom Golden, head of the antenna systems branch:

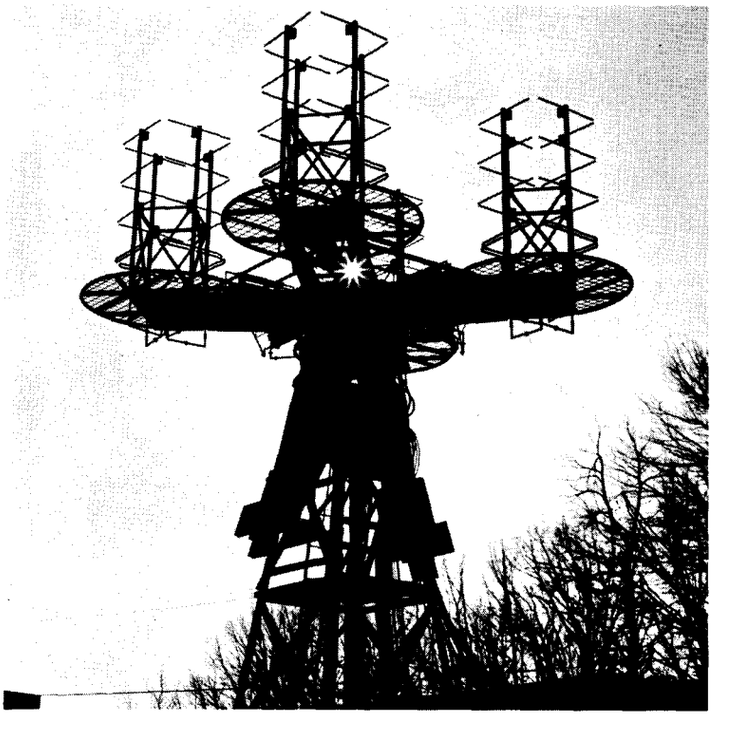
- The first is to investigate properties of hydraulic systems components (such as servo valves, actuators and filters). The equipment housed there allows complete operational tests and experiments on these components. This work is directed toward studies of problems which have occurred at various data acquisition sites.
- Secondly, the antenna is used as a representative system for the development and evaluation of new control systems concepts. It is a full-scale model of an automatic aiming antenna with a hydraulic-driven pedestal.

"The model has most of the characteristics of our 85 and 40-foot dishes," explained George Winston, head of the control section.

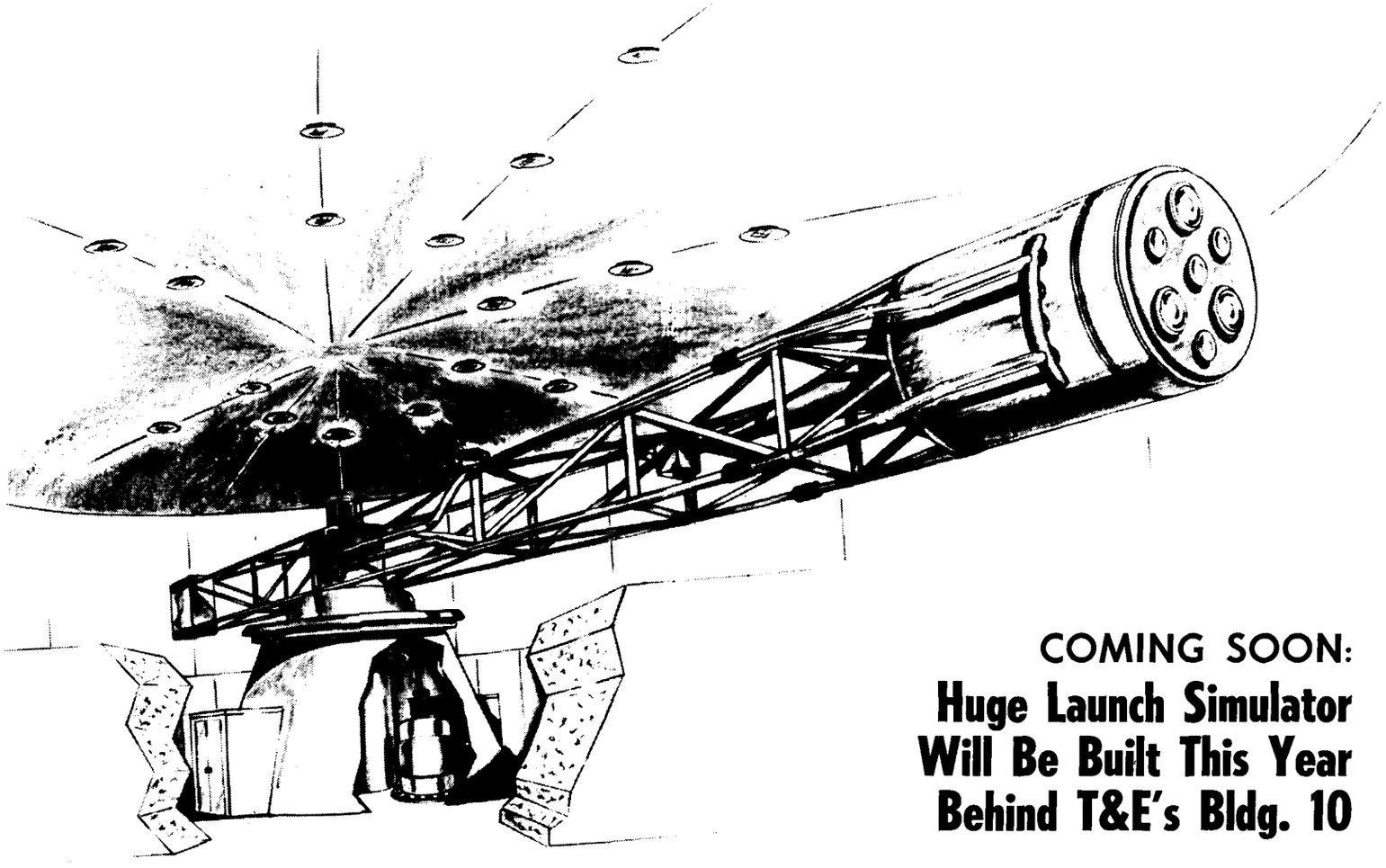
The building under the water tower has been in place about a year, but new equipment is still being added and installed. Golden pointed out the capabilities of the present facilities will continue to increase to provide added usefulness.

Demands will increase also, perhaps at an even faster pace, since the control section is called on to assist with tracking and telemetry for nearly all Goddard projects.

The building will continue and increase its functions as a laboratory for advanced development of control systems and for adaptation of existing ones.



The control building (left) and hydraulics building (right) frame the antenna as the sun settles behind it.



COMING SOON:
Huge Launch Simulator Will Be Built This Year Behind T&E's Bldg. 10

Construction is due to begin this summer on the launch phase simulator, pictured here. The simulator consists of a test chamber large enough for second-generation scientific satellites mounted on the end of a huge centrifuge arm. The combined launch conditions of acceleration, vibration, noise and vacuum can be simulated. A 2500-horsepower drive will rotate the arm (with a 60-foot test radius) at speeds up to 32 rotations per minute to create a "gravitational pull" ranging to 23 gravities.

Flight Program Begins for Versatile ATS, Second-Generation Syncom, Managed Here

After the completion of a 21-month feasibility and preliminary design study based upon the successful development of Goddard's Syncom, NASA has initiated a flight program for the versatile new Advance Technological Satellite (ATS). ATS, an advanced version of Syncom, will be a 650 pound spacecraft.

The ATS will be a Goddard-managed project under Robert J. Darcey, communications satellite projects branch.

The study was made by Hughes Aircraft Company, with whom negotiations will be made for the development and construction of five ATS spacecraft for flights beginning in 1966.

ATS will test several satellite techniques and devices, particularly spacecraft stabilization and orientation in higher altitude orbits.

Data from this project will provide the basis for maintaining United States' leadership in space communications, meteorology, and navigation.

The project will contribute to the technology of stabilization orientation and station-keeping.

Investigation to be undertaken on the Advanced Technological Satellite include meteorological sensor components, radio frequency propagation measurements, earth-pointing antenna systems, and radiation measurements.

Atlas-Agena Launch

Goddard's field projects branch will launch ATS atop the Atlas-Agena from Cape Kennedy. It will carry a variety of experimental instrumentation weighing from 100 to 300 pounds depending upon the mission. It is to be cylindrical.

Three types of missions are planned:

- A 6,500 mile earth orbit to experiment with a gravity-gradient stabilization system. Several long booms will extend from the spacecraft to interact with the earth's gravitational field to stabilize the satellite and align it toward earth.
- Two synchronous 23,500 mile earth orbits with the ATS orbit-stabilized to make meteorological, communications, and navigation investigations.
- Two synchronous earth orbits using the gravity-gradient stabilization system to make engineering and technological studies.

Goddard Coming Events

Goddard Colloquium Lectures:

- **March 17, 3 p.m., Auditorium, Bldg. 3—Dr. W. B. Thompson, BELLCOMM, Inc., "Resonant EM Modes of the Earth's Ionosphere Cavity."**
- **March 12, 4 p.m., Goddard Institute for Space Studies, Room 431, 475 Riverside Drive, New York, New York—Dr. Alar Toomre, Department of Mathematics, Massachusetts Institute of Technology, on "The Spiral Problem in the Disk-shaped Galaxies."**

Films:

- **March 19 and 26, 12:30 p.m., Bldg. 3 Auditorium — "X-15 Documentary." This film documents the research, development and flight testing of the X-15 rocket airplane.**