GODDARD NEWS

GODDARD SPACE FLIGHT CENTER / GREENBELT, MARYLAND

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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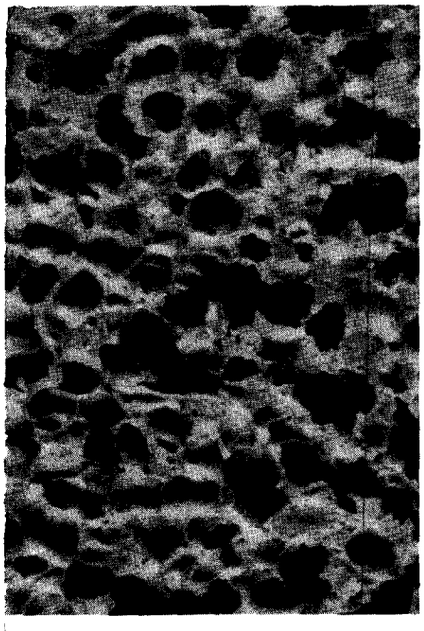


This light-looking "cake" looks good enough to eat—but don't try it. It is a new ceramic potting compound that can be foamed and "baked" around electronic components.

For Space Electronics We Bake a Cake

Researchers at the NASA Goddard Space Flight Center have developed a new high temperature-resistant ceramic compound in which space electronics can be baked like a file in a cake for protection against extreme heat.

The new compound combines protection for space electronics against vibration, a feature available in current potting compounds, with protection against heat ranging in temperature to 2500 degrees Fahrenheit. High temperatures effect the reliability of electronic components.

Much like baking a cake with a file in it, the new ceramic potting compound is mixed to the consistency of cake batter, poured around the electronic components contained in a metallic tray and baked (or cured) in an oven.

Differing from the edible cake with a file in it, however, the ceramic is allowed to rise and is then baked at temperatures half those required for the edible cake. The ceramic can be cured at temperatures as low as 150 degrees Fahrenheit.

Due to their high curing temperatures, current heat refactory materials used to protect space electronics against heat must be foamed and cured separate from the electronics. These materials are then cut and fitted around the electronics as a protective shield against heat.

Goddard developed the new ceramic compound to give satellite electronic systems protection against possible high temperatures from nuclear power sources carried on board satellites. The compound also will be used to shield a sounding rocket's electronics against high temperature heat encountered during launch and re-entry.

The new ceramic potting compound has characteristics which give it a potential structural application. If blocks or shapes of the foaming material are desired, the mixture can be poured into molds and then shaped after hardening if necessary. It can be cut with a hacksaw blade, shaped with a wood rasp, or ground on an abrasive wheel. The foaming material can be cemented with high temperature cements and most other cementing compositions.

For identification purposes, the foaming material can be made in the desired color. Small percentages of the usual second phase ceramic coloring materials can be added to the basic mixture to produce a permanent insoluble coloring effect. For example, chromium oxide can be added for green and cobalt oxide can be added for blue.

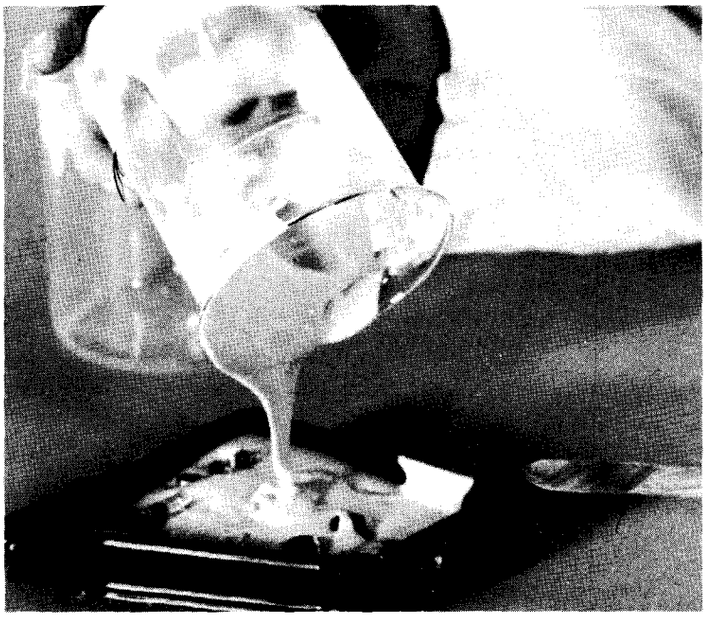
Components used in the preparation of the new compound include orthophosphoric acid, aluminum hydroxide, meta-aluminum phosphate, bentonite and a metal powder. Although any metal which will react with phosphoric acid to form gas can be used, aluminum serves best.

Fine Silicon Dioxide powder with a particle size of 10 to 20 millimicrons in diameter can be added to the compound to give it a more uniform and stronger structure in the cured state.

The total porosity of the foaming compound can be varied from approximately five percent to 90 percent by volume with a corresponding density variation of 140 pounds to 10 pounds per cubic foot. These properties can be controlled accurately by varying the aluminum metal powder particle size and content. Particles of 150 mesh to smaller than 325 mesh can be used, depending upon the desired pore size and foam structure.

An invention disclosure for the foaming compound has been filed by Alfred G. Eubanks and Ronald E. Hunkeler. Both men are from the materials research and development section of Goddard's spacecraft systems branch.

(Cont'd on p. 6)



Looking for all the world like cake batter, the new compound is shown here being poured over space electronics.

New Library To Honor Dr. Goddard

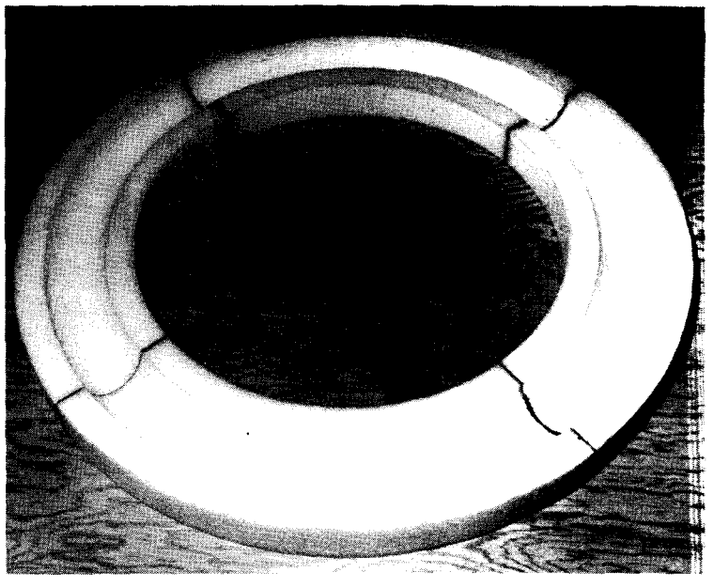
Dr. Robert H. Goddard's alma mater, Clark University, has announced that the school's proposed new library will be named in his honor.

Dr. Goddard, "the father of modern rocketry," was a native of Worcester, Mass. (where the University is located) a former student, alumnus and professor of physics for 29 years.

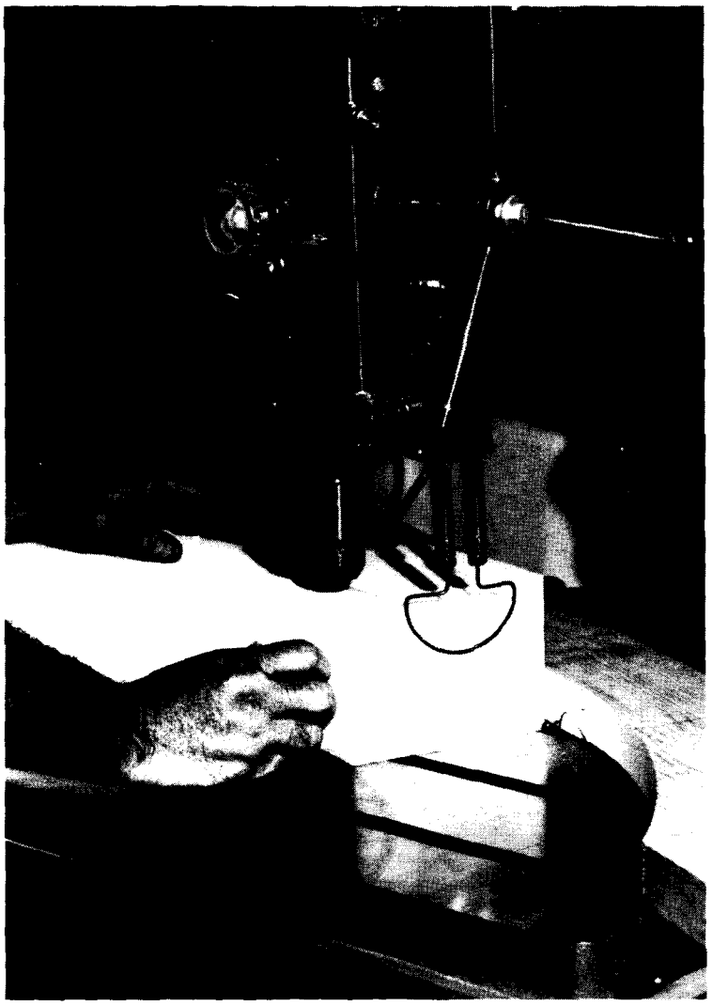
Now on the drawing boards, the "Robert Hutchings Goddard Library" will be a central feature of the campus. It is said to express in pure architectural terms many of the major qualities of the man.

The University's trustees described the design as, "A warm, dignified structure devoted to learning and scholarship (which) will evoke a feeling of intellectual strength and a firm sense of mission, perhaps Dr. Goddard's most outstanding personal characteristics."

Dr. Robert H. Goddard



This is the completed crush pad that was fabricated here. It has been made in sections, and glued together. The process used saved construction of expensive molds, and resulted in a perfect pad with hollow core, as ordered.



This photograph illustrates the technique devised by Andrew Hazen, plastics expert, to create the hollow core with a shaped hot wire. The idea and the equipment used to carry it through were originated by the fabrication division.

Foam plastic crush pads with hollow cores play an important role in the protection of delicate electronic equipment carried aloft by sounding balloons. The pads cushion the shock when the experiment packages return to earth.

The framework of the equipment gondolas is rather delicate due to weight limitations, and needs protection when it falls back to earth. Foam crush pads to provide a "cushion" were assembled by plastics expert Andrew Hazen, fabrication division, at the request of Donald Kniffen, energetic particles branch.

It was first believed that the job would require a special mold, an expensive and time consuming operation. Then, Hazen thought of a way to bypass this "standard" method. Instead of molding the crush pads, he decided to cut out sectors of foam plastic with a jig and split them longitudinally.

Then, by rotating the pieces through a stationary hot wire shaped in a semicircle, half of the hollow core would be carved out of each piece. When glued together the components parts would form a crush pad with the required hollow core.

Hazen assembled his apparatus and proceeded to turn out six perfect crush pads.

Although this idea is not revolutionary in the plastics industry, the ingenuity shown in adapting it to the project at hand is typical of the services rendered by Goddard's fabrication division.

FOLLOW THE PHOTOS . . .

Scientific Pipe-Lighting Techniques Demonstrated

The pipe-smoking renaissance is sweeping America and Goddard is no exception. In every building fragrant fumes from briar bowls linger in offices and hallways.

As a public service to aid the inexperienced new convert, GODDARD NEWS has asked a mellow long-time pipe addict to demonstrate several acceptable means of pipe-lighting. Eddie Lichtenstein of the photographic branch knows (from years of experience) on which end his pipe is lighted!

The following pictorial presentation will leave his exacting scientific methodology indelibly inscribed on your mind. He advocates a step-by-step process of elimination.

If this demonstration dissuades anyone from daring to begin puffing, it will be purely coincidental.

Anticipation is written all over the face of the pipesmoker as he packs his tobacco into place . . . just right!

News About Space & Aeronautics

● NASA has invited scientists to propose research experiments and studies for manned and unmanned space flights during the last half of the 1960's.

The agency gave the worldwide scientific community detailed descriptions and timetables covering a wide range of space flight research opportunities. These include placing scientific experiments in available space on Gemini and Apollo manned flights, weather satellites, sounding rockets, the X-15 research plane, orbiting observatories and balloons.

• • •

● The first tracking station to be completely built for Project Gemini was dedicated late last month at Carnarvon, Australia, close to the point on Earth exactly opposite from Cape Kennedy.

James E. Webb, NASA Administrator, participated in the dedication ceremonies by SCAMA telephone. Goddard's Director, Dr. Harry Goett also participated. He said that NASA established the new station at the new site because every spacecraft launched from the Cape passes close to Carnarvon on its first orbit.

NASA manned spaceflight tracking facilities were moved to Carnarvon from Muchea and Woomera late in 1963 after Project Mercury experience indicated the advantage of this location. Security of the astronaut's life, his flight direction, altitude and velocity must be established early in the first orbit, and Carnarvon is the first land station to see the spacecraft after it passes over southeast Africa and turns northeast up the Indian Ocean toward Australia.

Carnarvon will support the two Gemini astronauts while they maneuver their capsule to rendezvous and join with a second spacecraft, the orbiting Agena space vehicle.

Webb's remarks welcoming Carnarvon to operational membership in Goddard's Manned Space Flight Network also initiated the new station to membership in SCAMA, also operated by this Center. This is the NASA 13-country network of operational voice communications which carried the Administrator's words from NASA Headquarters to Carnarvon at the farthest west point of Australia via 4,800 miles of telephone land line and 8,200 miles of submarine cable.

During Gemini missions, SCAMA will keep flight controllers at the stations in voice contact with the control centers at Cape Kennedy, Houston, Goddard and all other stations in the network. Teletype circuits also connect all stations and control centers and will carry the flow of flight information from the stations to control center computers during the mission.

• • •

● The first joint satellite agreement between the new European Space Research Organization (ESRO) and NASA was announced on July 22 by the two agencies.

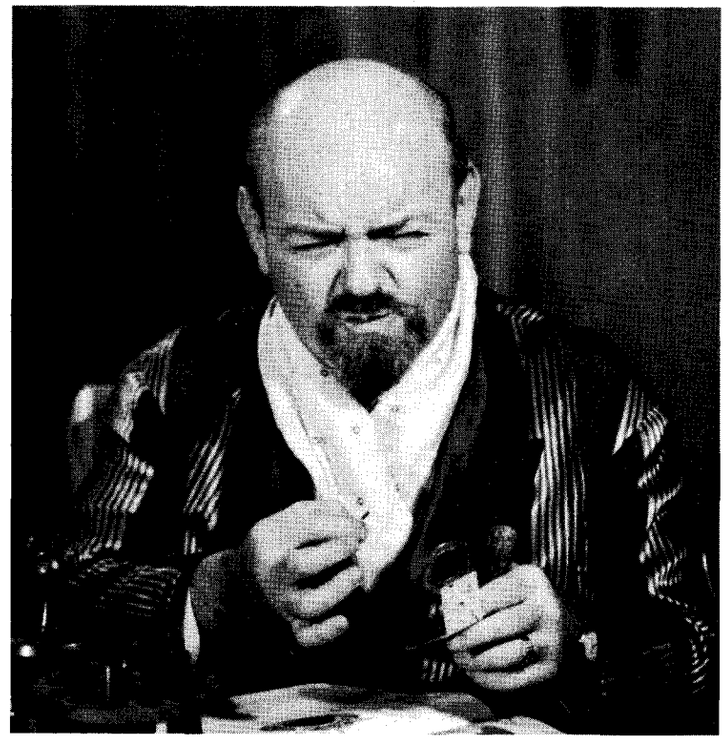
The organizations have signed a memorandum of understanding for a project involving two scientific satellites, reflecting further extension of the U. S. program encouraging cooperative space efforts with other countries. These two satellites bring to 13 the number launched or planned under the program.

ESRO, which came into formal existence in March 1964, is the nine-nation West European group formed to conduct scientific space research utilizing the capabilities of its member countries.

Membership includes Belgium, Denmark, France, Federal Republic of Germany, The Netherlands, Spain, Sweden, Switzerland, and the United Kingdom. Italy is expected to join when the Italian Government has ratified the ESRO Convention.

Pipe-Lighting (from p. 2)

After packing the pipe, try a cigarette lighter. Try not to be frustrated if it continually goes out. Also, be sure to notice that it is next to impossible to get the flame to curve down into the pipe bowl!



Ouch! Book matches may seem to be the answer. However, the long burn necessary to fire up a pipe will often result in burns which could fry your fingertips.

(Cont'd on p. 6)

GODDARD NEWS

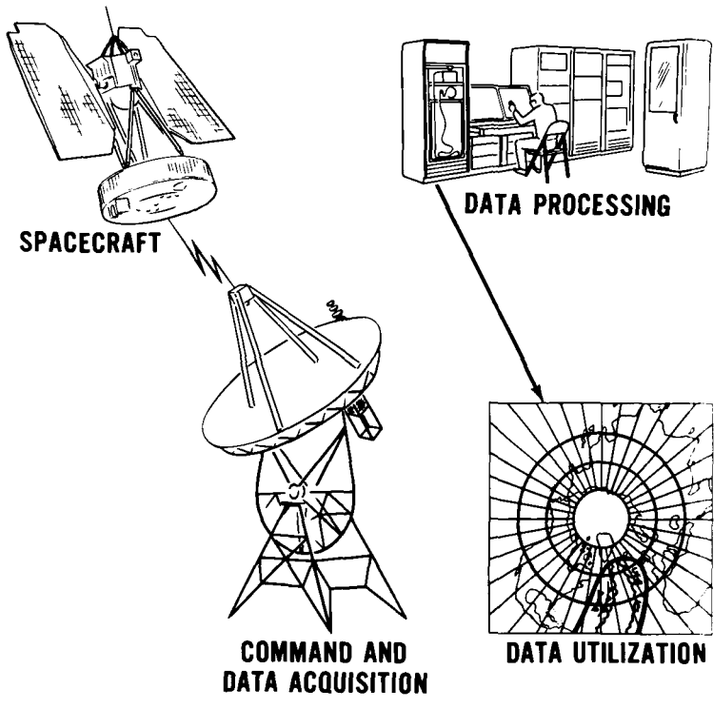
"It is difficult to say what is impossible, for the dream of yesterday is the hope of today and the reality of tomorrow."
—Dr. Robert H. Goddard

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

Photography by Goddard's photo branch

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

Nimbus is Readied for Launch in August from Calif.



The flow of information from Nimbus is depicted here. From spacecraft to antenna, then by land line or microwave to the data processing equipment goes information on cloud cover.

Four years of preparation will see fruition next month when Nimbus A, Goddard's first second-generation meteorological satellite, is launched from the Western Test Range into a near polar orbit.

Nimbus development and project management has been and is the responsibility of this Center, according to Harry Press, project manager.

Launch responsibility for the Thor-Agena booster rests with Joseph Schwartz of Goddard's launch operations branch.

Nimbus will give weather-watchers a look at the entire Earth twice a day through the eyes of a new advanced vidicon camera system (AVCS). Each picture in this panoramic presentation will arrive at Goddard and be printed approximately one minute after it is transmitted by the satellite. They will be of much higher quality than pictures presently available from TIROS.

The spacecraft will also carry a high resolution infra-red radiometer (HRIR) system which will transmit nighttime pictures when Nimbus is on the dark side of the Earth. These pictures should compare in quality and resolution with present TIROS pictures.

The large (800 lb.) spacecraft will carry a third system —automatic picture transmission (APT), which has been tested on TIROS VIII. This system can transmit cloud cover photos directly to any location on Earth where relatively inexpensive receivers are set up.

Data received from the AVCS and HRIR systems will be received at the Nimbus data acquisition facilities at Fairbanks, Alaska, and Rosman, N. Car. The information will be microwaved directly to Goddard and to the U. S. Weather Bureau at Suitland (see "There's a Nimbus Ground Station Under Building 3," March 9, 1964 issue).

Seven Rockets Launched Within Ten Hours

Seven Goddard sounding rockets were launched successfully from Wallops Island within a 10-hour period earlier this month, with two of the shots only five minutes apart.

All seven experiments were sent aloft by Nike-Apache vehicles. Four were sodium vapor meteorological experiments which produce pink and reddish vapor clouds visible for many miles. Two of these Goddard experiments were launched at dawn and two others at dusk.

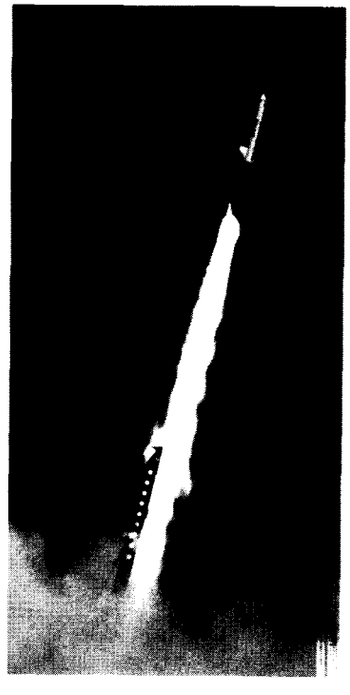
Sodium trails were ejected from about 32 statute miles altitude up through 119 miles.

Cameras at several ground sites recorded the motion of the dispersed vapor to provide data on wind directions and speeds at various altitudes and the changes which occurred during the period from sunset to dawn.

Sodium vapor experiments are used to provide information on winds and turbulence in the upper atmosphere as part of the NASA meteorological program carried on by Goddard.

The other three launches were ionospheric experiments for the University of Illinois.

The main purpose of these tests is to observe and measure structural changes occurring in the ionosphere from nighttime to daytime, as radiation from the Sun penetrates the ionosphere. "Piggyback electrons" which spend the night attached to gas molecules in space are freed by the dawn to become a part of the daytime ionosphere. These changes have a marked effect on radio communications. Under the influence of light, the number of electrons in the lower ionosphere (30 to 60 miles above the Earth) increases greatly, and they absorb radio signals, decreasing the listening range of stations.

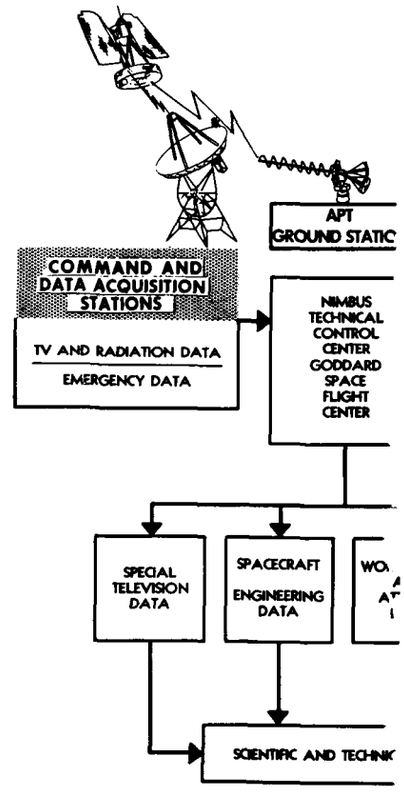


This is a Nike-Apache being launched. Seven were fired in a ten-hour period this month in two series of experiments.

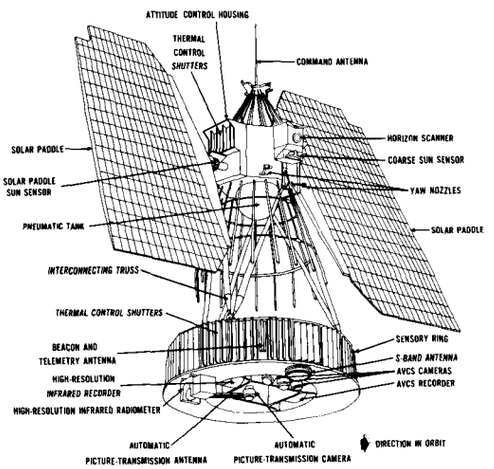
The increase in ionization comes from two sources. One is the piggyback electrons—electrons which had been free during the previous daylight period and during darkness attached to gas molecules.

The other is by photoionization in which light creates many new free electrons. These experiments may help scientists to better understand these phenomena, and possibly determine the proportion of electrons coming from the two sources.

This Center's sounding rocket branch, headed by Karl R. Medrow, provides support for all NASA sounding rockets. All vehicles are within this responsibility in addition to technical liaison with the various experimenters.



Nimbus in a nutshell: This Notice the two different flov stations. APT stations produ

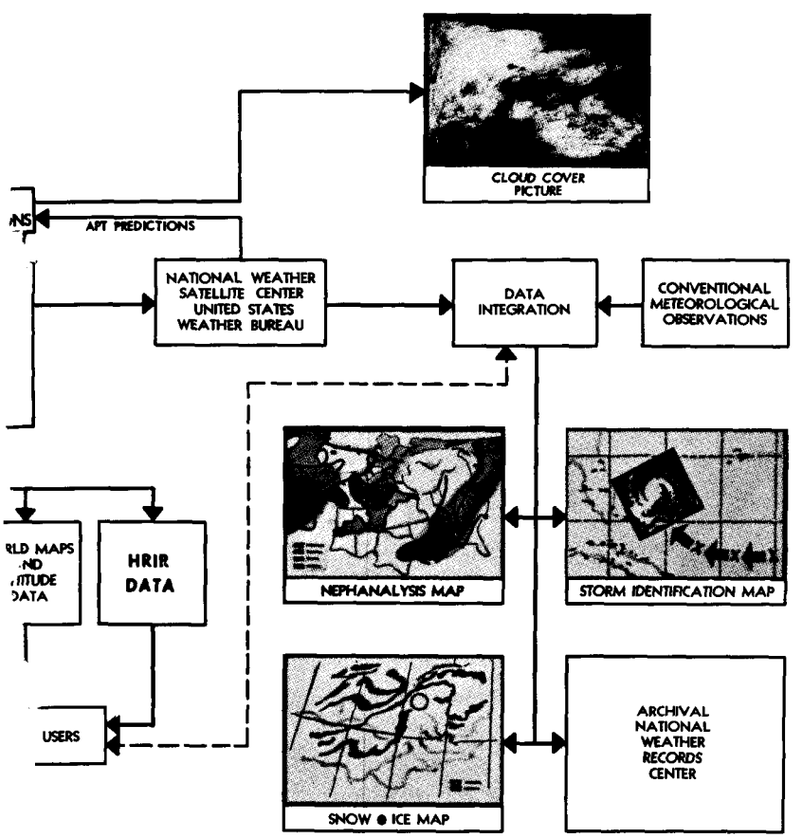


The Nimbus spacecraft is far more complex than TIROS, the first generation of meteorological satellites.

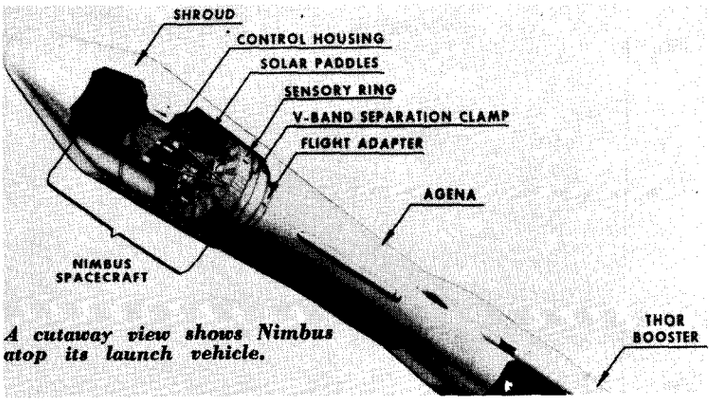
William G. Stroud, chief of the aeronomy and meteorology division, was instrumental in the early design effort of the Nimbus spacecraft and program which has grown out of TIROS —America's most successful applications satellite.

General Electric Co. is responsible for Nimbus spacecraft integration and testing. Radio Corp. of America built the AVCS and APT subsystems and I.T.&T. was responsible for the HRIR system.

The Nimbus program is under the overall direction of the meteorological programs division of NASA headquarters' office of space science and applications. Dr. Morris Tepper directs this office and Richard M. Kee is Nimbus program manager.



rt demonstrates the operation of the program in terms of data flow. ies for APT ground stations and command and data acquisition direct cloud cover picture in a matter of seconds.



A cutaway view shows Nimbus atop its launch vehicle.

Recent Technical Publications Authored by Goddard Staff

A. J. Smith, "Halphen's Method of Secular Perturbations Applied to the Determination of Long Range Effects in the Motions of Celestial Bodies, Part II," NASA Technical R-194, June 1964.

H.-Y. Chiu, "Supernovae, Neutrinos, and Neutrono, and Neutron Stars," NASA Technical Note D-2112, June 1964.

J. Nagy and G. Coble, "Flight Vibration Data of the Aerobee 150A Sounding Rocket," NASA Technical Note D-2314, June 1964.

M. Townsend, P. Feinberg and J. Lesko, Jr., "A Medium Data Rate Digital Telemetry System," NASA Technical Note D-2315, June 1964.

C. Prabhakara, "Effects of Non-Photochemical Processes on the Meridional Distribution and Total Amount of Ozone in the Atmosphere," NASA Technical Note D-2106, June 1964.

W. K. Allen, L. J. Ippolito, and D. Nace, "TWT Re-Entrant Amplifier Serrodyne System," NASA Technical Note D-2149.

G. D. Smith, "Designing Toroidal Inductors with dc Bias," NASA Technical Note D-2320, July 1964.

J. C. Lyons and D. R. Dargo, "Welded Electronic Module Fabrication," NASA Technical Note D-2321, July 1964.

P. Feinberg, "The MRIR-PCM Telemetry System—A Practical Example of Microelectric Logic Design," NASA Technical Note D-2311, July 1964.

R. A. Hanel, "Exploration of the Atmosphere of Venus by a Simple Landing Capsule," NASA Technical Note D-1909, July 1964.

P. J. Heffernan, "Non-Linear Noise Analysis for FDM Telephony Transmission in an SSB-PM Communication System," NASA Technical Note D-2365, July 1964.

E. Young, "The Use of a Helium Mass Spectrometer Leak Detector," NASA Technical Memorandum X-978, July 1964.

E. J. Habib, G. C. Kronmiller, Jr., P. D. Engels, and H. J. Franks, Jr., "Development of a Range and Range Rate Spacecraft Tracking System," NASA Technical Note D-2093, June 1964.

N. L. Bonavito, "Determination of Mean Elements for Vinti's Satellite Theory," NASA Technical Note D-2312, June 1964.

S. J. Bauer and J. E. Jackson, "A Small Multipurpose Rocket Payload for Ionospheric Studies," NASA Technical Note D-2323, June 1964.

T. W. Flatley, "High Speed Vacuum Performance of Miniature Ball Bearings Lubricated with Combinations of Barium, Gold, and Silver Films," NASA Technical Note D-2304, July 1964.

J. E. Balmont, D. Philippe and A. K. Stober, "Resonance Scattering at Lyman-Alpha by an Atomic Hydrogen Cell," NASA Technical Note D-2148, June 1964.

A. J. Rolinski, D. J. Carlson, and R. J. Coates, "Characteristics of the X-Y Mount for Data Acquisition Antennas," NASA Technical Note D-1697, June 1964.

R. E. Bourdeau and J. L. Donley, "Explorer VIII Satellite Measurements in the Upper Ionosphere," NASA Technical Note D-2150, June 1964.

R. C. Booton, Jr., "Demodulation of Wideband Frequency Modulation by a Phase-Lock Technique," NASA Technical Note D-1680, June 1964.

K. Maeda and T. Watanabe, "Infrasonic Waves from the Auroral Zone," NASA Technical Note D-2138, June 1964.

K. Stark, "Development of a 1200 Foot Endless Loop Tape Transport for Satellite Applications," NASA Technical Note D-2316, June 1964.

M. M. Grant, C. C. Stephanides, and W. N. Stewart, "Explorer XVII (1963 9A) Real Time PCM Telemetry Data Processing and Display Test Stand," NASA Technical Note D-2318, 1964.

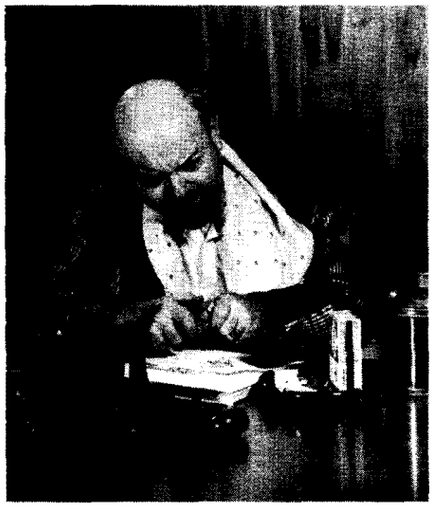
B. K. Lunde, "Horizon Sensing for Attitude Determination," NASA Technical Memorandum X-956, June 1964.

M. Maxwell and R. Kutz, "An Efficient PCM Error Correction and Synchronization Code," NASA Technical Note D-2317, June 1964.

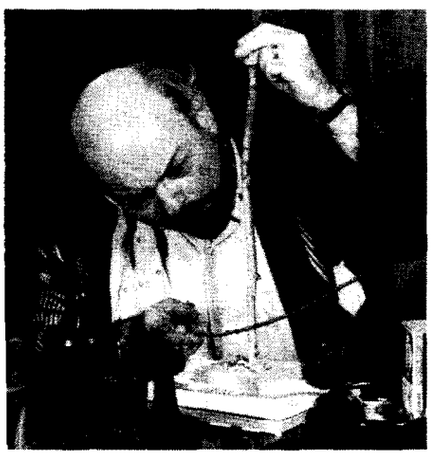
P. Yaffee, F. Starbuck, J. W. Bailey, C. W. Scott, A. C. Johnson, C. F. Riley, Jr., W. E. Flowers, and R. K. Hovey, "An Integrated System for Collecting and Analyzing Environmental Test Data," NASA Technical Note D-2322, June 1964.

Pipe-Lighting

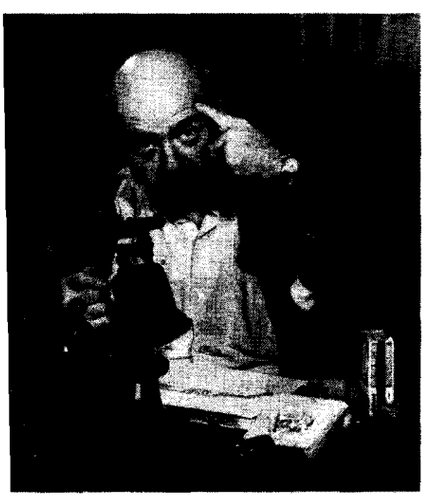
(from p. 3)



Flint and steel worked for prehistoric man, but seems to be just an added frustration to our pipe "expert," who is willing to try anything by this time.



Bringing his Boy Scout training into focus gets results similar to flint and steel—nothing!

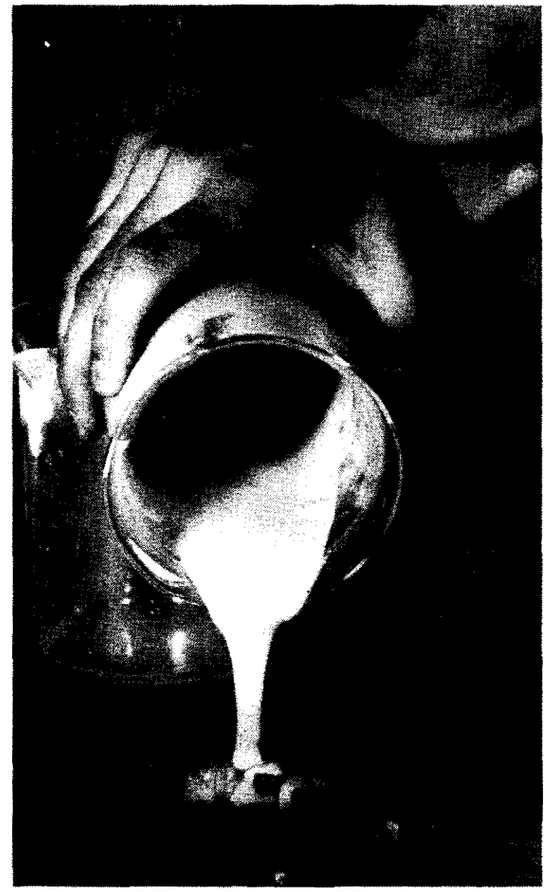


Why not? All else has failed. Another problem rears its ugly head—how do you light a blow torch?

(Cont'd on p. 7)

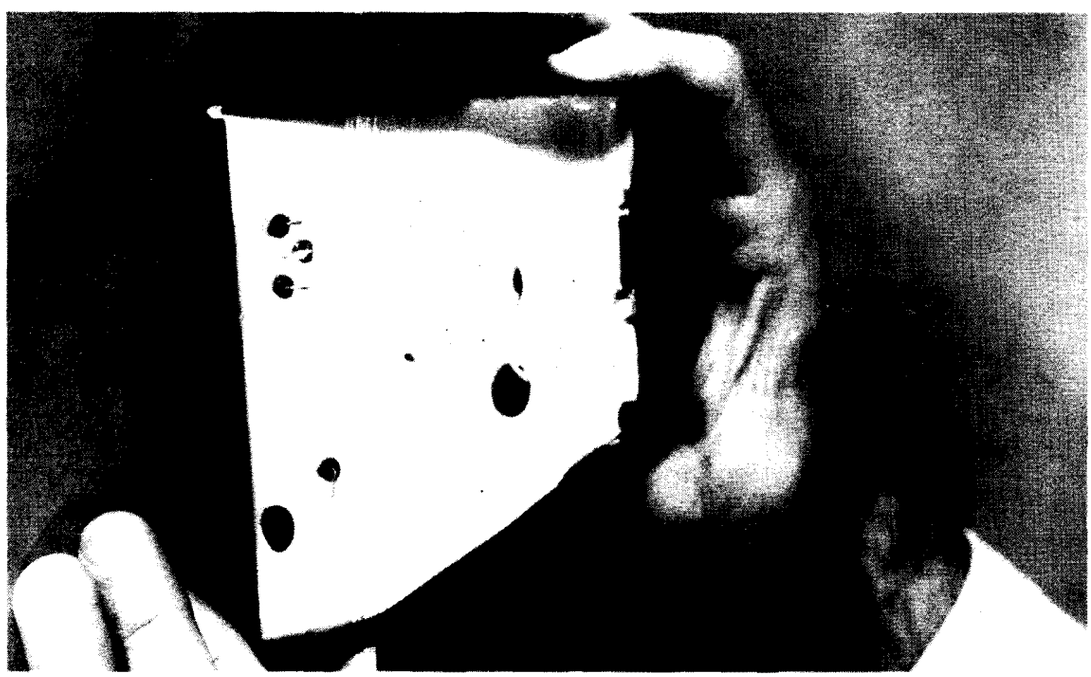
Baking Ceramic Potting Compound . . .

(Cont'd from p. 1)



MIXING . . . POURING . . .

Then Comes Foaming and Baking!



Ronald Hunkeler, shown mixing and pouring (above) holds the final product here, ready for "baking."

'What's Up There' Meets Math Students' Need

Who out there used "What's Up There," a source book in space-oriented mathematics for grade school students prepared by Goddard in cooperation with the U. S. Office of Education, during the past school year?

Obviously, a great many people did, and with good results. The U. S. Office of Education distributed 25,000 copies to the State Department of Education in each of the 50 states.

Each state school system cooperated by using the book in a pilot program of evaluation in 10 to 15 schools.

The mathematics teachers who used the book were then asked for their comments. Some examples of opinion and useage follow:

An Arkansas teacher wrote, "*What's Up There* was genuinely enjoyed by the participating students. . . ." Her students based a school open house program on experiments and demonstrations suggested in the source book. Their production was so successful it received area press coverage and warranted a repeat performance.

A principal in North Dakota commented, ". . . The mathematics instructors in both the elementary and high school . . . appear to be very enthusiastic about its potential."

A mathematics consultant from Rhode Island opened his note with, "May I congratulate you on *What's Up There?* It looks like it will be a great success. . . ."

"How can the teachers help doing a good job with wonderful materials like these?" responded North Dakota's director of certification, who is a former elementary school teacher.

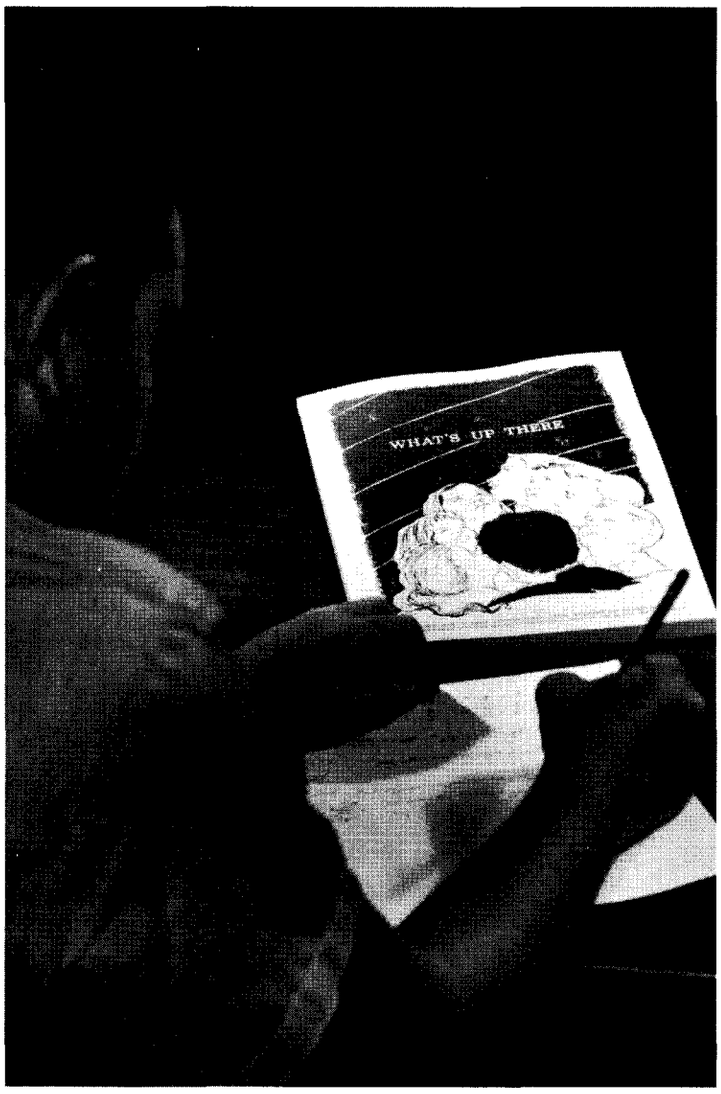
From New Mexico, a mathematics teacher said, "The responses from my students are all 'pro' *What's Up There!* The students are receiving the publication with much enthusiasm and interest. . . ."

Overseas Requests Met

In addition to the 25,000 copies which went to the nation's schools, an additional 25,000 were placed on sale by the Government Printing Office, Superintendent of Documents. Numerous requests from teachers here and abroad were referred there. Indonesia, Northern Rhodesia, South Africa and many Latin American nations have requested the source book.

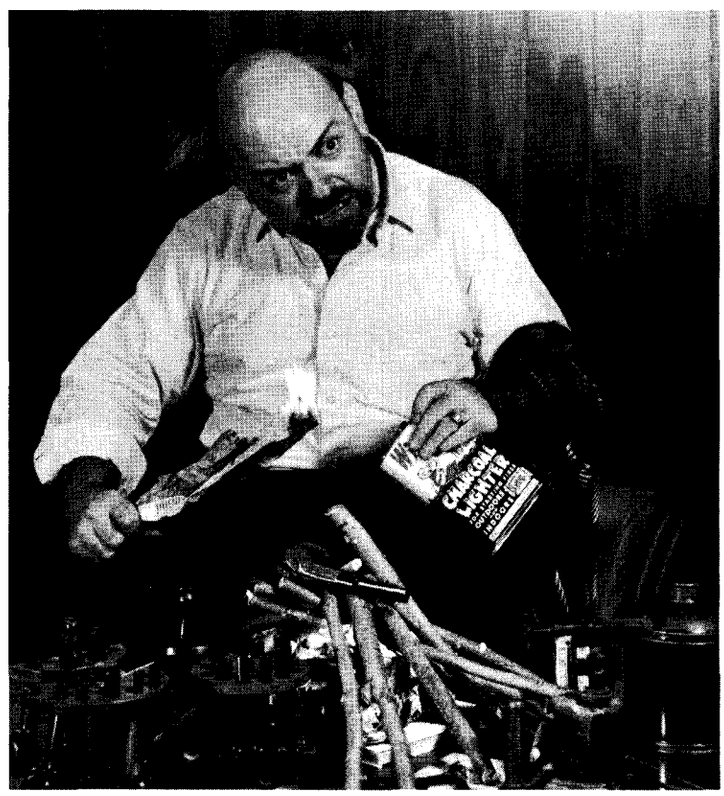
The original idea for *What's Up There* grew out of a discussion between Goddard's assistant director for administration, Dr. Michael J. Vaccaro, and Dr. Patricia M. Spross, specialist in mathematics, U. S. Office of Education.

A team of scientists and educators actually put the book together with Dr. Vaccaro acting as committee chairman and Dr. Spross as project director. Goddard's office of public information, coordinated the work.



Students all over America have been using "What's Up There" in a pilot project during the last school year.

Pipe-Smoker's Dream—Fulfillment



All else has failed, and our expert has lost his temper in the valiant attempt. Now, as a last resort only, he recommends the camp fire method. This, he guarantees, will light any pipe, and give the smoker complete satisfaction.

Goddard Speech and Paper Presentations

(Technical presentations approved as of July 21, 1964 for period through August 9, 1964. Requests for copies of speeches and papers should be made directly to the author.)

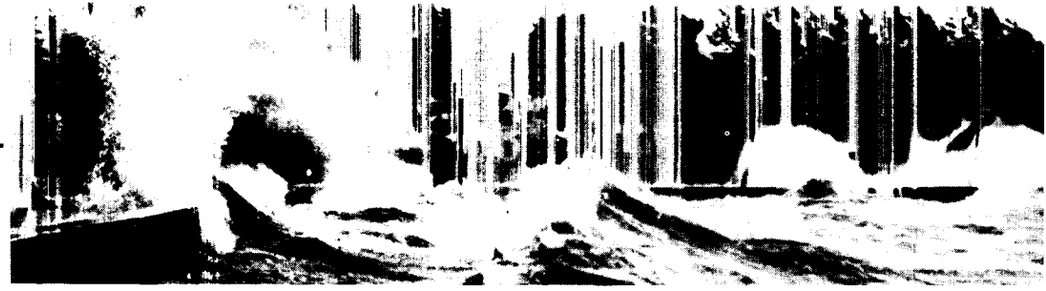
SPEECHES

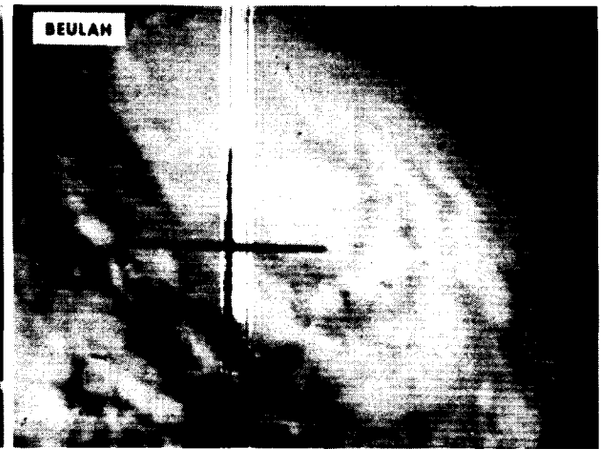
Robert Jastrow, Brooklyn Children's Museum, Brooklyn, N. Y., July 23, ***"Planetary Atmospheres."***

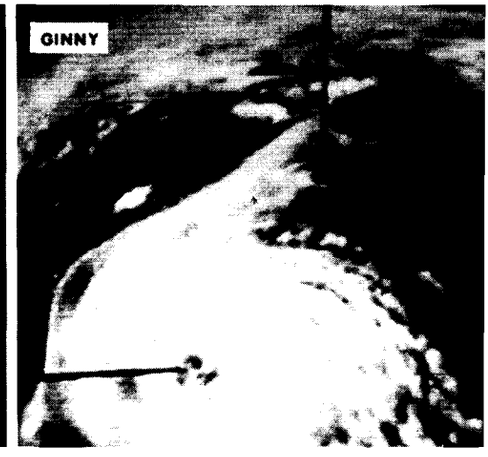
A. G. W. Cameron, The American Museum-Hayden Planetarium, New York, N. Y., July 29-30, ***"Extraterrestrial Life."***

S. Ishtiaq Rasool, International Union of Geodesy and Geophysics (International Symposium on Radiation), Leningrad, Russia, August 7, ***"Heat Balance of the Atmosphere and the General Circulation."***

TIROS Ready For '64 Hurricanes







These three TIROS pictures of 1963 hurricanes are a preview of what is to be expected from the satellite this year.

Student Satellite-Builder Visits Goddard After Science Fair

Professional space scientists met an amateur last month, and both were impressed. Ronald D. Jones, an 18-year-old senior from Welch High School in Welch, Oklahoma, won a NASA award for his home-made satellite at the National Science Fair in Baltimore. His prizes included a trip to the NASA center of his choice-- and he chose Goddard.

Jones, who resides on a farm near Chetopa, Kansas (near the Oklahoma border), built a 2.5-pound tetrahedral scientific satellite approximately the same size as Vanguard. It has two transmitters powered by 96 n/p solar cells.

The "amateur" satellite has the following objectives:

- Study of micrometeoroid erosion with three wire grids;
- Radio propogation;
- "Color center" formation studies of its silicone passive temperature control paint;
- Evaluation of 1" by 1" mirrors as optical tracking aids; and
- Obtaining data on radiation damage to semiconductors.

The high school student claims he has "learned a lot from the development of the satellite," even though it will never be launched.

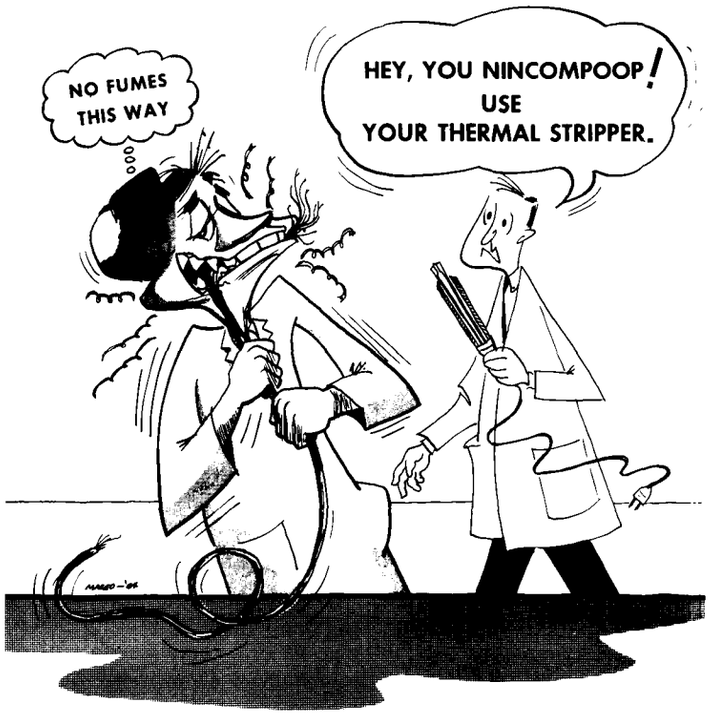
Conferences At Goddard

Since Goddard's mission in scientific satellite development and construction was more "down his alley" than any of the other Centers, he came here along with his science teacher, William Burgess, who had encouraged and worked with him on the winning project.

The young scientist spent two days touring the Center and conferring with space scientists. Conference topics and personnel were: "micrometeoroids," Otto Berg; "Solar cell fabrication," William Cherry; and "stabilization, environmental testing," Dr. Elias Klein.

Cherry said that Jones "had a good understanding of solar cells, and was impressed and delighted with our activities in space power systems."

The satellite was described by Goddard personnel who examined it as "remarkably well designed and well constructed, especially considering that the student had to 'dig up' the components on his own."

Ronald D. Jones (left) holds his "home-made" satellite beside Vanguard for size conparison. His science teacher, William Burgess, is at right. Jones spent two days here.

Lester Tester, T. & E.'s Reverse Psychologist, Still Refuses to Use His Thermal Stripper