GODDARD NEWS

THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GODDARD SPACE FLIGHT CENTER / GREENBELT MARYLAND

VOLUME XII, NUMBER 1 SEPTEMBER 5, 1966

THE FIRST U.S. [illegible]GRAPH OF [illegible] taken with the high[illegible] camera [illegible] The picture, with a reso[illegible] about [illegible] an area of the [illegible]

Two In A Row For Aerobee 350

The Aerobee 350, a powerful, new, liquid-fuel sounding rocket fully developed and funded by Goddard, has passed *summa cum laude* its second tough flight test.

Boosted by its solid-fuel Nike lower stage, the 53-foot rocket soared from the NASA/Wallops Island Station in Virginia on August 17 to a height of 222 miles, carrying a 410-pound payload of engineering and space science instruments.

The first Aerobee 350 flew in June, 1965, on a flight engineering test. It carried no scientific experiments.

The flight was a dual purpose effort intended both to evaluate the rocket's performance and also to demonstrate its capabilities as a scientific research vehicle. Scientific gear for these experiments comprised nearly half the payload instrumentation.

According to Project Manager John H. Lane, the excellent data received from the experiments give the 350 a bright future, and have already elicited enthusiastic response from scientists who wish to fly experiments on future missions.

"We are now officially out of the development stage and can swing forward into using the 350 as the scientific workhorse it was meant to be," said Mr. Lane. "In fact, the project is developing so fast that already we have to think about expanding the payload area to accommodate all the people who want to fly experiments with us."

Assistant Project Manager Francis M. Collins, Jr., said that "the payload area is now 154 inches long. We hope to extend it to 200 inches to make room for larger experiments. Maximum payload weight will also increase from 500 to 1000 pounds."

The Aerobee project has been developed at Goddard's Beltsville sounding rocket lab under Branch Head Karl R. Medrow and

(See Page 2)

Crystal Growing At Goddard

In the future, synthetic crystals will become an increasingly important part of Goddard's research program for use in communications and tracking. For example, maser crystals used to amplify the signals received from the Applications Technology Satellites (ATS) "have been shown to be the near ultimate in low noise amplification and will enable us to detect signals forty times weaker than formerly attainable," says C. Curtis Johnson, Head of the Quantum Electronics Section of the Advanced Development Division. "Laser crystals will be used in the modulation and demodulation of information on laser beams as well as in the generation of the beam."

According to Systems Division Chief Dr. Rudolph A. Stampfl, whose Materials Research and Development Branch will develop the crystals, "Research using lasers is conducted at Goddard and many other organizations because of its importance to wideband communication and tracking over planetary distances. Eventually man wants to explore the planets by unmanned and manned vehicles, and when the time comes we want to have the communication capability."

The crystals themselves are born in a small crystal furnace on the first floor of Building 6. Materials such as erbium doped calcium tungstate are slowly heated to 3,000 degrees Fahrenheit, almost a third as hot as the surface of the sun. So blinding is the light emitted from the furnace that direct viewing is impossible. Under carefully controlled conditions, a man-made crystal forms at the tip of a platinum seed wire. This crystal and others like it will, after laboratory analysis and fabrication, become an integral part of Goddard's maser and laser programs.

"What nature has taken millions of years to accomplish, we have duplicated in a matter of a few hours," says Dr. Henry E.

(See Page 2)

CRYSTALS. . . *from Page 1*

Frankel, Head of the Systems Division's Materials Research and Development Branch. Although similar work is being done by other organizations, "Goddard is developing one of the most complete analytical and solid state capabilities in the area."

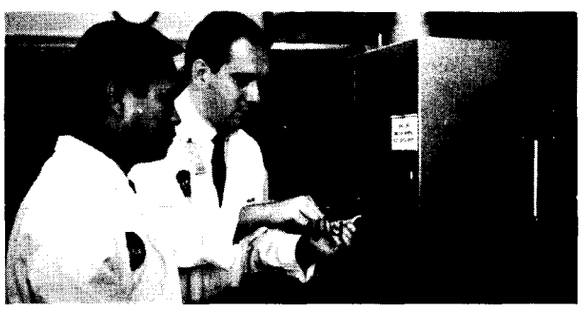
Man-made sapphire, ruby, titania and other crystalline compounds are far better for scientific research than natural stones. Chemical composition and crystal perfection, left to chance by nature, can be carefully controlled by man. Goddard's researchers are presently trying to determine the best methods for doing this.

First, the chemical purity and doping content of each crystal must be determined. Doping compounds, such as the erbium in our example, are added to the crystals to give them the properties needed in the finished rods. Spectographic analysis of crystal samples is done to show how much doping was lost in the high heat of the furnace.

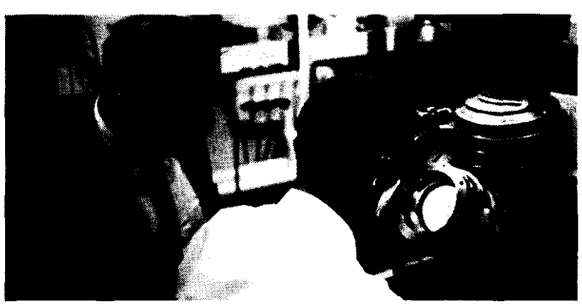
Second, X-ray defraction tests of rough crystals are made to determine crystalline orientation. Only after this laboratory analysis has been completed, can the final cutting and polishing be started.

"We are solid state tailors," says Thomas P. Sciacca, Jr., Head of the Electronic Materials Section of the Materials Research and Development Branch. "We begin with the raw materials, a mathematical model, and a four-leaf clover. We then go to work to produce crystals made-to-order for our current and future requirements."

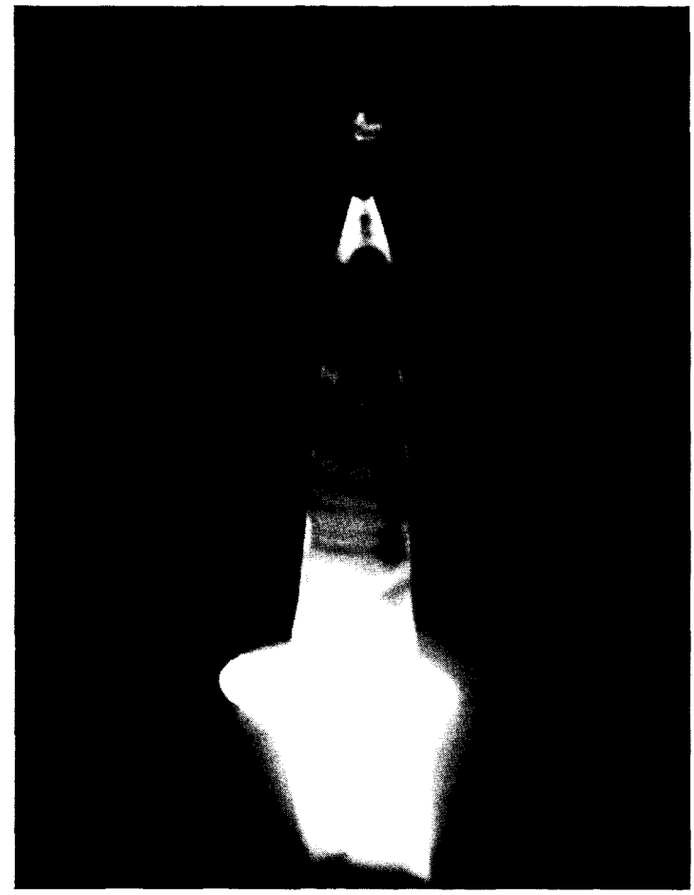
THOMAS SCIACCA, Head of the Electronic Materials Section, and Dr. Henry E. Frankel inspect finished examples of laser and maser rods and a rough crystal mounted for X-ray defraction tests.



TO TEST THE CHEMICAL COMPOSITION of a crystal, Pete Sarmiento and Dick Marriott prepare a sample to be placed in the Ebert 3.4 meter Emission Spectograph.



DR. HENRY E. FRANKEL, Head of the Materials Research and Development Branch (SD), and Ernest Mielke watch the growth of a crystal.



AT THE END OF A PLATINUM SEED WIRE, a man-made crystal grows out of a crucible heated to 3,000 degrees Fahrenheit in Goddard's crystal furnace.

AEROBEE. . . *from Page 1*

Flight Performance Section Head Ernest F. Sorgnit. Launch procedures at Wallops Island were the responsibility of Project Engineer Wayne Gunter and Launch Pad Supervisor Harry Bloxom.

The 350 is powered by four Aerobee 150 main stage engines. The main stage engines and the Nike booster fire almost simultaneously, developing a total thrust of up to 60,000 pounds. The Nike stage burns for 3.2 seconds, developing a thrust of 52,000 pounds, and the main stage engines fire for 52 seconds with a total sea-level thrust of about 16,400 pounds. The main engines cut off at an altitude of about 30 miles and the rocket coasts the rest of the 190 miles to apogee.

At 65 seconds into the recent flight, just over 40 miles above the earth, a Tip-Eject mechanism was activated which threw off the forward shroud to expose the scientific instruments. At about 70 seconds, the ionosphere antenna door was ejected and the two antennas, spanning about 18 feet, began to extend. "These processes occurred at this stage of the flight." said Mechanical Systems Manager James S. O'Brien, "because the loads and heat created by atmospheric resistance would be too great at lower altitudes." He adds that this is the first Tip-Eject mechanism to be incorporated in a fiberglass nosecone.

One of the most complex aspects of this flight was the series of strain gauges installed in the rocket. Because the signals from these gauges have to be amplified a thousand times, the Sounding Rocket Instrumentation Section had to shield all lead wires from stray radiation.

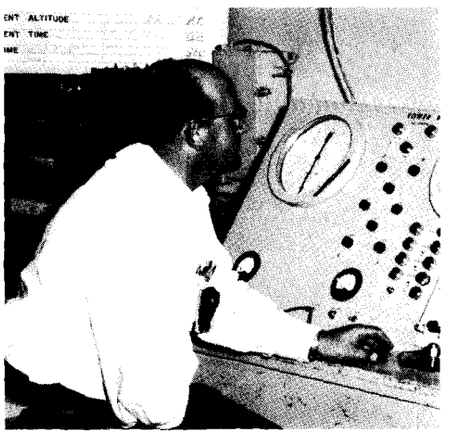
The instrumentation of the first 350 test was the most extensive ever flown on a sounding rocket, with five telemeters. The second test had four telemeters and even more instrument poundage, with 56 continuous channels, including about 17 for science experiments, and a total simultaneous capacity of 123 bits of information.

Said Instrumentation Systems Manager C. Donald Tackett, "A

(See Page 6)

Meet Our People

This is another in a series of articles on Goddard personalities



Paul S. Bushnell, Jr.

Paul S. Bushnell, Jr. has one of Goddard's most unique jobs. His job title is Aerobee Vehicle Manager, which places him organization-wise in Karl Medrow's Sounding Rocket Branch (SI&SR). But his current work as Goddard's Sounding Rocket Representative at the White Sands Missile Range (WSMR) keeps him full time in Las Cruces, New Mexico.

He is our launch supervisor and coordinator of Goddard operations at WSMR, and supervises the preparation and modification of Aerobee rockets to meet payload requirements. In addition to being responsible for rocket preparation and flight, he coordinates Goddard requirements with supporting agencies at WSMR.

Mr. Bushnell came to Goddard in October 1963 from the Pacific Missile Range, where he had been program manager of numerous projects, including Terrier, Tartar, Talos, Red-eye, Hawk, and Atlas/Agena, for 4½ years.

As Goddard's Aerobee Vehicle Manager, he has also been responsible for many firings at Wallops Island, Virginia, and Fort Churchill, Canada.

A native of Independence, Missouri, Mr. Bushnell was graduated from the University of Kansas with a B.S. degree in engineering physics. He is a member of the American Institute of Aeronautics and Astronautics (AIAA), the Institute of Electrical and Electronics Engineers (IEEE), and the American Physical Society. He served in the U.S. Navy as a communications technician from 1950 to 1954.

His hobbies are ham radio and photography, especially photographing the New Mexico desert.

He and his wife, Juanita Lou, and their daughter Cynthia Ann, 19 months, live at 1007 Ellendale, Las Cruces, New Mexico.

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SEPTEMBER 5, 1966

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

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Telephone 301-982-4141 (IDS-134)
Photography by Goddard's Photographic Branch

DATA TOPICS

JOHN L. WOLFGANG, JR. is an electronic engineer with the Spacecraft Technology Division, Flight Data Systems Branch. He is responsible for the operation of the 1800 data processing system. Mr. Wolfgang has worked on both the ground and flight systems for the IMP satellites. He received his BSEE degree from, and is presently doing graduate work at George Washington University.

The IBM 1800 System

by John L. Wolfgang, Jr.

The IBM 1800 Data Processing and Control System is a computer of a new class being manufactured for realtime process control and data handling. These new types of machines are designed with both hardware and software, oriented for realtime processing and control without sacrificing the abilities of the system as a general purpose scientific digital computer.

Specifically the computer being used by the Flight Data Systems Branch personnel is configured as follows: full hardware arithmetic, 8192 words of core storage, 500,000 words of storage on disk, magnetic tape, card reader and punch, and typewriter keyboard-printer. Real time data processing is facilitated by parallel digital input-output which allows data word transfer rates up to the core rate of 500 kc. A strong hierarchy of interrupts for use with hardware external to the computer system aids in data handling and control.

At the heart of the software systems is a disk-oriented time-shared executive program. This programming system will allow overlapping of real time data analysis time shared with open shop computations.

Interfacing of experimental hardware with the 1800 system will be eased by a universal data adaptor which is currently being fabricated and interfaced with the system. This hardware will accept various input levels and will allow serial as well as parallel data streams to be transferred into the computer. The external hardware has active control over data transfer to the 1800 system in that parallel-serial input and signal levels may be automatically changed by the interfaced hardware as required for ease of data transmission.

Analysis of spacecraft telemetry data will be performed using the 1800 to control the operation of and analysis of data from a rotating head analog tape scanner system. A digital tape drive is used to incrementally step an analog data tape around a rotating head wheel. The signal from this head wheel is operated on by a set of correlators, whose output is fed to the computer. Here the computer controls analog tape movement, the correlation frequencies, analysis of resulting data outputs and sync acquisition to the specific format and type of telemetry. This system will allow analysis, of spacecraft failures and other anomalies in the telemetry, which is not possible with the currently used processing systems.

A second area of work for which the 1800 system will be utilized is the theoretical investigation of new space flight encoding, data handling, and computation systems. The computer will also enhance simulation of these systems in real time during the early design phases.

As space flight data systems become increasingly more complex, the problem of testing for correct hardware operation becomes exceedingly difficult. Some of these problems will be alleviated by using the computer to interrogate the space flight hardware and verify that the unit performs the proper operations. Close akin to this is processing test results obtained from various flight hardware tests and calibrations.

NEW PROMISES HELD OUT BY

Scientists Note Value Of Hand-Held Shots By American Astronauts

It is a little startling to comprehend, but the wildest arenas of our vast Earth, once secure in their isolation, are being spread on exhibit for all the world's people to see, boldly photographed by camera-bearing astronauts on the threshold of revealing long-held geologic secrets and predicting meteorologic, biologic, and oceanographic events.

Synoptic terrain photography, or orbital photography, is yet another result of our magic tool the satellite whose uses have not even begun to be tapped. Later this week, Gemini 11 astronauts are scheduled to continue the pioneering efforts in this burgeoning field.

Goddard's Dr. Paul D. Lowman, Jr., has been active in terrain photography since 1962. Assisted by Herb Tiedemann, a structural geologist who mapped suspected meteorite impact structure craters at Vanderbilt University before coming to Goddard, and José Toro, a math aid from Ecuador on a University of Maryland scholarship, Dr. Lowman was responsible for the major step of injecting terrain photography into Mercury and Gemini missions.

It takes little rhetoric to describe the advantages of orbital photography. Since the first airplanes, man has realized the potential value of viewing the Earth from great heights. Even high altitude airplanes, however, can cover but a relatively small area. At a typical Gemini altitude, a single nine-by-nine-inch photo at 1:2,000,000 scale would include an 81,000 square-mile area about 284 miles on a side. The area covered by a high-altitude airplane shot at 1:40,000 scale would be so small that a mosaic of such pictures 37.5 feet wide would be required to duplicate the Gemini shot. Furthermore, the number of pictures for this mosaic would be prohibitive: 2500 with no overlap, and about 8800 with 60% forward lap and 30% sidelap.

The patchwork appearance of a mosaic, which satellite photos eliminate, causes difficulties in interpreting geological features, especially in identifying lineaments which constitute major tectonic elements of the Earth's crest. Subtle tone variations, one of the most important kinds of geological clues, may also disappear in mosaics. Since a satellite several hundred miles high travels at roughly 18,000 mph, successive photos can provide nearly simultaneous coverage of one or several continents, an impossible feat for an airplane because of fuel limits, weather obstacles, and national boundaries as well as scale limits. Entire states or continents can be recorded on film in only a few days. Another advantage of satellite speed is that they can monitor rapidly changing regional conditions, such as snow melting, vegetation dying, sand dunes migrating, or rivers changing their channels.

Orbital photography does have some limitations which seem to be inherent to our Earth. Cloud cover is dismayingly great: Astronaut Walter Schirra has estimated that clouds cover at least half the Earth, and even partially obscured targets are often difficult to identify. Also, considerable color distortion and contrast attenuation results from the thick, blanketing atmosphere, especially in the blue and green colors characteristic of humid areas. Thus, our dry Southwest has been well recorded, while the Gulf Coast remains poorly known photographically. For these reasons, successful photos should be taken vertically to encounter least atmosphere.

Uses of orbital photography seem limitless. Perhaps the most obvious is regional geologic mapping of little-known areas. The accuracy of the perspective obtained is invaluable, and even topographical dimensions can be assessed from good quality photos. The status of active volcanoes, glaciers, and potential avalanche areas can be checked. Forest fires, crop and forest diseases, insect plagues, and flood damage can be reported.

On a more theoretical level, knowledge from synoptic terrain photographs may also be applied to ideas of continental drift, the structure of rift valleys, and the study of fault systems.

Hyper-altitude photography first became a possibility after the Second World War when large rockets became available. The first photos of the Earth from space were made by small cameras aboard

***THE EASTERN ZAGROS MOUNTAINS** in Iran. Jagged up-and-down structure at lower right is probably a dry salt lake running for over a hundred miles, the remains of an ancient sea.*

***THE OCEANOGRAPHIC VALUE OF ORBITAL PHOTOC** Hole at left center, the end of a long trough called Ton of the long ridge (Great Exuma Island) is above sea lev Ocean is 40 miles across.*

YNOPTIC TERRAIN PHOTOGRAPHY

***FEARSOME-LOOKING CLOUD FORMATION** at left actually caused no storm damage. This giant whirlpool design was photographed between the Azores and Morocco. The convoluted structures are folded sedimentary rock in the Anti-Atlas Mountains.*

***PHY** appears in this shot of the Bahaman Grand Banks. of the Ocean, is nearly a mile deep while the high point Fifteen-mile furrows were caused by erosion. Tongue of the*

a V-2 rocket in 1946. These indicated the potential value of such work, and some of the best high-altitude photos taken to date have been made by sounding rockets. Since Goddard scientists Robert C. Baumann, Leopold L. Winkler, and Otto Berg were responsible for some of these Viking pictures, the Center's experience in space photography dates back to the early 1950's.

The beginning of orbital photography in the broad sense came with TIROS I on April 1, 1960. However, photographs which are transmitted back to Earth, as TIROS and Nimbus weather pictures, lose considerable detail, and though their value has been proven countless times, their resolution cannot match that of film which can be returned to be processed.

The first film was returned by Mercury-Atlas 4 in September, 1961, including good records of some 450,000 square miles of North Africa which have been used for geologic mapping by McGill University. Dr. Lowman saw these photographs in 1962 and became immediately convinced of their geologic value. He persuaded other NASA scientists of the value of flying photographic experiments on subsequent manned flights. Terrain photography was attempted on the next three Mercury flights, but clouds and other difficulties intervened.

"MA-9," says Dr. Lowman, "was our first good break. These results were good enough to get us onto Gemini." Part of this success, he observes, was due to the fact that Astronaut Gordon Cooper was an accomplished amateur photographer. Twenty-nine shots, almost all of high quality, were taken even though the spacecraft was in drifting flight.

McDivitt and White on Gemini 4 carried out an experiment that, in Lowman's words, "really broke it wide open. We got a continuous series of nearly vertical shots from Baja California to Central Texas. It was a roaring success—the greatest thing that could have happened to us."

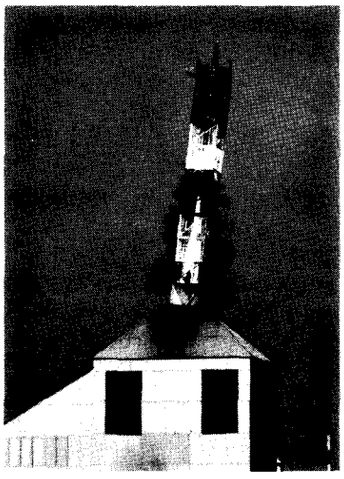
Taking orbital photographs on a regular basis is not easy. For best results, one man must remain at the controls making repeated fine adjustments to maintain orientation, while the other is taking pictures.

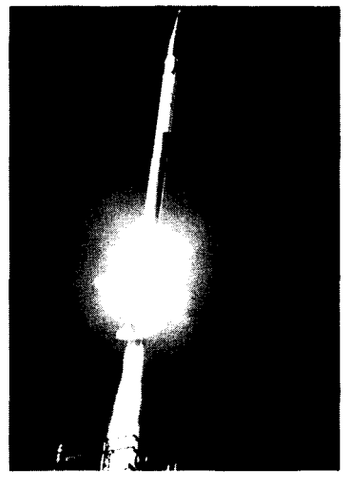
Though Gemini V ran short of fuel for orienting the spacecraft, many of the pictures returned were "stunningly good." GT-6, though aloft for only 24 hours, did "far better than expected." GT-7 had window visibility problems but obtained some good photos; GT-8 and GT-9 did not carry a formal photographic experiment, though the latter came back with the first good series of terrain shots of South America. GT-10 had more window trouble as well as docking problems and fuel shortage which detracted from photographic efforts. The GT-11 mission, scheduled to begin Friday, will attempt to duplicate photographically the perspective of Nimbus II, taking terrain photos from an altitude of 750 miles.

(See Page 6)

***JOSE TORO, HERB TIEDEMANN, AND PAUL LOWMAN** examine one of the hundreds of terrain photographs that have been taken by American astronauts. Map of the world provides appropriate backdrop as inspiration for the future.*

AEROBEE. . . *from page 2*





***OFF AND AWAY!** This unusual sequence of shots was taken by an automatic camera at Wallops Island, Virginia, as the second successful Aerobee 350 began its mission. Shot at left shows rocket emerging from launch tower about a second after ignition; in right-hand picture, the 350 blasts free roughly two seconds into the flight with both engines blazing. Nike lower stage dropped away almost immediately after picture was taken.*

***PRINCIPAL FIGURES** in the success of the Aerobee 350: left to right, Assistant Project Manager Francis M. Collins, Jr.; Instrumentation Systems Manager C. Donald Tackett; Project Manager John H. Lane; and Mechanical Systems Manager James S. O'Brien.*

major problem on the recent flight was making all the experiments compatible. With new engineering and fabrication of this kind, you even have to monitor the monitors. This is the only way to be sure if the data can be trusted." Many interference problems had to be solved before the mission could fly, especially since most of the experimental gear was radio sensitive. Important monitors were those observing flight dynamics, the propulsion system, and the temperature environment around the payload to help plan for future experiments.

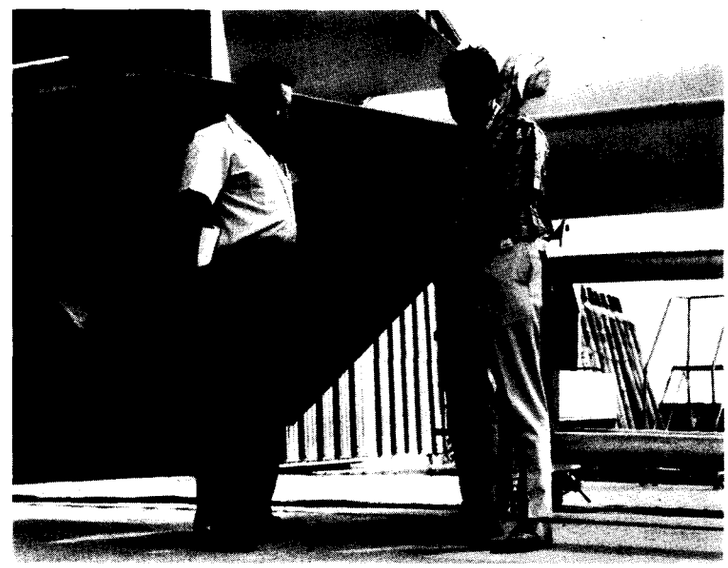
Two of the three experiments were run by Goddard. One, controlled by James Guthrie, yielded information on the behavior of a dipole antenna in the environment of the ionosphere plasma. One reason for doing this is that if accurate corrections are to be made for the environmental static effect on the Radio Astronomy Explorer, to be launched early next year, the phenomena that will be affecting it must be as thoroughly documented as possible. Though there have been attempts to simulate a plasma environment on earth (a plasma is a field of charged particles with a net charge of zero), such problems as scale and accurate regulation have not been solved.

The other Goddard experiment, under Dr. Henry Horstman, monitored X-rays from the sun and other sources in the energy range of two to twenty thousand electron volts. The detection device could not be pointed continuously at the sun because of the rocket's spin rate, but nevertheless obtained about 8½ minutes of useful data, roughly one-twelfth of that from the sun. This energy range was chosen because the lower regions have already been scanned with some thoroughness by sounding rockets and satellites, and X-rays of a higher energy occur only during the most violent solar outbursts. The sun is presently building toward maximum activity in 1968-9.

The third experiment was run by Dr. Paul Kellogg and David Cartwright of the University of Minnesota to test for naturally occurring electrostatic short waves in the ionosphere.

"This was a preliminary experiment," said Dr. Kellogg, "and we're generally happy with the results. Eventually, we plan to fly into the shock wave of the earth's magnetosphere. We'll want to measure electrostatic waves there which I think play a major part in shock wave structure and behavior."

Development of a land recovery system for 350 payloads has been initiated for use at White Sands Missile Range, where a new launch tower adapted to the 350 will be built. As a further refinement for the experimenters, an attitude control system will be added to allow radiation and other measuring instruments to be directed toward specific corners of the sky.



***WALLOPS ISLAND's** Harry Bloxom, Aerobee Launch Pad Supervisor, meditates with Project Manager John H. Lane before the test flight. Rocket will now begin service as scientific workhorse.*

PHOTOGRAPHY. . . *from page 5*

Proponents of synoptic terrain photography have had the satisfaction of realizing that it is not a passing fad. More and more people are proclaiming its uses as applications become more apparent.

Of greatest interest at present to geologists is the possibility that several synchronized cameras will be carried on Apollo spacecraft in the future. This experiment would cover all of the visible light wave lengths and a little of the infrared. Because each camera is to be limited in its coverage, i.e., one may include the red and yellow wavelengths, another blue, another green, another purple, and another infrared, it will be possible to overcome the difficulty of scattering in one wave length region, as happens over humid areas of the Earth.

"As far as I can see," says Dr. Lowman, "terrain photography can go nowhere but up—and that's not a pun. This Apollo experiment is of great importance indeed, and we look forward to manned flights specifically for this purpose.

Goddard Scientific Colloquia

COMMITTEE ANNOUNCES 1966 FALL SERIES

Dr. John F. Clark, Director of the Goddard Space Flight Center, will be the first speaker in the 1966 Fall Series of Goddard Scientific Colloquia and will talk on "Scientific Research at Goddard: Views and Discussion." The colloquium is scheduled for 4 p.m. on Friday, September 9, in the Auditorium of Building 3. Due to limited space, this location will be reserved for the Goddard scientific staff and other members of the Washington scientific community. Administrative and other staff members who wish to attend are requested to go to one of the following places where the colloquium will be carried by closed circuit TV: Bldg. 8, Auditorium; Bldg. 7, Rm. 231; Bldg 3, Rm. 200; Bldg. 6, Rm. C206A; Bldg. 8, Management Information Center. Additional locations may be arranged by contacting the Committee Secretary, Mrs. Dolores Reeves, X-5213.

Colloquia are open to anyone from the Center or from the Washington scientific community. They are scheduled and organized by a committee composed of representatives from the Laboratory for Space Sciences, the Laboratory for Atmospheric and Biological Sciences, and the Laboratory for Theoretical Studies. Members of the committee this year are William Bandeen, Dr. Elihu Boldt, Larry Brace, Jaylee Burley, Dr. David Fischel, Dr. Richard Goldberg, Dr. Frank Jones, Dr. Gilbert Mead, Dr. Ernest Ray, Dr. David Stern, and Dr. Masahisa Sugiura.

The entire 1966 Fall Series is listed below.

9/23 Professor Russel von Eshleman, Center for Radar Astronomy, Stanford University
BISTATIC RADAR ASTRONOMY

9/30 Professor Richard M. Goody, Director, Blue Hill Observatory, Harvard University
DYNAMICAL NOVELTIES ON THE ATMOSPHERES OF MARS AND VENUS

10/7 Professor Leonard I. Schiff, Executive Head, Physics Dept., Stanford University
THE EXPERIMENTAL BASIS OF GENERAL RELATIVITY

10/14 Dr. Francis S. Johnson, Director, Earth and Planetary Sciences Laboratory, Southwest Center for Advanced Studies
THE STRUCTURE OF THE LOWER THERMOSPHERE

10/21 Professor Leverett Davis, Jr., Norman Bridge Laboratory of Physics, California Institute of Technology
THE INTERPLANETARY MEDIUM

10/28 *The John F. Lindsay Memorial Lecture*
Professor Bruno Rossi, Physics Dept., Massachusetts Institute of Technology
(Title to be announced)

11/4 Dr. Joanne Simpson and Dr. Robert H. Simpson, Environmental Science Services Administration
EXPERIMENTS ON TROPICAL HURRICANES

11/11 No Colloquium—Veterans Day

September 9, 1966
Building 3 Auditorium, 4:00 p.m.

Dr. John F. Clark, *Director, GSFC*
SCIENTIFIC RESEARCH AT GODDARD: VIEWS AND DISCUSSION

Current scientific problems facing the Center and some thoughts on its future will be discussed. There will be an opportunity for an extensive question and answer period.

September 16, 1966
Professor Robert Adair
Physics Dept., Yale University

QUARKS

Quarks are the fractionally charged entities that could form the basis for all elementary nuclear interacting particles. The fundamental symmetry that led to their formulation will be introduced, and some experimental consequences will be discussed.

11/18 Donald Beattie, Office of Manned Space Flight, NASA Headquarters
POST-APOLLO LUNAR EXPLORATION

11/25 No Colloquium—Thanksgiving

12/2 Professor William M. Kaula, Institute of Geophysics and Planetary Physics, University of California at Los Angeles
THE GRAVITY FIELD OF THE MOON

12/9 Professor George Herbig, Lick Observatory
(Title to be announced)

12/16 Professor W. D. McElroy, Director, McCollum-Pratt Institute; Chairman, Biology Dept.; Johns Hopkins University
BIOLUMINESCENCE

12/24 No Colloquium—Christmas

12/31 No Colloquium—New Year's

Movie On Model Rocketry Filmed At Goddard

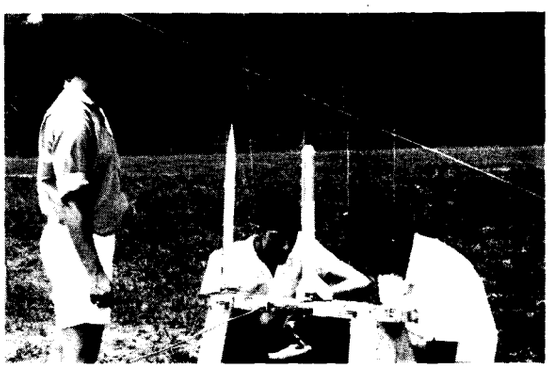
Goddard took on the atmosphere of a Hollywood movie set at the Antenna Test Range when a TV camera crew showed up August 10 to make a video-taped movie on Model Rocketry.

WETA (Ch. 26) is producing a 26-minute kinescope in conjunction with the National Educational Television Network (ETV) as part of the popular "What's New?" program series. This movie will be made available later this year for distribution to more than 100 member stations.

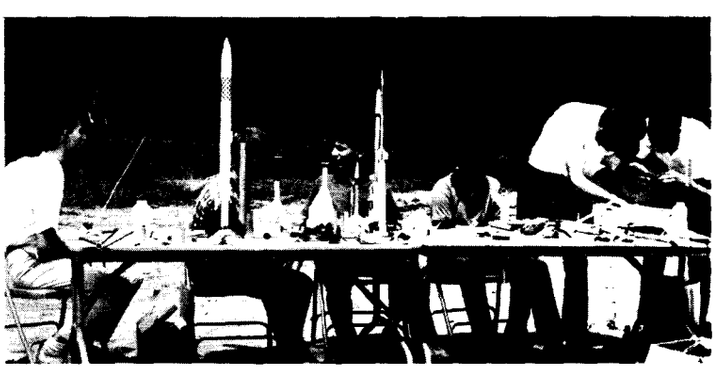
The day's shooting took place on the ball diamond at the Goddard Antenna Test Range. Youngsters from two local model-rocket clubs provided the equipment and the enthusiasm. Several members of the Youth Opportunity Campaign, working at Goddard this summer, acted as extras on the set location. Jim Solt was the WETA producer-director with John Robbins the narrator and host. John Nowakowski of Howard Galloway's "Star Spangled Banner" section of the National Association of Rocketry (NAR), carried a major responsibility on camera, in explaining the rewards and challenges of model rocketry.

Mr. Robbins pointed out that John's performance in the resource role was the finest he had ever seen.

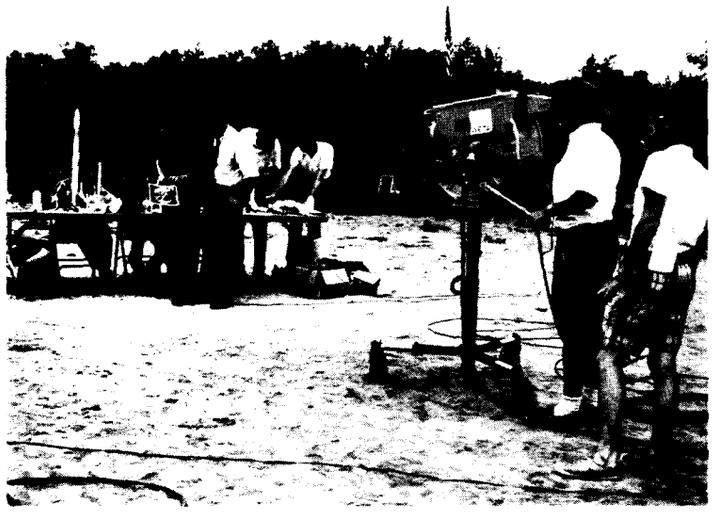
The tape is designed to introduce teachers and their students to the newest space age educational tool and hobby, model rocketry, which provides new vistas of adventure in exploring photography, mathematics, physics, electricity and aerodynamics! An example of one educational sequence on the tape was the egg-gravity experiment. Fertile eggs are launched at forces up to fifty-three G's. Recovered by parachute unbroken, the eggs are incubated and hatched to determine the effect of gravity extremes on embryo development. The whole operation had NAR Executive Secretary Jim Kukowski "up a tree," recovering rockets.



LAST-MINUTE CHECK of the rocket ignition system by Kathy Maxen, Carl Kratzer, and Jim Kukowski, insured a high degree of launch reliability with only one misfire in over 20 shots.



ROCKET CLUB MEMBERS must work at the job of looking busy as the TV camera shoots footage of a model rocket meet. Left to right at table—Mike Meerdter, Paul Guercio, Jim Glass, Barry Kukowski, Jim Kukowski, and Carl Kratzer.



TELEVISION CAMERA moves in for a close-up of an aerial photograph as John Nowakowski explains the model rocket camera to the show's host, John Robbins.

Safety is emphasized as the most unique feature of model rocketry. The rockets are constructed of paper tubing, balsa wood, and plastics, with screw eyes and fasteners the only metal parts. The high strength and low weight of the materials enables modelers to make exacting scale models of sounding rockets and rocket gliders which have the high performance capability of their prototypes. The solid-fuel engines are commercially manufactured. They are consistent, reliable, and so safe that they are accepted by the Post Office Department for mailing. Rockets are launched electrically and contain recovery devices such as parachutes which return the rockets safely. Some model rockets have been flown as many as 100 times.

The last 3 minutes of the video tape took over two hours to record. Camera crewmen found it difficult to track the rockets as they zoomed from their launch pads at speeds of over 400 mph. Finally at about 5:30 p.m., as 100 softball players patiently waited to begin their games, heavy payloads and small engines slowed down the rockets and the scene was completed. It was a real experience for everyone involved, and as one youngster put it, "It was the most exciting 26 minutes I have ever spent."

For further information on model rocketry, contact the Educational Programs Office, Extension 5572.

RANGE SAFETY OFFICER Howard Galloway looks on as John Nowakowski explains the egg-gravitational experiment to John Robbins while Kathy Maxen stands ready at launch control.