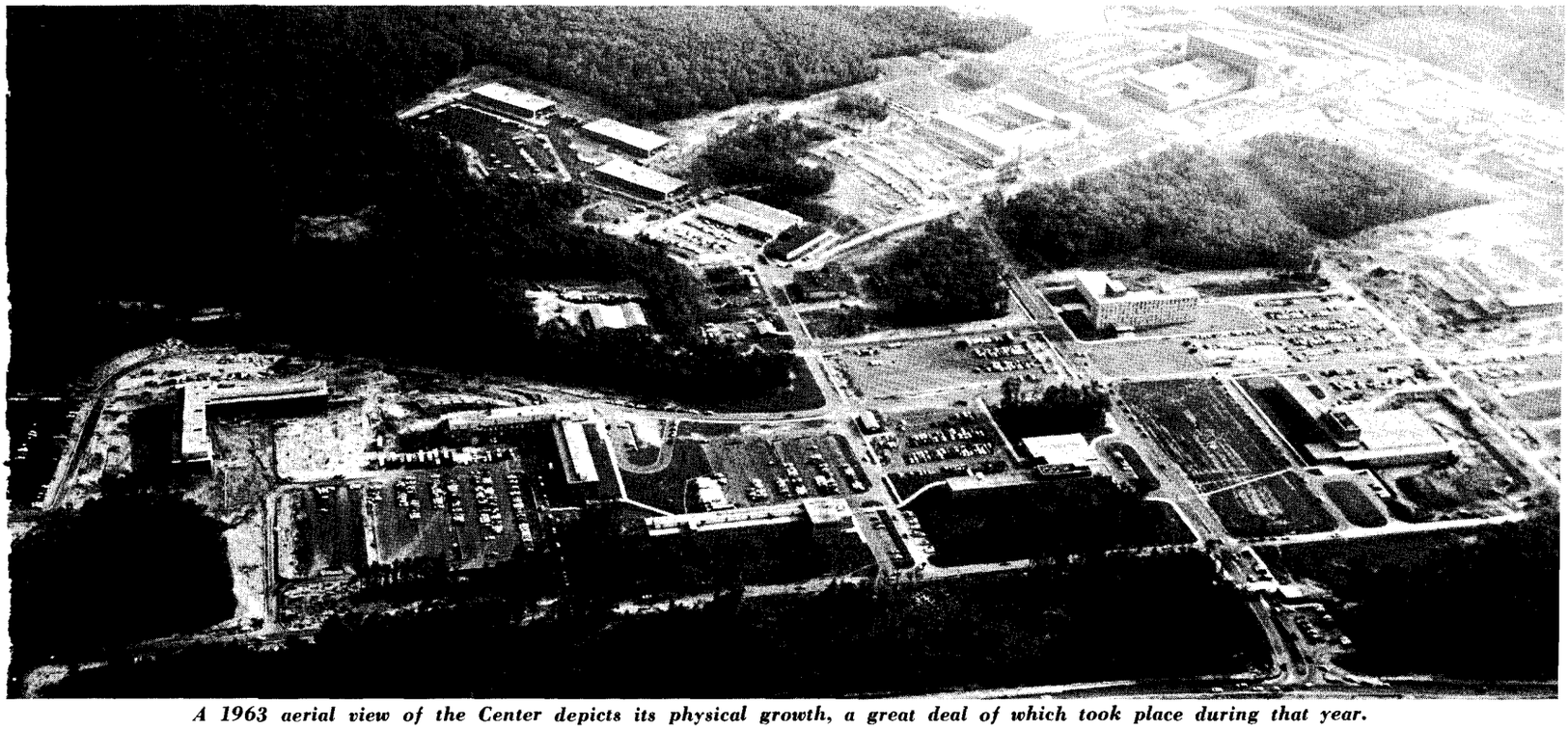
This was Goddard in April, 1959: Just a benchmark and trees.

GODDARD NEWS

VOLUME VI, NUMBER 4 JANUARY 13, 1964



A 1963 aerial view of the Center depicts its physical growth, a great deal of which took place during that year.

Special Issue: 1963 in Review—A Memorable Year

Goddard played a great game in the 1963 World Series of space exploration. Nothing spectacular like having a star player, such as an astronaut, drive in a home run with the bases loaded. Just steady, but hard-driven singles, doubles and triples by ordinary players which didn't bring too many fans to their feet in ovation, but nevertheless, won the ballgame.

Goddard, and other NASA centers, stepped up to the launch pad and successfully completed 14 out of 15 major program launching attempts. Goddard batted in more than half of the runs, eight—and all successful, to be exact. And in the Sounding Rocket League—where some of the best plays were performed—Goddard got off 90 rockets of which 83 were successful, giving an unheard-of 92% record.

The big program launches are now legend, but worth repeating:

- Syncom I, launched February 14, once and forever answered the skeptics that while a synchronous orbit is difficult to achieve, it is not impossible.
- Explorer XVII (S-6) launched April 3 dealt "Doubting Thomases" another blow: A battery-powered satellite can exceed its 60-day lifetime and measurements of neutral gases in the upper atmosphere can be made without contamination from outgassing.
- Telstar II, launched by Goddard on May 7, became another vital communications link.
- TIROS VII, launched June 19, took up its hurricane-hunting role, put out 105 storm advisories and transmitted about 42,000 photographs back to earth by late December.
- Syncom II, launched July 26, again proved it's easy as making home-made pie to achieve a synchronous orbit—if you use the Delta rocket.
- IMP, named Explorer XVIII went aloft on November 26, successfully achieved its highly eccentric orbit of nearly two-thirds of the way to the moon.
- TIROS VIII, first of the APT (automatic picture transmission) spacecraft followed on December 21, treating the world to what could be called "instant weather."

All the above were sent aloft by the tried and true Delta. In addition, Goddard successfully launched Centaur I on November 27, marking the first orbital flight of a liquid hydrogen engine.

Astronaut Gordon Cooper's historic 22-orbit journey brought the NASA Group Achievement Award to personnel of Goddard's manned space flight operations division.

Last year also saw the Center hire 1390 employees, of which 355 were for summer employment. Approximately $8 million worth of new contruction was completed under a master plan.

But final scores or statistics don't necessarily tell the complete story. In this issue of the GODDARD NEWS, each division was requested to list some of its achievements during 1963. A roundup, by division, begins on page 2.

Roundup '63—Communications

When you ask LaVerne Stelter, chief of the **communications division** of the tracking and data systems directorate what the division's crowning achievement was in 1963, he invariably responds:

"Cooper's MA-9 flight—high reliability communications performance for the entire mission."

But he's also quick to add that "it was not NASA people alone who made the system perform so beautifully." He gives due credit to the thousands of skilled engineers and technicians all over the world who "did things far and beyond those actually required or expected of them."

Stelter says some sort of record for sustained good network performance over a prolonged period was set, and that he knows of no other global communications systems that has ever performed so consistently with such an outstanding degree of reliability.

"If a bill were to be actually presented for all of the nice things that people did for us to insure that the Cooper mission was a success, we probably couldn't pay for it. Favors born of dedication are hard to return," he said.

The difficulty during the Cooper orbital mission was not in making the communications system perform correctly for four, five or ten hours, as had been required for previous manned orbital flights. The greatest task was making it perform for 44 hours straight, eight hours prior to the flight; during the actual flight of 34 hours; and for several hours afterwards.

"The probability is always greater that something will go wrong over a 40 to 50 hour period than over a shorter period of time," he explained.

Two major changes were made in the network during the year. A "real-time" Univac 490 digital message switcher was installed, giving solid-state reliability and instantaneous communications on a global basis to both the STADAN (Satellite Tracking and Data Acquisition Network) and the Manned Space Flight Tracking Network.

A new SCAMA (Station Conferencing and Monitoring Arrangement) console was installed which permits any combination of three major NASA network stations STADAN, Manned Space Flight and JPL (Jet Propulsion Laboratory) to converse at any time of night or day by simply pushing the right buttons.

Procurement Returns from Exile in '63

Since more than 90 percent of Goddard's budget is being spent with private industry, it is not surprising that the **procurement division** grew during 1963, just as Goddard grew, in both programs and budget.

The division grew in size also, particularly with financial analysis joining the family, and by the end of the year strength was approaching 270. As for activity, it seems almost unbelievable that the division spent approximately $1 million for every calendar day and placed over 30,000 orders and contracts with hundreds of firms both here and overseas.

One of the highlights of 1963 was the "return" of the majority of the division from its "exile" in Bladensburg to new quarters in Building 8. This was a long awaited event and the benefits are becoming more evident every day, according to division chief Gordon Tyler. In early 1964, the remaining "Bladensburgites" will return to Building 16 and for the first time the entire division will be on the Center proper.

New Methods

The division has been experimenting with various new and different contracting methods since 1961. During 1963, the results of this experimentation began to pay off and Goddard has become known throughout NASA as a leader in developing and using new contract techniques such as "incentive" contracting.

"The credit for these accomplishments belongs to everyone in the division and particularly those who poured out the volume of routine actions which gave time for the others to innovate," Mr. Tyler said.

The new SCAMA board.

GSFC Institute Is 'Think Factory'

Goddard's "think factory"—the **Institute for Space Studies** located in New York City had a busy year of research activities.

Some of the principal areas of research at the Goddard Institute for Space Studies this past year were:

Drs. Albert Arking and Ishtiaq Rasool undertook extensive analyses of the TIROS cloud cover and radiation data. These data can provide an important addition to the information thus far available for gaining an understanding of the causes of weather activity.

Dr. Arking obtained the latitude distribution of cloud cover by analyzing 1500 TIROS photographs for the period July through December 1961, using a semiautomatic process on the IBM 7094 computer. His TIROS results for this six-month period show good agreement with earlier results which required a study of 50 years of ground based data.

Dr. Rasool obtained the net energy balance of the earth and its atmosphere from the TIROS III radiation data. The energy balance drives the general circulation of the winds. It also plays an important role in regional weather distributions.

Further research into the origins of the atmospheres of the earth and Venus is being conducted by A. G. W. Cameron. This work is related to studies of stellar evolution and early phases of the sun's development is being carried out by him in cooperation with Dilhan Ezer.

Management Services Div. Supports Moves

The **management services and supply division,** headed by Herbert J. Fivehouse, can name numerous accomplishments it has credited to NASA's account during 1963. However, there are three that bear major attention.

The first was the assignment of property branch representatives in all major operating divisions to facilitate utilization, maintenance and accountability of equipment as well as more efficient provision and distribution of supplies. The growth of Goddard's equipment inventory to over $40 million was a major factor leading to the initiation of this program.

Following a pilot project, the program was put into full effect last year. During the past five months, it has resulted in savings of at least $374,000 according to Fivehouse.

The second item is the centralization on site of all warehousing and freight receiving facilities. The saving in manpower, time, money and improved service, is obvious.

Thirdly, as responsible organization for the planning and assignment of housing space, the division reports that during 1963 more than 4000 personnel are now housed on site with less than 700 working in leased buildings.

This was accomplished by the opening here during the year of buildings 8, 11, 17, 18, 19, 20 and part of 16.

The division is responsible for accomplishing the moves, and providing support and service after the actual relocation.

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*

Roundup '63—Goddard's Milestones Revisited

Theoretical Div. Stimulates Others

1963 was a rewarding year for Goddard's **theoretical division.** The Physics and Solar Flares Symposium in October attracted some 203 scientists throughout the world and did much to stimulate theoretical thinking.

The year saw the establishment of a geochemistry laboratory in building 4 where John O'Keefe, Lou Walters and Charles Schnetzler are doing research on materials from outer space. Meteorites and tektites are being analyzed by optical spectroscope but later on it is hoped that the laboratory will get samples from the moon and planets. Techniques which will be employed will be x-ray diffraction, electron probe mass and spectrographic.

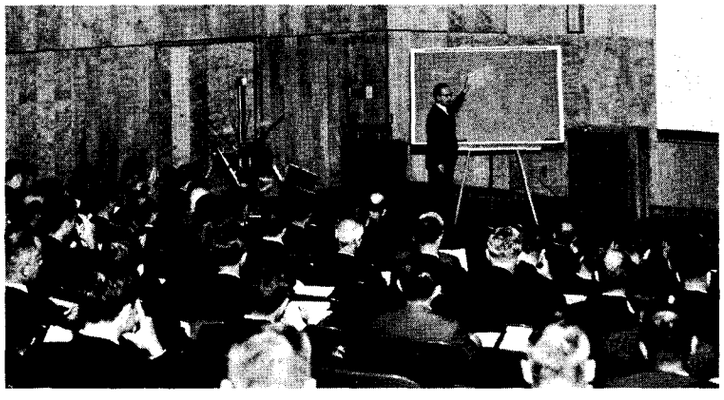
During the year, Winifred Cameron came up with an explanation for the river-like markings, particularly one called Schroeter's Valley, which have been perplexing astronomers for many years. In essence the problem has been to theoretically identify what kind of fluid could create such rills—whether they were created by liquid or gas. Mrs. Cameron contends that a reasonable explanation is that fluidized volcanic ash is responsible.

In the field of celestial mechanics, Dr. Peter Musen has been doing work on planetary and lunar bodies to adapt current, or modified theories to a form compatible for large computer use.

He developed a planetary theory for general perturbations in rectangular coordinates and published a modification of Hansen's lunar theory that is adaptable for computers. He has been assisted by Milton Charnow of the tracking and data systems directorate who has put in many long hours of programming efforts. An application of this theory appears possible in determining general perturbations and possibly orbital predictions of some planets. In another effort, Dr. Musen has been assisted by Arthur Smith of the theoretical division in programming the possible general behavior of highly eccentric satellite orbits in deep space over a 10 to 15 year period.

Dr. Gilbert D. Mead has constructed a theoretical model of the solar wind bouncing off the earth's magnetosphere. This new theoretical description should be of particular benefit to scientists in permitting them to make more accurate calculations and perdictions of the effect of the solar wind on the trapped particles in the radiation belts and magnetic field lines of earth.

Data operations branch head James Donegan during MA-9.



Hundreds of scientists attended theoretical division's Solar Flares Symposium late in 1963.

TID Opens New Library

Goddard's library is now one of the finest in the area.

Goddard's **technical information division,** charged with in-house printing services, photography, library services and preparation of technical reports, put out a record volume of material during the past year, according to division chief Don Hutchison.

The division made some 42 million printing impressions; took 38,000 feet of engineering motion picture footage in support of Goddard projects, plus an additional 30,000 feet of documentary film.

Some 150,000 still prints were furnished and 120 technical reports were issued. A contract is being negotiated for the purchase of 65,000 volumes of library material which should make the library one of the best equipped in the area.

Global Tracking Wins NASA Award

Personnel of the **manned flight operations division** were justifiably proud when Administrator James E. Webb singled them out for praise with the NASA Group Achievement Award for the MA-9 mission. But to a man, the division is even more proud that through their efforts the global tracking and data acquisition network functioned almost perfectly for some 44 hours, and Astronaut Gordon L. Cooper was able to successfully complete his 22-orbit globe-girdling mission.

Cooper himself described the significance of this achievement of the division, headed by Niles R. Heller, when he spoke at the Mercury Program Summary Conference in Houston, last October:

"It is certainly comforting to know, when you are out there, that the world's finest communications network and the finest electronic facilities that man can devise are functioning with a fantastic computer complex that will allow the on-board systems specialists to break out their diagrams and tell you immediately what your situation is in the event of trouble. . . . Without this marvelous organization, it might have been a little more than difficult to get back home. . . ."

Besides the Cooper mission, the division was assigned other major tasks during the year. One was to change or modify the manned global network to meet different mission requirements posed by the Gemini manned flight mission. To meet tracking and data requirements of Gemini-Agena, a dozen new major systems and many more subsystems were planned, designed or installed.

The division was assigned the responsibility for implementing instrumentation for the upcoming Apollo program, and had to plan and implement NASA's first dual-purpose tracking station at Carnarvon, Australia. At this station, the first equipment will be used in manned space flight missions with ground systems for scientific spacecraft being installed later.

T. S. Johnson and H. D. Matthews of optical systems inspect a LASER device.

Advanced Dev. Has Busy Branches

The future requirements of communication with spacecraft is the responsibility of the **advanced development division** of the tracking and data systems directorate which has a number of development projects in process.

Antenna Systems Branch

During the year, the branch completed one phase of a continuing study of phased array antennas. This study provides a precise basis for analyzing a large class of antenna problems and will make possible the determination of numerous antenna array characteristics. Additionally, the 1963 effort will permit more advanced investigations related to multiple beam antennas.

Development of a portable, solid-state Dicke radiometer weighing only 60-pounds that fits into a pair of suitcases was accomplished. The device can easily be transported to remotely located space data acquisition antennas. This should permit further improvements to reduce antenna noise, allowing the "listening" range of typical antenna systems to be greatly increased.

A feasibility study for the development of a new precision mounting to support and move a laser satellite tracking device was completed.

Extensive studies into the complexities relating to the design of a multiple aperture antenna system were pursued. The system uses several smaller size antennas in such a way that when separate signals received by each antenna are combined, their signals add up to develop the same characteristics as that of one antenna with a surface area equivalent to the sum of all the smaller surfaces.

A greatly simplified antenna feed system was developed which uses spiral antennas with a simultaneous improvement in frequency coverage.

Space Electronics Branch

A PCM telemeter was flown in the Atmospheric Structures Satellite S-6. It was the first PCM telemeter to be used in a Goddard scientific satellite and was conceived, designed and fabricated as a joint in-house and contract effort.

A redesign of the 136-mc transmitter flown on S-6 was completed. Mechanical integrity was improved by dip-braze fastening of all interior partitions to the case.

Branch personnel provided engineering services and flight TV hardware in support of the A-12 Echo project. TV cameras and transmitters were provided and checked-out as a system here.

A study was initiated and completed for the purpose of determining optimum code patterns for frame synchronization of PCM telemetry ground receiving equipments with the spacecraft telemeter, and to provide a means to evaluate the degree of performance of any proposed code pattern.

RF Systems Branch

In 1963 the branch completed the development and integration into the 85′ and 40′ data acquisition facilities of a new family of unique calibration signal generators and boresight sources operating in the three frequency ranges employed by these stations.

A phase demodulator was developed and installed in the field which performs close to the theoretically optimum and yet is simple to operate. With this equipment, readable signals are being obtained from the IMP spacecraft even though the received signal level at ranges exceeding 200,000 miles is only about −145 dbm. This is less than one millionth the signal level television receivers conventionally require.

A maser amplifier was developed with 80 db of gain in the surprising structural length of only three inches. These results have been achieved through the use of Rutile crystal.

Development and fabrication of completely field operational multi-channel, solid-state, and electron beam parametric amplifiers for use in the Goddard 85 foot antenna stations was accomplished during the year.

Sophisticated monopulse autotrack receiving systems, used to automatically point the antennas toward the spacecraft for optimum data acquisition, have been developed which meet predicted theoretical performance. The radio star, Cassiopeia, was autotracked at 1700 Mc, using the 85 ft. dish at the Fairbanks, Alaska site, in spite of the extremely low flux density at this frequency.

Optical Systems Branch

Work progressed on a real-time automatic digital optical tracker. Mechanical development was completed and accuracy was checked.

A new field-operable, water-cooled pulsed ruby laser was developed in-house for the S-66. The satellite reflector optical properties were measured, and ranging data system was tested with airplane fly-by.

The optical systems branch played host to NASA Optical Communication Symposium.

A precision multi-mode telescope mount was completed and installed in the optical research facility. A 24-inch telescope was designed and is in fabrication.

Television boresight calibration equipment was installed at 5 major data acquisition stations. Mechanical structure and alignment acceptance tests were conducted.

Space Data Control Branch

A PCM/computer data processing system designed during 1962 successfully supported the 1963 Relay operational schedule.

The first PCM wireline transmission and data processing system for S-17 was delivered and installed.

A programming system for the SDS-920 digital computer to be used in the OGO control center has been formulated and partially implemented.

The first OGO command console was completed and loaned to Hughes Aircraft Company for work on the Advanced Syncom project.

Roundup '63—More In

New Division

November 5 marked the first anniversary of the **spacecraft integration and sounding rocket division,** and division personnel can well be proud of their accomplishments during 1963.

Division chief Robert C. Baumann reports that there are many stories that could be told about "each individual's contributions, his problems, his successes, his frustrations, his pride of accomplishment and his team spirit."

The sounding rocket branch, for example, had 90 firings during the year of which 83 were considered total successes, giving a 92 percent record. Ariel I is still operating with one experiment giving data since launch on April 26, 1962. The division can also take pride for its work on the S-6 team that successfully launched the satellite, named Explorer XVII, which performed with 100 percent success. The same holds true for the IMP (Interplanetary Monitoring Probe)—Explorer XVIII launched November 26 and still performing great.

The division presently has 17 major projects and many minor ones. Personnel have readied the S-52 and S-66 for launch, and are now awaiting availability of launch vehicles. The FR-1 French cooperative program and the Italian San Marco project are both proceeding on schedule after several successful rocket flights.

During the year, 19 foreign representatives visited the division for training. Eight came from India, 6 from Argentina, and Australia, England, Spain and Italy each furnished a representative.

Three employees—J. Madey, X. Moyer, and J. Fedor re-

INSIDE GODDARD

GODDARD SPACE FLIGHT CENTER / GREENBELT MARYLAND

JANUARY 13, 1964

New York Employee Displays Talent in Kennedy Portrait

President Kennedy's action during last year's Cuban "missile crisis" was recorded by Theodore Psaropulos, technical science illustrator at Goddard's Institute for Space Studies, through the eyes and hand of a portrait painter. Using as a model an Associated Press photograph showing the late President signing the quarantine order, Ted finished the portrait in six months.

"In this one painting," he explained, "I wanted to show the strength and determination of the President during this national emergency."

The 56-year old Athens-born artist has been painting for 37 years. In this time he has rendered over 500 portraits and landscapes. Ted has been commissioned by interested organizations to paint, among others, former Secretary of State Dean Acheson, the first Secretary of Defense James G. Forrestal, former Supreme Court Justice Felix Frankfurter, one time mayor of New York Vincent Impelliteri, and Fred Haggerson, President of Union Carbide Corp. His paintings hang in galleries and homes in 32 states and 11 foreign nations. Among his many honors he has received first prize for a portrait of two childen exhibited at the Riverside Museum in New York.

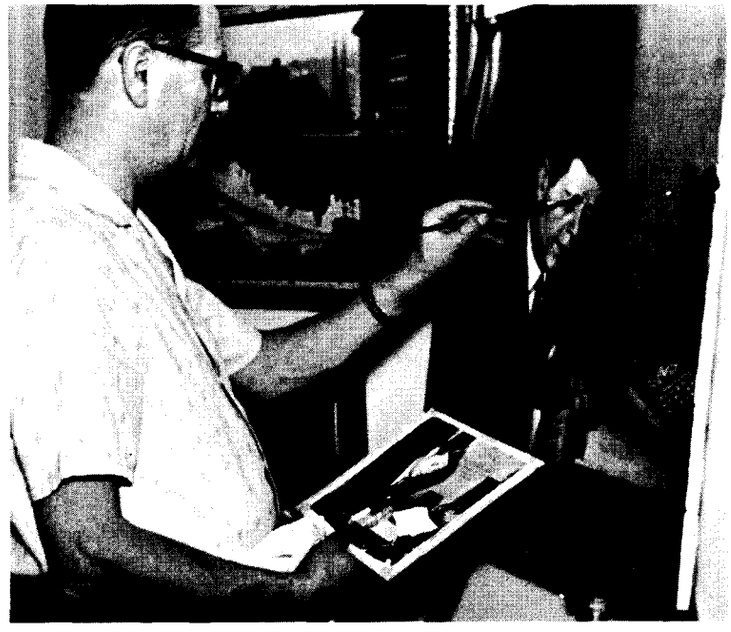
"It takes me about three or four months to finish one portrait—a little less time for a landscape," Ted said. "But since I am usually working on several at one time there is always a painting on the easel."

Ted commutes one-and-one-half hours to Manhattan each day. It is already dark when he returns to his home at 6204 78th Street in Queens. Since Ted paints only by daylight, his current output of four or five paintings a year is all produced on weekends in an 8 by 10-room in his two-story home.

During the past year a major project, which he pursued as a matter of personal interest, has been the painting of the director and the research associates at the Institute.

"It is fascinating to me" he commented, "to paint these scientists whose complicated charts and drawings I work on during the week."

So far Ted has completed four of these paintings and is working on ten others.



Ted is shown working on his portrait of the late President, using an AP photo as a model.

"These paintings are not for sale," he pointed out, "they are my own gallery of the people I work with."

Ted studied painting at Milan under Prof. P. Marinelli, a renowned European artist. At one time he had hopes of a career as a portrait painter.

"But I have a wife and two children," he shrugged. "It is very hard to provide for your family on the spotty income of commissions."

He went on to study electrical engineering at night at Cooper Union and studied technical illustration for two years at New York Drafting Institute. Ted has worked as technical illustrator for the past 22 years, the last two of them at the Institute. Some day, however, he hopes to devote his entire energies to painting on an isolated island in the Aegean Sea.

Above, Ted is pictured with his gallery of some of the Institute's employees that he has painted: Top, from left, Patrick Thaddeus, Hong Yee Chiu, Wolfgang Priester and Jackson Herring. Center, from left, A. G. W. Cameron and Harold Zapolsky. Foreground, from left, Arthur Levine, Myron Lecar, and Robert Jastrow, director, Institute for Space Studies.

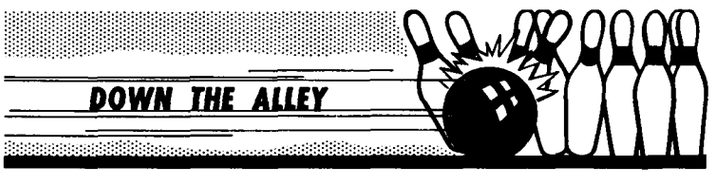
Address Change for Rosman

Rosman, North Carolina, Tracking Station has dropped the Brevard Post Office box address. The correct mailing address for the Rosman Data Acquisition Facility should now be Post Office Box 838, Rosman, North Carolina.

Dear Sir, Dec. 7/1963

I would like some ~~infom~~ information on space and pictures of rockets and astronauts and satellites, and information on satellites and astronauts I'm very interesting in the space program that you are getting out, Thank you,

Everett



All bowling standings should be submitted one week prior to publication.

GODDARD MEN'S TENPIN LEAGUE STANDINGS

Wednesday (As of Dec. 18, 1963)

	W	L
Rabs	35	25
Bandits	34	26
Outcasts	33+	26+
Gubaths	32	28
Quiet Ones	32	28
Rackets	30	30
The Junto	29+	30+
Snakeyes	29	31
Vibrators	28	32
Rattfinks	26	34
Keglers	26	34
Boxcars	25	35

Thursday (As of Jan. 3, 1964)

	W	L
Pinspallers	39	21
Gutterballs	37	23
Kiboshers	33½	26½
Marvelous Ones	33	27
Longshots	33	27
Tartars	31½	28½
Old Goats	31	29
Spoilers	31	29
Fink's Grp.	30	30
Hi Lows	28½	31½
Guided Muscles	27	33
A&M PM's	27	33
Bad Risks	27	33
Fat Sparks	26	34
Markers	23	37
Manywatts	22½	37½

GODDARD MIXED TENPIN LEAGUE STANDINGS

Tuesday (As of Jan. 7, 1964)

	W	L
Apaches	41	19
Twiggits	38½	21½
Alley Cats	36½	23½
Orbiting Elements	35½	24½
No Names	35½	24½
Ichi-Bans	35	25
Elites	35	25
8-Balls	34	26
Mor-Wood	33	27
Scatterpins	31	29
Full House	29	31
Alley-Ops	21	31
Imps	26	34
Spouses	26	34
Split Fits	22	38
Zooms	20	40
Lucky Five	19	41
Team No. 17	15	45

GODDARD MIXED DUCKPIN LEAGUE STANDINGS

Thursday (As of Dec. 19, 1963)

	W	L
Tick Tocks	29	16
Safety Pins	27	18
Woodchoppers	25	20
Moon Pilots	25	20
Astronauts	25	20
Meteorites	25	20
Bob Cats	25	20
Wombats	24	21
Starliters	22	23
Thor Heads	22	23
Syncoms	18	27
Satellites	18	27
Space Katz	15	30
Strikers	15	30

An Opportunity to Save By Bonds

All Goddard employees will be provided an opportunity to participate in the Payroll Savings Plan, when the second phase of the Pay Reform Act of 1963 becomes effective this month.

Goddard's percentage of participation, which is 30.9%, is substantially below the total NASA average of 41.3%. The average participation for the entire Federal Government is 41.3%.

Bond savings can help to finance a new home, provide security and pleasure when working years are over, and build up a reserve for emergencies. They also help the Treasury to manage the national debt in order to protect the value of our dollars and ensure the greatest benefits for all Americans.

Application forms will be distributed with all pay checks on January 24. Completed forms should be mailed to the payroll office, Code 212. For those already enrolled in the Payroll Savings Plan, who wish to increase their allotment, forms will be available in division and staff offices.

For further information regarding the Payroll Savings Plan, call the payroll office ext. 5141.

Toothpaste Tale

Astronomers looking into the sky one night noticed that a baby planet had broken out of the orbit of its mother sun. The little planet darted about in elliptical, spiral, elongated and circular orbits—in and around other planets it zoomed. "Junior, come back," said the mother sun. Finally, Junior came zipping back close to its mother, proudly exclaiming: "Look, Ma, no gravities!"

Goddard Welcomes

Harry K. Charles
Organization & Personnel Div.

Carol L. Cogar
Financial Management Div.

Marion Craig
Technical Information Div.

William A. Mecca, Jr.
Procurement Div.

Carroll H. Clatterbuck
Spacecraft Systems & Projects

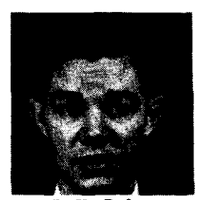
Charles G. Dan, Jr.
Test and Evaluation Div.

John K. Jackson
Network Engineering & Operations Div.

Loretta R. Davis
Network Engineering & Operations Div.

Roger A. Mattson
Spacecraft Systems & Projects

Warren L. Jackson
Network Engineering & Operations Div.



S. K. Dolan
Spacecraft Systems & Projects Div.

D. J. Hershfeld
Test & Evaluation Div.

ıovations per Individual

Space Sciences Discovers Comet

Among the scientific accomplishments of the **space sciences division** during 1963, according to division chief Dr. Leslie H. Meredith, are the following:

The solar eclipse expedition discovered the existence of a comet near the sun. This was interpreted as showing that there are probably large numbers of small comets. (Donn, Dossin)

Analysis of nuclear emulsions launched during solar flare events gave the relative flux of the various types of heavy solar cosmic rays. The measurements have led to new estimates of the solar composition. (Fichtel, Guss, Biswas, Waddington)

Satellite counter measurements showed that solar cosmic ray beams can be long-lived. On some occasions the beams were still present after a complete solar rotation. (McDonald, Desai, Bryant, Cline)

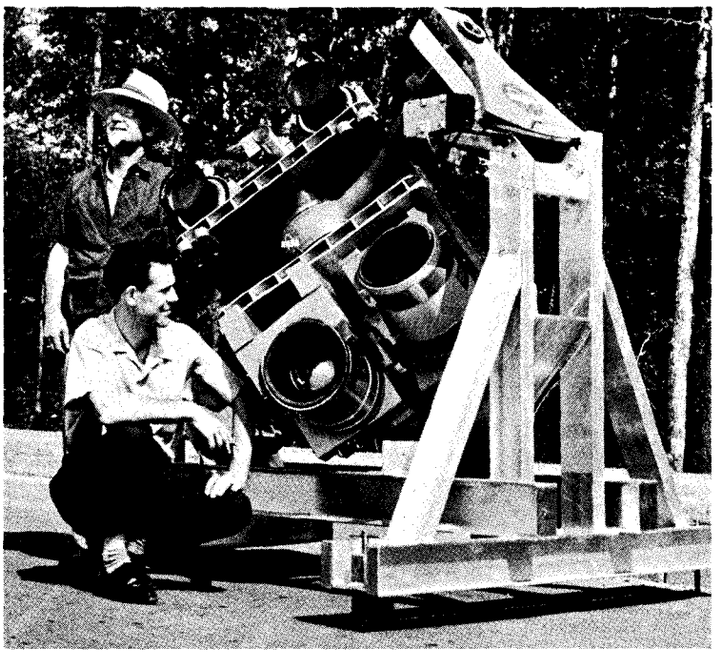
The micrometeorite flux in deep space was found to be several orders of magnitude less than near the earth. (Alexander, McCracken)

Simultaneous rocket-borne measurements of solar radiation and the ionospheric electron density provided strong evidence that Lyman Alpha produces the normal D-region. (Aiken, Kane)

The theoretical predictions of Bauer of the shrinking at night of the helium ion region in the upper ionosphere was verified. (Bourdeau, Donley)

Explorer VIII results showed the existence of a pronounced sunrise effect in the diurnal variation of electron temperature. (Bourdeau, Donley)

The relative importance of chemical and diffusive equilibrium to the altitude distribution of the light ionic ionospheric constituents was demonstrated. (Bauer)



Luc Secretan and Francois Dossin, space sciences division, used this device, fabricated at Goddard, to discover a new comet.

A strong correlation was found between the frequency of whistler occurence at satellite altitudes and magnetic field disturbances on the earth's surface. (Shapiro, Stolarik, Heppner)

Explorer X provided the first direct measurements demonstrating the existence of a geomagnetic cavity. The measurements also showed a direct correlation between changes in the solar wind magnetic fields and the world-wide field changes at the earth's surface. (Heppner, Ness, Scearce, Skillman)

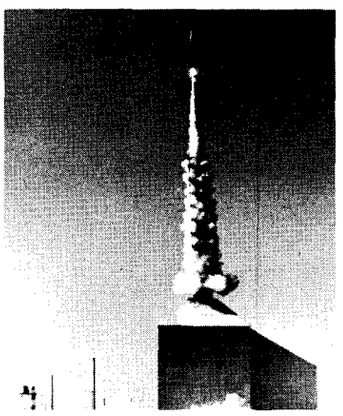
A slowly-varying component was observed in the solar X-ray flux that correlates with the slowly-varying component of the 2800-Mc solar radiation and with the plage (a bright region on the sun often associated with sun spots) activity. It is evident that plages are the major source of solar X-rays for relatively quiet sun conditions. The X-ray flux from the sun was found to be quiet variable. Out of several hundred hours of observation only six hours were found in which the X-ray flux did not vary by more than five percent. (White)

The first Orbiting Solar Observatory measured variations in the extreme ultraviolet radiation from highly ionized atoms. These enhancements, due to plage activity, were larger than those observed during flares that occurred during the observational period. (Neupert, Behring)

ɜats .920 in '63

ceived patent awards totaling $1900 and Eleanor Pressly won the Federal Woman's Award for 1962. Mr. Baumann and Joe Shea received quality increases and D. Krueger received a Superior Performance Award.

The division authored 15 NASA Technical Notes and personnel gave lectures covering a wide variety of topics. Eighteen patents were applied for.



Goddard's sounding rocket program batted .920 in 1963.

Six New Buildings Completed

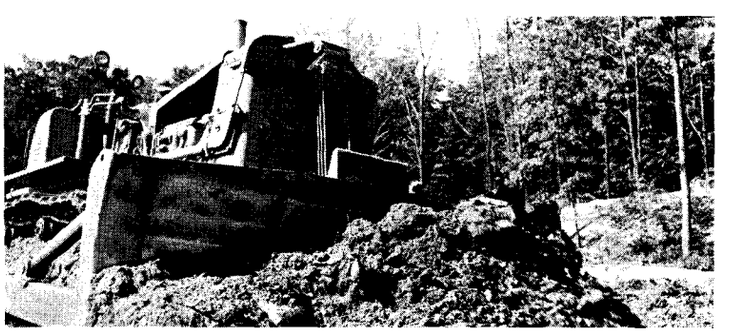
Approximately $8 million worth of new construction was completed at Goddard by the Center's **facilities engineering division** during calendar year 1963.

This includes six new buildings, five of which are completely occupied. One of those occupied is building 11, the Applied Sciences Laboratory. Others include buildings 16, 17, 18, 19 and 20—all multi-purpose buildings with laboratory and office facilities.

On the drawing board is Goddard's new Meteorological Systems Development Laboratory.

The rapid expansion at Goddard over the past year has required considerable work in the area of special projects. This included installation of the Nimbus Data Handling Facility in building 3. Other work of this class included building modifications to facilitate the shifting of Goddard employees as new buildings were completed.

The year also saw the intiation of a master site study to insure that the Center's expansion proceeds in a logical manner as requirements change.



Building after building saw completion and occupancy.

According to division chief N. Phillip Miller an automatic data processing system has been established in his division to keep track of ever-increasing work requests. This system reports on where the requests are and what is being done with them at two-week intervals.

Financial Roundup is Impressive

During the past year, an improved system became operational in the **financial management division** for processing financial and procurement transactions and for reporting status. The system is superior to previous systems in accuracy, quantity, and time-processing. Three principle reports are produced:

- Research and Development Direct Program Status Report
- Administrative Operations Division Status Report
- Procurement Control System

The Research and Development Direct Program Status Report provides top management (to the project manager level) information on funds allocated for each task under his cognizance, the available balance for each task as of the date of the report, commitments which have not been obligated, obligations, and disbursements.

The Administrative Operations Division Status Report provides the same type of information to Goddard functional managers from assistant directors through branch level on items pertaining to administrative operations.

The Procurement Control System provides a listing of all procurements in process, indicating detailed status such as the nature of the last procurement action, the date it was accomplished, the responsible negotiator, the forecast date of obligation, etc.

These reports are produced bi-weekly and distributed to management within two working days after the end of the reporting period. In addition, the financial management officer, and other key members of management receive a daily report of transactions and status.

The system has resulted in improved management and more effective utilization of manpower through better information. It provides more flexibility and responsiveness to changing circumstances. It pinpoints procurement delays and other problem areas and permits prompt corrective action.

The overall result is better control of programs through accurate and timely information and represents a vital step in the continuing improvement of the financial system.

In addition, the following functions have converted to computer application:

- Payroll, leave, bonds
- Cost accounting—obligations, commitments, and disbursements
- Equipment accounting—types of equipment, quantity, models, locations, etc.
- Inventory—materials and supplies
- Personnel accounting
- Manpower utilization report.

Carl Walch points to tape recorder designed by the spacecraft technology division.

Fab. Says, 'We Make Anything!'

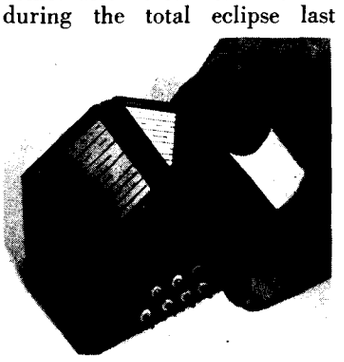
The primary function of the Goddard **fabrication division,** headed by Maurice Levinsohn, is to provide highly specialized manufacturing services required to support the Center's mission of the peaceful exploration of space. This includes the fabrication of the so-called "black boxes," satellite components and ground support equipment.

In addition to the manufacturing support, the division also furnishes product analysis and design services, fabrication process development, quality control, inspection and metrology, and planning services.

The division is well staffed and equipped to perform all these services, as evidenced by its performance during the year just past.

During 1963, fabrication developed a floating-head optical device for polishing an elliptical electroform master. This new process, which can maintain critical tolerances, should have wide application in the manufacture of highly-polished non-spherical devices.

The division built the unusual camera assembly that was used to photograph a faint comet discovered near the sun during the total eclipse last July. The division was able to build it at a relatively low cost since it used a truck rear axle as part of the camera mounting.



This digital solar aspect sensor was built at Goddard.

Fabrication also built special torroidal-shaped mirrors which were used in a research project to photograph the sun's corona in ultra-violet light. The division developed interlocking dovetails on wave guides to facilitate dip brazing for components used on the Relay project.

In the field of special tooling, fabrication personnel developed a long-reach milling attachment that can machine multiple v-groves inside a copper cylinder. This cylinder was used in laboratory apparatus. To fulfill another special tooling requirement, division personnel came up with equipment to machine guide tubes for the magnetometer used on the IMP spacecraft and developed magnetometer tubes for the satellite that do not out-gas.

The division also furnished special tooling to modify a new vacuum optical bench in the test and evaluation area.

As another example of furnishing superior workmanship, fabrication developed F.8 parabolic mirrors for the stellar spectrophotometer which is being used on the S-17 OSO project, and manufactured various optical aspect sensors for numerous in-house projects.

The fabrication division also continued investigations to determine the degree of magnetism of many so-called "non-magnetic" materials which, under cryogenic (very low temperature) conditions, do exhibit magnetic properties.

Satellite Parts Are Designed Here

For the **spacecraft technology division** headed by N. Whitney Matthews, 1963 proved to be a year of impressive achievements. Matthews' shop is one of the most unusual at Goddard. Its job—little known perhaps to the outsider—is to carry out applied research and to build satellite electronic and power systems. Overall, the division's 145 electronic engineers and aerospace technologists have as their objective the task of making sure Goddard gets "more data for the dollar" from its satellites.

They did just that last year. Reflecting upon 1963 recently, Matthews singled out three significant achievements which he feels are indicative of his divisions work and its objectives:

- Design and fabrication of the digital data processor for the Interplanetary Monitoring Platform (Explorer XVIII), launched from Cape Kennedy November 26, 1963, marking the first such device flown in a satellite. Design and development of the processor was supervised by Hosea White.
- Development of a range and range rate system for the IMP satellite that has proven extreme accuracy. All work was done at Goddard under Dave Hepler.
- Continued pioneering work in modular tape recorders, including the recorder to be used on the S-52, the UK-US ionosphere satellite scheduled to be launched this year. This work, adaptable to a number of future Goddard spacecraft, is being conducted under P. T. Cole.

Matthews also pointed out that research on satellite batteries and solar cells here at Goddard has paved the way for more reliable power sources for future satellites. Much of this work was done by William Cherry's space power technology branch.

Looking to the new year, Matthews sees continuing progress in his division. Particularly noteworthy, he feels, is work being done on special adhesive and thermo-photo-tropic paints for satellite temperature control. These, he hopes, will be used in 1964, adding still another feather in Goddard's cap of space age achievements.

T & E Breaks Testing Records

For the **test and evaluation division,** 1963 was a busy and rewarding year. According to John C. New, the division handled a full work load while increasing its facilities and improving its capabilities.

During the past 12 months, T&E processed eight spaceflight units, three of which were completed in the record time of 90 days. In addition, the division provided support of eight other spacecraft tested out of house. As a result of this work, ten failure and analysis reports were prepared for use by other NASA centers.

Probably the most familiar new facilities in the T&E laboratory are the Space Environment Simulator (SES) and the Dynamic Test Chamber (DTC), designed to test second-generation scientific spacecraft under simulated outer space conditions.

The SES was completed and tested with the exception of the solar simulator which is presently being installed. This chamber is expected to be made fully operational during early 1964.

The DTC was completed and made operational for mechanical tests during the calendar year. Several spaceflight units have undergone tests in this chamber.

The DTC was further improved with the development of a paper tape controlled programmer to precisely control its test operations. The general purpose programmer already has been used with the IMP and Echo II experiments in T&E.

The operational test facilities of this division were increased by the addition of four 3x3-foot thermal-vacuum chambers and a 6x6x10 and a 12x12x20 temperature-humidity chamber. Another 12x15 thermal - vacuum chamber and a new vibration exciter were made operational. The vibrator will be used to test Agena-type spacecraft in horizontal and vertical directions.

During the past year, much of the groundwork was laid for Goddard's new Launch Phase Simulator, a device which will be used to test spaceflight units and their components under simulated launch conditions. Negotiations have been initiated for the design and construction of this facility.

Last year also saw the establishment of an optical test group at Goddard. Two optical test facilities were made operational by this group for testing optical experiments of the OAO spacecraft series. These are the Low Temperature Optical Facility and the Vacuum Optical Bench.

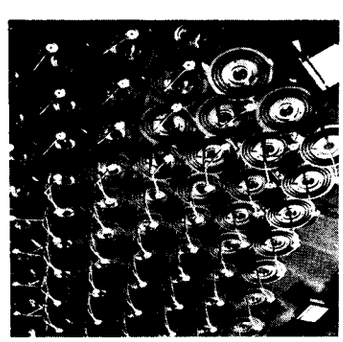
A universal Pulse Frequency Modulator simulator was developed during the last year in T&E to check out ground test stations. These stations are used to receive telemetered signals from satellites.

T&E's effort on the Ariel satellite resulted in the development of a new system for displaying hardline and telemetry data on a single recording chart. This system provides for ready comparison of the telemetry test signal with a standard hardline signal.

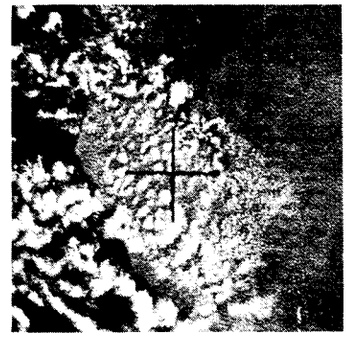
Several foreign nationals were accepted on T&E's staff during the past year to assist them in gaining knowledge of the Center's environmental facilities.

During the summer, the T&E division planned, organized and administered a workshop which dealt with radiation simulation and damage, heat transfer and cryogenic pumping and magnetic environment simulation.

Six senior and five junior faculty members from various universities were brought in to assist in the workshop. They represented Catholic University, Columbia Union College, Georgetown University, George Washington University, Johns Hopkins University, the University of Maryland, the University of Missouri and the U. S. Naval Academy. Eleven graduate students also participated in the workshop.



T&E's solar simulator resembles wound-up watch springs.



Clouds over the West coast of Africa via TIROS APT.

A & M Advances With TIROS, Nimbus

Five major events topped a long list of 1963 space achievements in Goddard's **aeronomy and meteorological division,** according to William G. Stroud, chief of the division.

Heading the list of space feats was the launching and successful operation for 100 days of the areonomy satellite Explorer XVII (S-6). Stroud notes that this satellite has provided the most comprehensive measurements of temperatures, pressures and composition in the altitude region 250 to 900 km, and as functions of geographic location and time of day. In addition, the measurements will serve as a reference in the solar cycle since they will be repeated at a more quiet solar period. The most significant new result has been the computation of the energy absorbed in the high atmosphere using the directly measured parameters of electron temperature and density and the neutral gas temperature.

Another milestone met during the year was the successful integration, test, and qualification of the full Nimbus prototype spacecraft including its control and stabilization subsystem. This 800-pound spacecraft is the largest Goddard spacecraft to have reached this stage of qualification for flight. In addition, the flight controls subsystem successfully passed qualification test and was mated to the flight ring.

During 1963, the TIROS VI satellite set a record for meteorological satellites with 13 consecutive months of operation. TIROS VI, launched September 19, 1962, returned a total of 66,000 pictures to command and data acquisition sites. Data from the satellite permitted more than 2,000 nephanalyses to be prepared, and nearly 300 space advisories to be issued.

The perfect string of TIROS launchings continued during the year with the successful launching of TIROS VII on June 19, 1963. Both TV camera systems and five channel IR systems were properly functioning at the end of the year. The TIROS VII spacecraft provided complete hurricane surveillance during the 1963 season.

The old year came to a bright and happy ending with the successful orbital flight of TIROS VIII. As the sleek, white Delta rocket rose from its launch pad at 4:30 a.m., Dec. 21, three notable accomplishments were inscribed in the record book: When the Delta hurled the 300-pound TIROS into orbit, it marked the 21st straight success for the three-stage rocket; the eight consecutive orbit for the new experimental camera TIROS; and the first flight for called Automatic Picture Transmission (APT).

Seven hours after launch, the first "instant" cloud pictures from space were received at tracking stations in Eastern United States. These pictures showed almost complete cloud cover from the Great Lakes to the Atlantic Ocean, but also revealed land markings of the New York area and south-eastern United States.

The APT camera subsystem, designed for the advanced Nimbus weather satellite, is receiving extensive evaluation aboard TIROS VIII.

This antenna is part of the ground equipment for the TIROS VIII APT (Automatic Picture Transmission) system.

Network E & O Works on 6 Fronts

The **network engineering and operations division,** headed by Clarence A. Schroeder, gives us this report branch by branch:

Network engineering branch: a range and range rate system was built by the tracking section. Successfully tracked Syncom I, Syncom II and IMP spacecraft. Also, completely transistorized diversity telemetry receivers were developed for STADAN.

Field facilities branch: this branch was responsible for the construction of Rosman DAF, construction of facilities at Fairbanks, and for design and construction of telemetry building at Joburg, Santiago and Quito. They also accomplished site survey and construction of mobile telemetry station at Malagasy, site survey and design of DAF in Canberra, and construction of manned flight facilities at Carnarvon.

Engineering support office: this office has negotiated contracts for a 2nd 85-foot antenna facility at Rosman, as well as supporting the first "dish" and the Fairbanks installation.

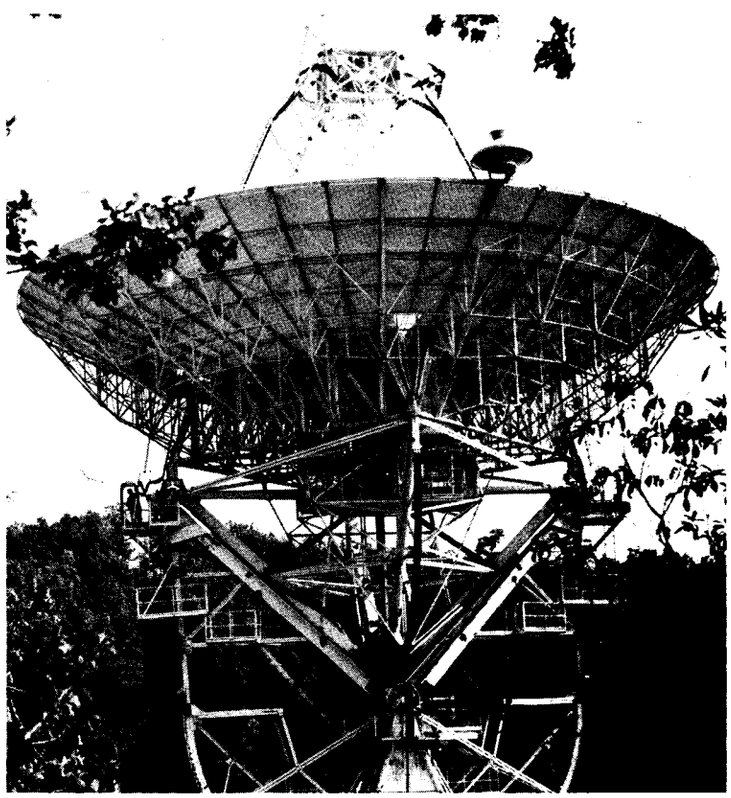
Spaceflight branch: Project operations control centers were established that will provide centralized operations and control facilities to various orbiting spacecraft programs.

The branch has started standardizing documentation procedures which can be utilized by the various spacecraft programs to obtain ground systems support in the T&DS directorate.

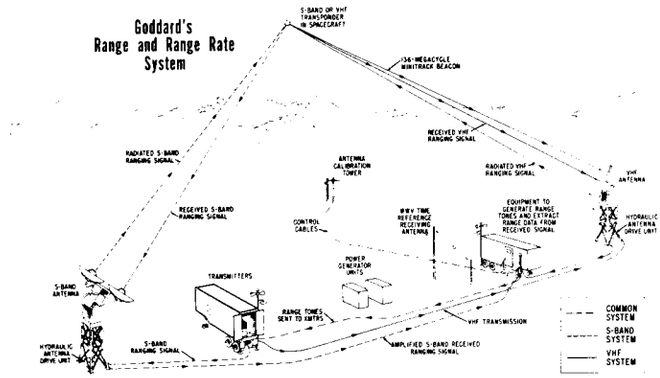
Control center branch: the most significant project for which the control system branch is responsible is the design and implementation of the OGO control center.

Network Operations and Support branch: Under a new maintenance and operations contract with RCA, the office implemented the operational support requirements of the new DAF (85-foot dish) stations at Rosman, Ulaska, and Gilmore. This included logistics support and special tasks for supplying additional technical personnel and technical services, special logistics, fabrication, non-technical services, etc., as well as involvement in transportation and shipping problems.

Similar responsibilities have been handled for the Minitrack Network. Added requirements have come from the new 40-foot dish sites at Quito, Santiago, and Johannesburg as well as from many projects, such as Nimbus, TIROS, OAO, OGO, Syncom and Relay.



The 85-foot dish at Goddard's Rosman Station in North Carolina, which is 120-feet high, weighing some 300 tons.



Network engineering branch's range and range rate system.

Personnel Progress Reflected by Figures

Some 1390 employees were hired at Goddard during 1963; the college recruiting schedule was expanded; enrollment of employees at local universities increased, and new programs to service employees were instituted, the **organization and personnel division** reports.

Division director Robert Hutchison reported these developments during the year:

Indicative of Goddard's continued expansion and adjustment to technological advances, 15 organizational changes involving all major areas were effected during the year.

Conversion to automatic data processing resulted in elimination of manual compilation of several large time-consuming reports and many small ones.

During the year 1390 employees were hired, including 355 under the Goddard Summer Employment Program.

The college recruiting schedule was enlarged from 43 colleges to 66 in anticipation of increased competition for the nation's scientists and engineers.

The first Goddard Graduate Trainee Program was completed in June with 74 new college graduates participating. The program included orientation, course study, on-the-job training, and individual oral panel presentations.

Enrollment of Goddard employees has grown at local universities. During 1963, 258 employees participating in a total of 319 courses. During 1962, 174 employees took a total of 234 courses.

Goddard and the Catholic University have cooperated in establishing a new approach to Graduate education. The first year of the "¾" Credit Graduate Study Program was completed in June with 5 employees participating. Thirteen employees are now participating in physics, space science, and aerospace engineering.

Institutes in space technology were established this year in cooperation with local universities.

Data Systems Div. Expands Computer Use

The **data systems division** operates numerous digital computers supporting Goddard's missions which include calculations associated with scientific data, launch operations, tracking, orbit prediction and data reduction. A major effort is underway to lower the computational response time to the user, and to increase quality of work produced along with improved efficiency.

The data support office performed a feasibility study for real-time reduction of Mercury PAM/FM telemetry which was demonstrated during the MA-9 flight by a small general purpose computer located at Bermuda.

As a result, it was decided to install computers for real-time telemetry reduction at each of the MSF network sites to support the Gemini missions.

Range & range rate tracking data was used in determination of orbits at Goddard in 1963.

Systems analysis and computer programming to meet many project mission requirements was a continuing effort for the division. In 1963, major effort was contributed towards the TIROS, OAO, S-6, Apollo, IMP and Echo projects.

Improved computer programming for general applications were provided to achieve more precise, functional or efficient programs.