GODDARD NEWS

GODDARD SPACE FLIGHT CENTER / GREENBELT, MARYLAND

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Shown in the computer control room during the tense early moments of the MA-9 launch are (left to right) John T. Mengel, Goddard's assistant director for tracking and data; Edmund Buckley, director, office of tracking and data acquisition, NASA headquarters; and Dr. Harry Goett, Goddard director.

Goddard Burns Midnight Oil During Cooper Mission

"Quiet on the outside, busy on the inside. . . ." This phrase describes Goddard during a manned space flight, such as the recent and dramatic MA-9 22-orbit mission earlier this month.

From the outside, Goddard seemed no different than on any other day. But inside building three, a high-tension, round-the-clock operation was in progress. Due to the length of the Cooper flight, bunks were set up in several rooms in the building—some with colorful signs such as "Goddard Hilton"—to allow the manned space flight support people to keep on the spot for the duration.

As in other Project Mercury flights, Goddard acted as communications hub for the 18 tracking stations around the world, routing all necessary information to Mercury control at Cape Canaveral.

Goddard's Mission

Both voice communications and computer data are channelled through Goddard during flight, processed in instants, and sorted as to importance and timeliness—then shunted to the proper place.

When Gordon Cooper's Faith 7 was found unable to accept commands from the ground for automatic retro-fire and re-entry sequence, the astronaut was called upon to maneuver his capsule to the correct attitude, and to fire his own retro-rockets after a countdown from John Glenn on the tracking ship Coastal Sentry. Both Cooper's voice and that of America's first man to orbit, Col. Glenn, cut clearly through the hushed silence here at the communications center.

Clear Communications

As the computers continued to hum quietly, the eyes and ears of the entire group at Goddard followed the drama in the Pacific area as if it were happening over Maryland. Communications continued uninterrupted as the retro-rockets fired after the verbal countdown from Glenn, each kicking hard against the heat shield at the astronaut's back.

At Goddard, as around the world, men held their breath and waited for words to circle the shrinking earth: rockets were jettisoned, re-entry attitude was attained, the drogue parachute was deployed and sighted by the Kearsarge below, the main chute deployed and—splash.

Lights Were Burning

From the awesome tension of lift off and orbital insertion to the intense pressure of re-entry and recovery (and the routine hours in between), the lights at Goddard were burning. Hundreds of hours of training for each member of the team were translated by the events of those days into smooth coordination, with every man in command of his respective responsibility. The mission—A-OK!

The astronaut, who set free-world records for space flight, is shown here posing before a map of the world he circled 22 times.

(Turn to page 8 for photographs taken during the MA-9 mission—Ed.)

Goddard Engineer Publishes Textbook

E. Norman Lurch, electronics engineer of the RF systems branch, tracking systems division, has recently had his second college-level text book published by John Wiley and Sons, New York. The book, "Electric Circuits," begins with the fundamental concepts of d-c circuits and Ohm's Law, and develops a-c circuit fundamentals including considerations of circuit coupling, polyphase systems and complex waveforms.

Complete algebraic and trigonometric developments are used, but complex mathematical derivations are avoided, keeping the level of the text to that of the college freshman.

The book is heralded as one of the most complete and comprehensive in its field. The basic concepts of electrical inductance and capacitance are introduced by field concepts "Thus," the publisher explains, "the book may be used as a stepping-stone for the modernization of present day courses in circuits."

"Electric Circuits" has the distinction of being one of the rare technical books written on a full-time basis. Unlike most technical authors, who devote only part-time effort to writing, Mr. Lurch left the position of associate professor with the State University of New York, where he taught for 12 years, to devote one year of concentrated effort to his new book. This followed 6 months of initial research and preparation. "A good understanding of the fundamentals of electric circuits is so very essential to the student entering this field of study that I felt preparation of the final text deserved special and exclusive attention," Mr. Lurch commented. Upon completion of the book this January, Mr. Lurch joined Goddard to "get away from writing and back to work," as he puts it.

E. Norman Lurch, author and engineer, is shown here with his second college level textbook, "Electric Circuits."

Lurch's first book, "Fundamentals of Electronics," was published by Wiley in 1960. Now in its fifth printing, "Fundamentals" has sold nearly 30,000 copies in the U.S. It has been adopted by more than 120 colleges, universities and technical institutes, including Penn State University, William and Mary, Spring Garden Institute (Phila.), Hampton Institute (Va.) and the University of Sidney in Sidney, Australia. In January of this year, release was given for translation and publication in Poland, in the Polish language. Negotiations are now being finalized for printing in Japan, in a special edition, for distribution in East Asia and Africa.

Currently, Mr. Lurch is updating and expanding the coverage of "Fundamentals" for future publication in a revised edition. Indications are that the book will continue, for some time, to enjoy its present status as one of the most successful books of its type ever published in the U.S.

Mr. Lurch is a good example of the highly creative and capable engineers who are lending their special talents to the advanced technical activities here.

He received his B.S. and M.S. in electrical engineering from New York University, completing his studies in 1943. In addition to his associate professorship at the State University of New York, Mr. Lurch has taught electrical engineering at the University of Florida and Clarkson Institute of Technology. He has been employed as a senior engineer with the Lewyt Corp. assigned to the Radiation Laboratory at MIT, as a development engineer with the Arma Corp., and has been associated with Lear, Inc. From 1954 to 1958, Mr. Lurch also served as a consultant on electrical and electronic subjects for the Encyclopedia Americana.

Mr. Lurch lives in Kings Woods, near Goddard, with his wife and four children, Emily 6, Victoria 8, Henry 18 and Mary Ann 20, a junior majoring in English at the University of Maryland. For diversion, Mr. Lurch dabbles in stamp collecting. He specializes in postal cards and embossed envelopes.

Mr. Lurch is now negotiating and planning future writing projects. The world of technical education will look forward to future contributions from the pen of Mr. E. Norman Lurch.

Recent Technical Publications Authored by Goddard Staff

W. N. Hess, "The Artificial Radiation Belt," NASA Technical Memorandum TM X-788, April 1963

N. C. Schaller and J. M. Lewallen, "Methods of Expressing Mass Unbalance," NASA Technical Note D-1446, May 1963

J. A. Foschetti, "Vehicle Technology Considerations for a Solar Probe," NASA Technical Note D-1747, April 1963

Goddard Space Flight Center Staff, "The Observatory Generation of Satellites," NASA Special Publication 30, March 1963

Impetus

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

"Now that the public has at last become interested in science and, incidentally, in scientists, *the problem of getting the most out of the latter is occupying much time and attention.* Books are being written on 'creativity,' and, of course, the ubiquitous symposia are being held. Through all these words it is hard to discern any clear patterns. So hard has it become that we have turned to looking around among our friends to see what happens to creativity with the passage of time.

"It seems to come quite simply to this: A young scientist's mind is not filled with many facts or responsibilities. He is ignorant enough to undertake the unreasonable and the unlikely and yet come up with a solution, sometimes with a significant discovery that overthrows entrenched ideas.

"Once he has made an original discovery he finds it increasingly difficult to make another. He may be busy working out the details of the first, writing about it, or supplying samples of the material and know-how to others. Before he knows it he is overwhelmed by those who rush in to take advantage of the newly created opportunities. He may get lost in the jockeying for position that results.

"If he does not quickly carry his discovery further, preferably to the 'molecular level,' he may well be accused either of resting on his oars or of having lost interest. There are plenty who will take up where they think he has left off.

"The significance of all this is that, once he has been creative, the young scientist finds it very difficult to become creative again. Committees, review articles, symposia, and society meetings consume him. He has no time or spirit left for creativity. He loses his willingness to strike out into the wilderness. He begins to follow the safe and well-worn paths. He does not know that he has but a few years to go after the big discoveries and that, with age, so many things will crowd out his chance to try again.

"To discover the really new requires not only an attitude of mind but the ability to keep the roads to the solution of problems clear and, finally, to drive full speed down them. The timorous, insulated mind will not make the grade. Roads will be blocked by too much equipment, too much money, and too much seeking after status and security. The power to drive down the roads must be self-generated—a restless urge satisfied only by movement culminating in achievement. The price is high, the material rewards are minor, and the satisfactions must come chiefly from within. If you willingly pay this price, you have a ticket of admission to the ranks of the creative. However, the society of man is a great leveler; not to be leveled requires singular force of character. From such stuff creativity arises. To keep it alive in the face of the social forces that accompany maturity requires even greater strength. It is more than worth a try."—*Irving H. Page, Research Division, Cleveland Clinic Foundation*

Ames Specialty: High Speed Aerodynamic Research

Ames Research Center, located near San Francisco at Moffett Field, is making major contributions to the United States' program in space, especially in high speed aerodynamic research, the center's traditional specialty.

For example, a new hypervelocity test device has just been contracted for a part of the hypervelocity free-flight facility now under construction at Ames. The new wind tunnel structure, combined with a light gas gun, should help attain rational designs for manned satellites, vehicles returning from the moon and other planets, and possibly space vehicles for entering the atmosphere of other planets.

Along these same lines, the M-2 wingless spacecraft was conceived and proven feasible at the center. This spacecraft (see photo of model) will encounter temperatures well in excess of 9,000° fahrenheit under certain conditions during re-entry.

Another Ames project of special interest is research on soft landing on the lunar surface. Landings are simulated at the research center using the Bell X-14A vertical take-off and landing aircraft. In the X-14A's jet exhaust pipe, vanes are turned downward to allow the craft to descent vertically to an easy landing, as displayed by the accompanying photo series.

Ames scientists are particularly interested in research in the space sciences, geophysics, interplanetary and planetary physics, planetary sciences, astronomy, and astro-physics.

Mercury Contributions

The research center contributed important wind tunnel studies on basic atmosphere re-entry heating of the Mercury capsule, and on the Mercury-Atlas missile combination.

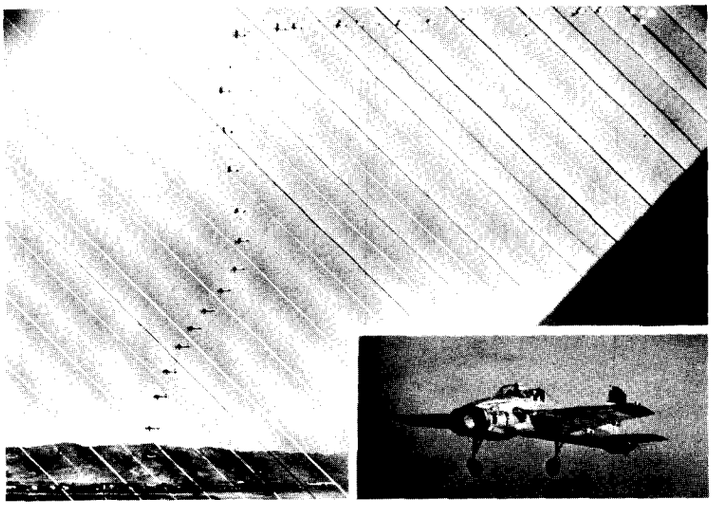
Another active program in progress at Ames explores the ability of a pilot to control his vehicle during re-entry. Corollary research work is involved in seeking design techniques whereby vehicles capable of human control can actually be bult.

A cooperative effort between Ames and Goddard in connection with the Orbiting Astronomical Observatory began while Dr. Harry Goett was still working at Ames. He, along with John Foster and William Triplett, prepared the preliminary requirements and specifications.

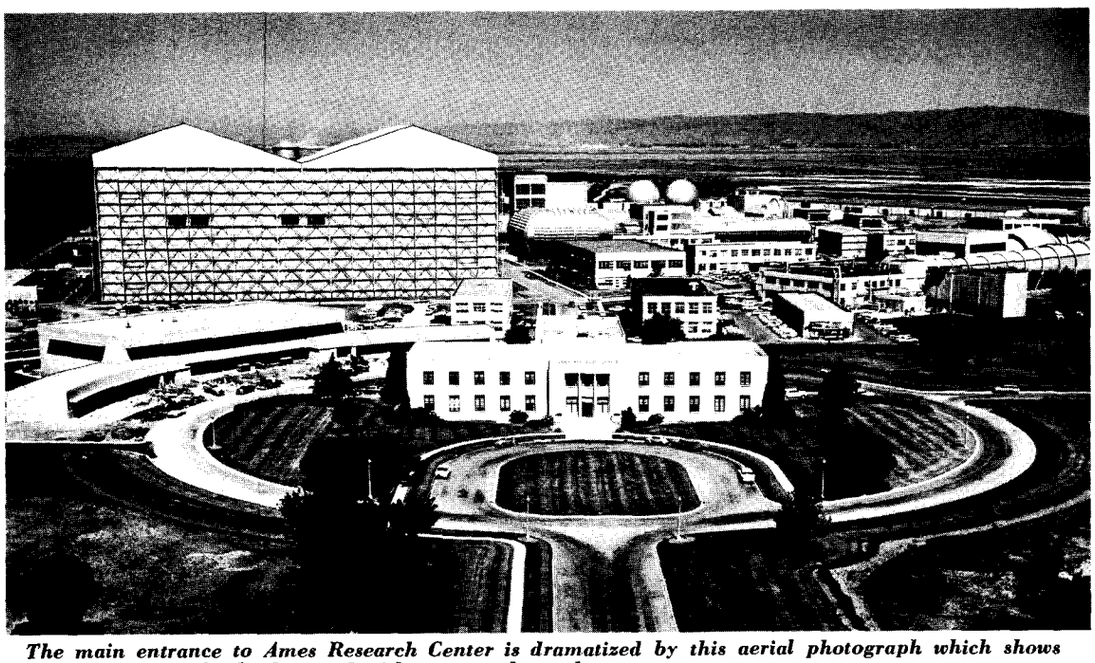
Due to the center's experience in guidance and control it is providing research for stabilizing and controlling Nimbus and OAO (orbiting astronomical observatory).

The current staff at Ames is approximately 2,000. The Center—named for Dr. Joseph S. Ames (who was chairman of the National Advisory Committee for Aeronautics from 1927 to 1939)—is still growing in staff and stature: Another part of the NASA team working for the future.

This model of the proposed M-2 wingless spacecraft is shown here during a reentry test in the 1-foot hypervelocity wind tunnel at Ames. Heat transfer distribution is being measured.



Shown close-up in the lower right insert is the Bell X-14A simulating a lunar landing. The stripped photograph is taken by a flight data analyzer camera, which shows the plane approaching from the right at 1,000 feet, then descending vertically. The forward motion near the ground was the result of a pilot's correction to assure a pin-point landing.



The main entrance to Ames Research Center is dramatized by this aerial photograph which shows test facilities in the background with runways beyond.

Dr. Smith J. DeFrance, Director

Editor's Note: This is the fifth in a series of special articles on the activities and responsibilities of NASA's far-flung installations and operations.

Satellite Network Calibration Plane—

A Peruvian astronomer reported it as a phenomena in flight—"much faster than any aircraft."

A Washington, D. C., housewife called it an "unidentified flying object" when she sighted it over Blossom Point.

Some ask for it in emergency to fight a fire or transport the sick. Others want it to haul cargo, or calibrate a new device.

You may have seen it skimming the roof tops of Goddard buildings in one of its many special assignments.

Whatever it looks like from the ground, or whatever its varied uses in flight, it makes a unique contribution to the center's world-wide tracking function.

This is Goddard's DC-4 Satellite network calibration plane.

Assigned to the operations and support division, this globe-flying converted C-54 of World War II vintage has compiled an impressive record of service and performance since getting its first assignment in 1960.

In three years of flying to the distant stations of Goddard's space tracking and data acquisition (STADA) network, the assigned aircraft has performed an estimated 100 calibrations while logging an average 1,000 hours of flight time or the equivalent of 200,000 miles each year.

Calibrated Twice Annually

Each STADA station is scheduled for calibrations twice annually, according to Harold L. Hoff, acting chief, operations and support division. Often the schedule depends upon "calibration weather," favorable for taking star plate photographs, since the optical measurements are the basic reference for the radio system field evaluation.

Cold weather is not necessarily bad calibration weather, added Ken Hunter, senior electronic technician in the section. "We play for the spots—the clearings in the sky—regardless of the temperature. Even the slight haze is not good. A clear night with a bright moon may be prohibitive as well."

Some stations provide the crew with peculiar circumstances that make calibration more difficult. For example, the Quito, Ecuador, site "sits under a small friendly cloud a half mile square, about 70 per cent of the time," said Fred Nemir, of the operations branch. "We can calibrate anything else in the vicinity except the station when the cloud is overhead." The high altitude of the station—about 11,700 feet—and a near-by mountain apparently are responsible for the persistent cloud obstruction.

To take advantage of the most favorable periods, trips to Quito generally are scheduled in November and May, two months preceding and following the normal rainy season. For Alaska, September and March have proved to be the best times because daylight hours are exceptionally long during the 5 month period in between.

Sites at Woomera, Johannesburg and Winkfield normally are not evaluated by the STADA network plane, their calibration being the responsibility of the countries in which they are located.

Efficient Operation

In the few short years of the space program, the calibration function has grown from a virtually unknown and untried technique to an efficient and well-defined operation.

In the early years of the Minitrack system in the late 50's, calibration was attempted with balloons, radio stars and the sun, all of which demonstrated substantial shortcomings for a system in which the highest precision was required. In early 1957, the first aircraft fly-over was performed, first with AD-5's and subsequently with DC-3's, S2-f's, WV-2's, and whatever else was available to do the job.

Here the calibration plane sweeps low across building 1 as it heads for a low level test of instruments set up on the roof of building 3 (see other photo).

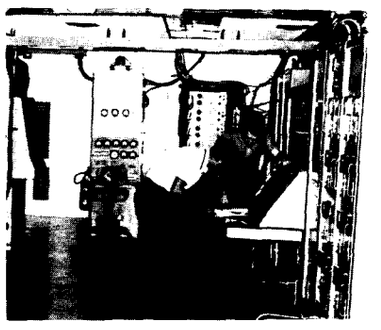
Since then, the plane technique has been used and perfected despite "changes in concepts, make-up, crews and mission," according to Ralph Stroble, operations branch head. "At first we had no crews, and we 'nominated' volunteers on a one-mission-at-a-time basis."

Increased Responsibilities

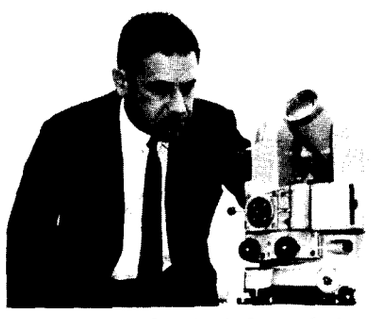
After brief trial periods with permanent crews provided first by contractors, then by Goddard, the present Bendix-operated system utilizing a leased aircraft came into being.

With the establishment of a permanent concept of network calibration, the branch has worked at perfecting a smooth-working calibration operation. At the same time, it has taken on increasingly more responsibilities beyond those dealing only with calibration. It has expanded its function to include the calibration of additional tracking and telemetry equipment and numerous special tests necessary in the development and acceptance of new data acquisition facilities. Included in the new assignments are numerous fly-over tests of dish antenna sites, range and range-rate equipment and laser optical tracking systems.

The added responsibilities have been reflected most of all in the "increased expectations of the crews," said Mr. Stroble. "Their duties have greatly enlarged in the process of expansion, and they have performed them in a highly commendable manner."



Peruvian technicians operate th control console of the 136/108 megacycle systems in the operatio room of the Lima, Peru, Minitrack station.



Fred Nemir, head of the technica section, inspects a theodolite whic the analysis and evaluation offi contemplates using in checking t angular read-out of the Godda range and range rate antenna The theodolite was returned by th calibration plane after being use in Alaska during the past sever years for optical satellite trackin

MUSICIANS rehearsing in building 3 auditorium. Ed Graham is at the piano; front row; Jack Coulter on guitar; saxes, Charlie Runk, Joe Skladany, Tom Cherrix and Herb Whitelock. Second row; trombones, Walt Hensel, Bill Leavy; trumpets, Barry Hendrickson, Howard Dixon, Chuck Liebau. On the drums Walt Eiker. Not present are John De Luca and Vic Simas.

INSIDE GODDARD

MAY 27, 1963

Peake's Pirates Win Space Cup

Nearly two years after its initiation the Space Cup Challenge series between Jack Peake's flight R.F. systems branch and Bob Bourdeau's planetary ionospheres branch was renewed Monday, May 13. By agreement, the losers of each event may specify the next event in the series. The flight R.F. systems boys were the losers two years ago in the Tenpin bowling match; consequently, they challenged Bourdeau's planetary ionospheres crew to a slow-pitch softball game. Bourdeau's Tigers were no match for Peake's Pirates who won the game, and possession of the Space Cup, by the lopsided score of 28-9.

Pirates Break Tie

The game featured numerous home runs by the power-laden Flight R.F.'ers as well as their sparkling play afield. Bourdeau's Tigers furnished good opposition except in the pitching, batting, fielding, and baserunning departments. At one point early in the game the score was tied at 8-all. Then Bourdeau himself took over the mound duties and Peake's Pirates really bombed him with numerous long hits by a parade of sluggers.

The toothless Tigers were bolstered considerably by the brilliant fielding and batting of the planetary ionospheres branch secretaries, Dyanna Harris and Lila Shiren. Apparently the Tigers could use more secretarial help.

The historic victory by Peake's Pirates will be commemorated by a Space Cup presentation in about three weeks. The losing Tigers must now choose a type of contest for the next challenge. The Pirate's depth in athletic prowess will make the Tigers think long and hard before daring to challenge for the Space Cup again.

AFTER REHEARSAL enjoying some improvisational dixieland "jamming" are: (left to right) Bill Leavy, Charlie Runk, Chuck Liebau, Tom Cherrix, Ed Graham (at the piano) and Jack Coulter.

New Band Swings 'Old Standards To Twists'

The scope of Goddard employee activities has developed a bulge in a direction quite foreign to the usual bowling, softball, basketball and the like. This bulge, the first musical organization at Goddard, is being cultivated by Tom Cherrix of the physics branch. He started the organization around Christmas time, by putting a notice in the Goddard Bulletin. "My original intention," said Tom Cherrix, "was simply to locate interested musicians and find out what type of group they would be interested in. A poll showed a dance band filled the bill. Several people contributed equipment and music, so two months ago we began weekly rehearsals. We blow everything from old standards to twists and 'good' popular tunes like 'Desifinado' ".

Open Doors To All

The band now meets in the auditorium of building 3 every Wednesday at 4:30 but hopes to re-locate to the new auditorium in building 8, when construction is completed. "We don't lock the doors, in spite of the bad notes that inevitably sneak into a rehearsal," Tom told us. "We hope that interested musicians, and listeners, will feel free to drop in any time. The present group consists of about fifteen men, but there is plenty of room for everyone interested."

Future Outlook

The outlook for the band will include, basically, the best modern arrangements available and continued weekly rehearsals. "We actually 'play' more than we 'rehearse' every Wednesday. Our main purpose is, of course, to play well, but we have no current plans beyond that. Maybe people will drop in to listen and dance when we move to building 8."

Whatever the future accomplishments of the band, the members will definitely enjoy it. As a matter of fact, you might say the whole idea "sounds" like a pretty "sound" idea.

Interested swingers call Tom Cherrix, ext. 4231.

GODDARD TENPIN LEAGUES END THE SEASON

MEN'S

The season ended for the Men's Tenpin League on May 16 when the two division winners, the Quiet Ones, Wednesday nights, and the Pinspawlers, Thursday nights, met to roll off for the league championship. The "Quiet Ones" came out on top wining 83½ games.

The big night was on May 28 at the VFW where the banquet was held. Presentation of the large trophy to the winning team, the Quiet Ones, was made by Ted Wood, manager for Capital Plaza Lanes. Individual trophies were presented by Allen L. Franta, president of the Goddard Welfare Association. Bill Long, construction management branch, and league president gave out the cash awards and introduced the new officers for next year—1963-64: president, Ron Browning, mechanical systems branch; vice president, Fran Federline, mechanical systems branch; secretaries, Bob Underwood, test and evaluation division and Dusty Rhodes, data instrumentation development branch. Here is how the team and individual standings tallied up.

First Place Team
Quiet Ones

WINNING TEAM . . . (left to right) William Tucker, Ray Whitten, Robert Wettingfeld, John Huddle, George Ubeges and captain (center) Carl Tonty.

Individual Standings (Wednesday)
High Game:
Dale Sollars ...300
High Set:
Dale Sollars ...641
High Average:
Dale Sollars ...175

Individual Standings (Thursday)
High Game:
Vern Barnes ..253
High Set:
Ted Rager 615
High Average:
Bill Putney ...174

Team
High Game:
Gosobs 1123
High Set:
Gosobs 3122

Team
High Game:
Pinspawlers ..1146
High Set:
Markers 3172

MIXED

The Mixed Tenpin League bowled their last game of the season Tuesday, May 21. The victory team was the "Scatterpins" winning 89 games.

Recipients of awards met on May 27 in the auditorium of building 3 for the main event. League president, Dave Butcher of the systems integration branch, presented the trophies and cash awards. Assisting Dave, from the trophy committee, was Dorres Hughes, theory and analysis office.

When final scores were tallied it was discovered that the men's high average was so close that the scores had to be figured to the nearest hundredth. Tony Andrella, property branch, came out on top with an average of 169.929. For the women, Betty Gerheiser, employee services branch, was "winner take all" (see below).

The end of this season earmarked the third year for the Mixed Tenpin League, since they were first organized here at Goddard in 1961.

New officers for 1963-64 are: president, Richard Plock, vice president, Tony Andrella; and secretary-treasurer, Dorres Hughes.

Those interested, keep a sharp eye on "Inside Goddard" for "what's happening next year."

First Place Team
Scatterpins

WINNING TEAM . . . (left to right) Roger Tetrick, Richard Plock (team captain), Frank Lawrence and Betty Gerheiser. (Not shown, Dick Gerheiser.)

Individual Standings (Women)
High Game:
Betty Gerheiser.213
High Set:
Betty Gerheiser.525
High Average:
Betty Gerheiser.148

Individual Standings (Men)
High Game:
Richard Plock..241
High Set:
Tony Andrella..636
High Average:
Edward Leary 169.833

Team Standings
High Game:
Astrogators ...958
High Set:
Orbiting Elements 2652

200 Turn Out For Slow-Pitch

The Goddard Welfare Association has added a Slow-Pitch Softball League to the list of many sports activities within the Center. When asked how many persons turned out to organize the league, Bob Snyder, flight R.F. systems, said "Close to 200 Goddard and contract employees turned out."

There are 12 teams, each averaging 15 members. The teams are divided into two divisions, six teams each. At the conclusion of the regularly scheduled games a playoff will be held between the top three teams in each division. The two winners will compete for the championship.

Goddard employees can enjoy real ball playing, every Tuesday, Wednesday and Thursday at 5 p.m. The new diamond at the recreation area or the temporary diamond behind building 7 is where the action takes place.

Slow-pitch softball is similar to the normal softball game with several exceptions. A moderate slow pitch is required, no base stealing or bunting, and a team consists of ten men. With these exceptions, the pitcher is no longer the most important man on the team and it becomes a fielding game.

Slow-Pitch Softball Teams

Team No.	Captain
1	Walt Nagel, spacecraft systems branch
2	Sid Jones, fields and particles branch
3	Gene Humphrey, R.F. systems branch
4	Norm Goldman, flight R.F. systems branch
5	Jim Knapp, test and evaluation division
6	Harry Montgomery, special projects branch
7	Jim Murphy, data systems division
8	Walt Clark, advanced projects branch
9	Walt Flournoy, advanced orbital programming branch
10	Bob Wettingfeld, space data control branch
11	Lee Eisenhower, instrumentation branch
12	Al Newman, sheetmetal branch

One Up—Three Down With Fourteen To Go

After ending in second place last year in the District Recreation Department League, it was a surprise for the Goddard softball team to lose three out of the first four games of this season.

This year, the team entered in the Prince George's County Softball League. Opening game was on May 7 against the Maryland Stars, who won, score: 5-0.

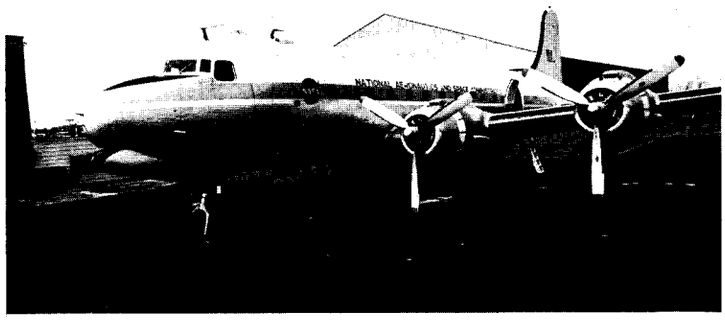
Goddard took a real beating in the second game on May 8. The Largo Sports Club ended the game with 11 runs against Goddard's 2.

On May 14, the third game, Goddard came back swinging. Dale Sollars, communications branch, put an end to what looked like a "losing streak" for the team. Dale pitched a two hitter and struck out ten, giving Goddard a 3-0 triumph over Budget Finance.

In the fourth game, the two teams were well matched and Goddard held its own for awhile but Southeast Auto scored two runs, final score: 2-0.

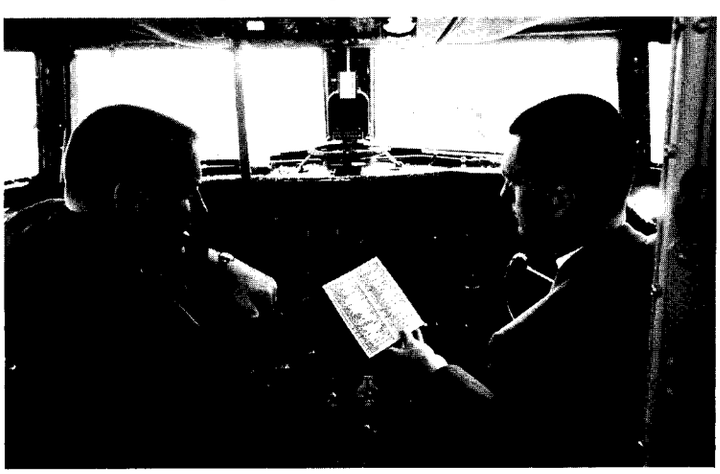
Go team! It's still early and anything can happen with 14 more games to play.

In the Air Everywhere



Goddard's DC-4 calibration plane uses oversize engines and has been specifically outfitted for high altitude flights between 25,000 and 30,000 feet.

Example of a special test performed by the Minitrack plane is shown here. Atop building 3, John Berbert, head of the analysis and evaluation office, and Michael Cartwright, of the same office, evaluate the performance of the Tellurometer Aerodist during a flyover of the C-54. The system will be used to check Goddard's new range and range-rate tracking system.

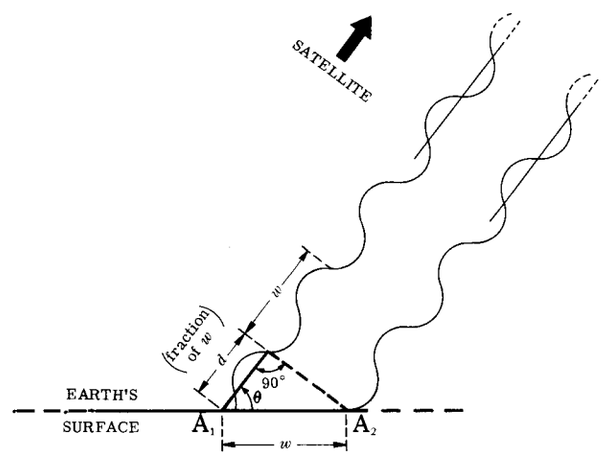


Fred Handley, plane captain, and Lewis Whitaker, first officer, both Bendix contract employees, go over a standard pre-flight check list prior to take-off.

Ken Hunter, Harry Pritchett and Alphonso Hargis, all of the technical section, examine a photographic plate from a Minitrack site calibration.

How It Works—#3

The Minitrack System



A rather neat way to track a satellite is to measure its changing angle as it passes overhead. A basic way to do it is by *radio interferometer* or *phase comparison* techniques. This requires only a tiny satellite transmitter, so we originally called it Minimum Weight Tracking. That's right, *Minitrack!*

The satellite transmits a continuous radio signal whose *wavelength* is w (about 7 feet for a 136 megacycle signal). The two ground antennas, A_1 and A_2, are placed this same distance w apart. Arriving at some angle θ, the satellite signals reach A_1 later than A_2 and so travel an extra distance d.

Now, this extra distance d obviously depends on the *direction* from which the satellite signals are coming; and the ratio of that distance to the antenna separation is d/w, which is the cosine of the angle θ. *So we can determine the satellite's direction angle θ from d and our known w.* We measure d electrically by noting the *phase delay* between the signals at the two antennas; this is the fraction of a wavelength that d contains.

This system gives the *direction angle* of the satellite with respect to the line between the two antennas. Adding a similar measurement by antennas placed perpendicular to the first set establishes the *line of sight* to the satellite.

In actual practice, the base stations are spaced closer and *one more antenna*, spaced further out, is used for improving precision.

Magnetic Fields Facilities to Have Unique Capabilities

Two test facilities designed to simulate the weak magnetic fields of space to a greater precision than is now possible are being developed under the direction of Goddard's test and evaluation division.

The magnetic fields component test facility and the attitude control test facility will provide a controlled magnetic environment to measure the fields produced by a spacecraft on its components and to evaluate the effects on the performance of the spacecraft.

The facilities are expected to generate fields of unusual uniformity that have only been approached on a laboratory scale, according to Bill Brown of the engineering design branch and project manager for the facilities.

The primary mission of the component test facility is experimental development and calibration of flight magnetometry.

The larger attitude control facility is designed to accommodate entire spacecraft up to the size of the Orbiting Astronomical Observatory. It will be equipped with instruments and special traversing and positioning devices so that the contours of the field surrounding a spacecraft can be determined with great precision.

A special gimballed suspension with a unique capability for measuring tiny torques or forces exerted on a spacecraft in a magnetic field is part of the facility.

A sealed miniature study model (½ inch to 1 foot) of the attitude control test facility is the subject of interest of Ken Ruddock, left, project manager for Spectra Physics, Inc., contractor for the project, and Bill Brown, Goddard project manager. The model was built by Goddard's fabrication division under the supervision of Bill Noyes of the test and evaluation division. With the exception of a few details, it also is a replica of the component test facility.

The ultimate results obtained from these facilities will be most rewarding, in the opinion of Mr. Brown.

"There is evidence that some of the planets of our solar system either exhibit no magnetic field or possess a field too weak to be measured accurately by present instruments. On the other hand, the sun and a few of the planets probably possess intense fields. Therefore, the development of instruments combining extreme sensitivity with extended dynamic range is an important step in the exploration of space. Such new instruments must function reliably and with precision in the thermal and pressure environments expected nearer the sun and farther from it than earth orbit."

Mr. Brown said that force and torque measurements may have critical applications to station-keeping and attitude control in satellites of extended duration.

"When disturbing torques can be more precisely evaluated and minimized, the energy and fuel in some instances necessary for stabilization and attitude correction can be minimized. Weight and space savings thus effected will permit larger scientific payloads to be launched by a specific vehicle."

The generation and control of magnetic fields is confined to the limited work space within each facility. However, at its center each facility can generate an artificial field of any direction and any intensity from 0 to 60,000 gammas, i.e., slightly more than the intensity of the earth's field in the vicinity of Greenbelt.

Remote Site Selected

To avoid the intrusion of certain man made disturbances, a site has been selected on a tract provided by the Agricultural Research Center about a mile east of Goddard. This remote site provides a uniform and quiet geomagnetic background away from commercial activity.

The magnetic fields component test facility is presently under contract with Spectra Physics, Inc., of Mountain View, Calif., and is scheduled for completion in late 1964, although it will be available for limited use at the end of 1963. The attitude control test facility is scheduled to go out for bids in the near future and to be completed by mid-1965.

Thirty-three Office of Administration Employees Receive Service Awards

Recipients of 15-year service pins are the following office of administration personnel: seated, Jack Newman, Alfred Rosenthal, Elizabeth Hendricks, Margaret Keating, Albert Fuchs, Thomas Donaldson; standing, James McKinney, Eugene Bishoff, Pen Stephens, Marl Hemphill, Anthony Andrelli, Robert Huddleston, Leonard Drohan, Willis Mason, James Hines.

Receiving 10-year pins from OA are, seated, Mary Tayman, Mildred Harris, Tillie Kroto, Sylvia Lookabill, Evelyn Peters, and Mavis Sharpe; standing, Vincent Capitello, Donald Menard, Saul Cohen, Chester Kleyps, Joseph Schiavenne, Franklin Marsh, Celeste Simms, Raymond Lee, Natalie Dutile, Florence Kenny, Vincent Horgan, Bea Wyatt.

Goddard Speech and Paper Presentations

(Technical presentations approved as of May 22 for period of May 27-June 9)

PAPERS

The following personnel are presenting papers at the COSPAR Fourth International Space Science Symposium, Warsaw, Poland, June 3-11.

Dr. Wilmot N. Hess, chief, theoretical div., ***"Lifetime of Trapped Radiation Belt Particles."***

Dr. Siegfried J. Bauer, planetary ionospheres br., ***"A Small Multi-Purpose Rocket Payload for Ionospheric Studies."***

Arthur C. Aikin, Jr., planetary ionospheres br., ***"The Determination of the Origin of the D-Region by Rocket Experiments."***

Lawrence Dunkelman, astrophysics br., ***"Visual Observations of the Atmosphere from U. S. Manned Spacecraft in 1962."***

Dr. John C. Lindsay, chief, solar physics br., ***"The Solar Spectrum from 50A to 400A."***

Dr. Werner M. Neupert, solar physics br., ***"Emission of Extreme Ultraviolet Radiation from Solar Centers of Activity."***

William A. White, Assistant chief, solar physics br., ***"Solar X-Ray Micro-Flares and Quiet Sun Radiation."***

Dr. Albert Arking, Institute for Space Studies, ***"Percentage Cloud Cover from Tiros Photographs."***

William M. Kaula, theoretical studies br., ***"Satellite Geodesy."***

William M. Kaula, theoretical studies br., International Astronomical Union, May 27-31, Paris, France. ***"A Review of Geodetic Parameters."***

SPEECHES

William W. Wolman, systems review group, Operations Research Society of America, May 27-28, Cleveland, Ohio. ***"Reliability Analysis for Space Science."***

Dr. Henry H. Plotkin, chief, optical systems br., Society of Engineers & Scientists, May 29, Patuxent River, Md. ***"Electro-Optical Tracking of Spacecraft."***

Goddard Scientist in Switzerland

Elden C. Whipple, Jr.

Early this month, Elden C. Whipple, Jr., planetary ionosphere branch, presented a paper at the Third International Conference on Atmospheric & Space Electricity at historic Montreux, Switzerland dealing with that part of the atmosphere, between the altitudes of 20 and 50 miles, which has been largely neglected in the past.

Whipple was the only Goddard representative at the meeting, which is the first of its kind since 1958. The region discussed is too high to be explored by balloons, and too low to be investigated by satellite. The only way data has been obtained there in the past is by sounding rocket. This method, however, is limited since the rocket passes through the area with extreme speed.

Little useable data can be obtained, and even this is difficult to interpret.

The recommendation was advanced by Whipple in his paper, "Electricity in the Terrestrial Atmosphere Above the Exchange Layer," that some kind of drag device be designed and fabricated which could float equipment down slowly from approximately 50 miles—thus enabling more leisurely data procurement.

The conference in Switzerland was held May 6-10 to review progress since 1958, to enumerate and discuss unsolved problems, to discuss possible new approaches to old and new problems, and to explore the applications of the basic concepts of atmospheric electricity to the investigation of the upper atmosphere and the atmospheres of other planets.

Goddard Coming Events

- **June 6,** 10:30 a.m. to 4 p.m., cafeteria conference room, Bldg. 1. Lecture-presentation and demonstration of various products of Parker-Hannifin Corp. for those interested.
- The film program will present the **"John Glenn Story"** on Thursday, **June 6** and Thursday, **June 13,** 12:30 p.m., Auditorium, Bldg. 3 and at Jackson St. on Tuesday, **June 11,** 12:30 p.m.
- The Goddard colloquium lectures will not be held during the summer months (beginning June 1) due to summer vacations at the universities and colleges. The colloquia will resume in September.
- **May 29,** 2 p.m., Institute for Space Studies, 475 Riverside Drive, N.Y., N.Y. Colloquium: **W. V. R. Malkus,** Institute of Geophysics, U.C.L.A., **"Penetrative Convection."**

News About Space & Aeronautics

● Marshall Space Flight Center technicians use some 47,000 feet of household type aluminum foil each month, but they're not squirreling away leftover space vehicle parts.

The foil—waterproof, easily visible and instantly shaped to fit the various contours of rocket components—serves pretty much the same purpose at the space rocket center as it does in the kitchen, except on a larger scale.

Technicians at the NASA center use enough foil each month to last a housewife a lifetime.

It provides protection for odd-shaped, exposed rocket components during assembly, checkout and movements before launch at Cape Canaveral.

No one seems to know the person who decided that foil was "the thing" to keep parts clean, but almost everyone in the shop feels there is "nothing else that does the job as well."

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● The Orbiting Solar Observatory (OSO), the most complicated satellite orbited by NASA to date—and one of the most successful—completed its first year in orbit in March. OSO's estimated lifetime was over long ago, yet 11 of the 13 original experiments on board are still operating, and still returning data to earth. OSO has already sent "back home" more data on the sun than all previous rocket, satellite and balloon flights combined.

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● At last count, Millie Guice, Cape secretary for the Project Mercury pilots, had received in the mail, eight different spellings for the word astronaut.

Future space enthusiasts have spelled it astranut, astranaut, astranaist, asternaught, astroanut, astrounat and asternot.—*Spaceport News*

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● NASA has ordered 23 Scout launch vehicles from the Chance Vought Corp.

The four-stage Scout is this country's only all-solid propellant satellite launch vehicle. Scout is now used by both NASA and the Department of Defense.

During its developmental series of eight launches, the Scout achieved a success record of about 60 percent.

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● Research and development work conducted on the now defunct Skybolt program has resulted in a control system that will have certain application in very large solid fueled rocket space boosters, according to Aerojet-General Corporation, the firm responsible for Skybolt propulsion development.

Aerojet Vice President Werner R. Kirchner, manager of the firm's Solid Rocket plant in Sacramento, Calif., identified the control system as "a fully gimballed nozzle." He said the nozzle, able to move in any direction and thus turn the rocket to any desired heading, was employed in Skybolt's second stage.

Aerojet designed and developed the control system to take advantage of the lack of a length limitation in Skybolt. Because Skybolt's length wasn't restricted by the size of a submarine or the depth of an underground silo, the Skybolt propulsion team was able to substitute a single nozzle for the four short nozzles previously used on large solid rockets.

This saved weight, and less weight enables an increased payload, making this system particularly adapted to large space boosters.

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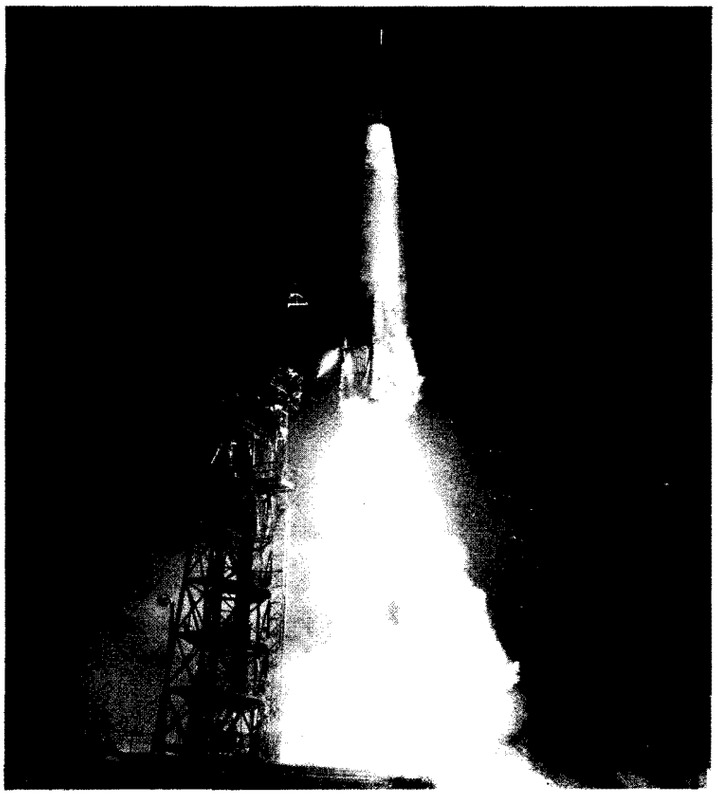
● "Lack of hard-vacuum testing may conceivably have doomed the October, 1961, West Ford experiment, in which the Air Force attempted to orbit 50 lbs. of fine copper wires at an altitude of 2,000 miles. (M/R, May 13, p. 13). A scientist connected with the experiment pointed out that benzene was used as the adhesive to hold the 10^{-6} mm-dia. needles together. It was thought that in space, the benzene would sublimate, and the needles would become separate entities in packages ready for injection. In a test vacuum of about 10^{-7} torr, the surmise was correct. But later, after the Air Force failed to put the needles into orbit, a second test presumably at a pressure greater than 10^{-10} torr revealed that the copper wires became cold-welded to one another."—*Missiles and Rockets*

AN ASTRONAUT'S WEEK:

Dramatic Lift-off, Close Goddard Support, and Congressional Session



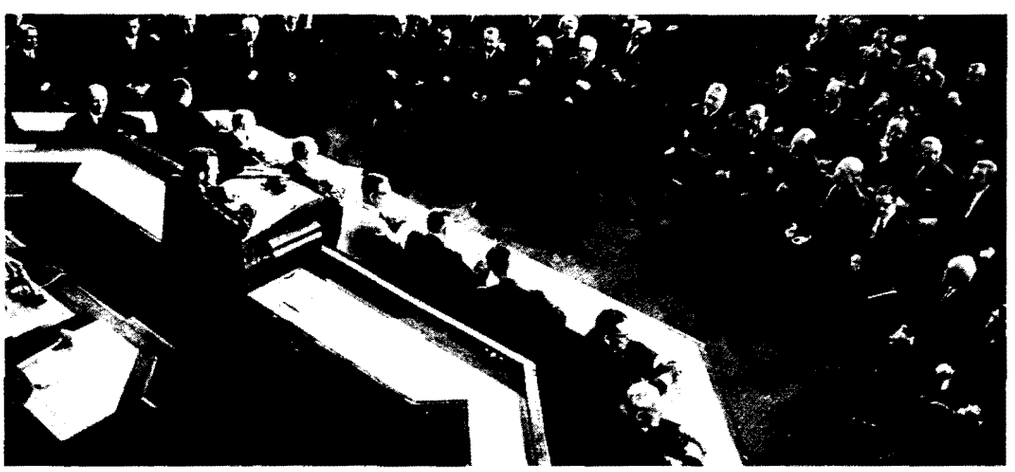
With a roar and a flash of fire from the frost-covered Atlas launch vehicle, Gordon Cooper heads for his weightless rendezvous with space. A perfect textbook lift-off to begin the 34 hour mission.

Dr. John A. O'Keefe, assistant chief of Goddard's theoretical division and Dr. Jocelyn R. Gill, geophysics and astronomy programs, NASA headquarters, are shown here at the space operations control center checking the azimuth of Antares which had been supplied to the astronaut.

Laverne R. Stelter, head, communications branch, observes his team in action during the mission.

Frank Conley (l.), George Brown (c.) and Tom Gibbons, facilities controllers (Bendix), are shown on the job at Goddard's SCAMA.

Preparing the "Goddard Hilton's" cots for round the clock operation in building three are: Cathy Carroll (l.), data operations, and Rebecca Hanchak, IBM Corp. contract employee.



Astronaut Cooper closed his comments to a joint session of Congress with a prayer he had recorded during his 17th orbit; a contrast with the statement of Soviet cosmonaut Titov, who commented, "I saw no God or angels."