GODDARD NEWS June 1973 Vol. 21, No. 3

GOODARD'S LAKE in back of Building 26 is one of the natural areas on center where employees can relax and see wild animals in their natural habitat. Other areas include the nature trail between Building 8 and Building 5, the roads just inside the fences, the settlement pond near the NTTF, plus the many GEWA-sponsored recreational facilities. For a story on Goddard wildlife and conservation efforts, see Page 4.

Space Instrument Provides Fire Alert

One of the oldest threats to life on Earth, forest fires, is now being attacked by the newest of man's tools, space technology.

Instruments developed to sense conditions when fires start easily are being teamed with a satellite relay station and computers to give the California Division of Forestry (CDF) a "Fire Index Measurement" from an experimental unmanned remote station in a fire area near Sunol, California.

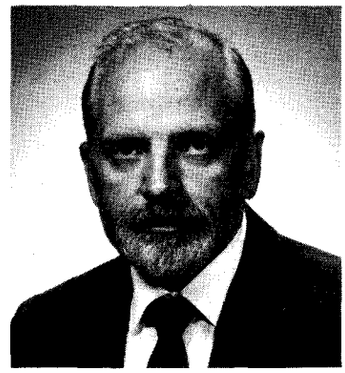
Foresters say that knowing where fires are probable and how they might act is almost as important as men and equipment actually fighting fires. An unmanned station to establish the fire index in remote areas is doubly important because it gives timely readings which have in the past been made by forestry personnel as only one of their many duties, and it has been a problem for them to get the information to their headquarters by telephone. Important, too, is the idea that when fires occur, forestry personnel are often pulled into firefighting duties and can no longer monitor their areas.

The system is based on sensors developed by the CDF and NASA's Ames Research Center, Mountain View, California, to check wind velocity and direction, air temperature, relative humidity, and fuel moisture content, a measure of the flammability of forest floor litter. Under an agreement between Ames and the Division Forestry, Ames aerospace technologists have joined the CDF instruments with a NASA "black box" which converts their measurements into data which is beamed to the Earth Resources Technology Satellite (ERTS) at least twice a day.

The ERTS, orbiting Earth every 100 minutes 915 kilometers (540 miles) overhead, picks up the signals with special receiving equipment. The satellite automatically relays the information to a NASA tracking station in the Mojave Desert which passes it along electronically to NASA's Goddard Space Flight Center in Maryland. The coded data is sorted out by computer and sent to Ames back in

(See Page 2)

Dr.Hanel Receives Lindsay Award



Dr. Rudolf A. Hanel

Dr. Rudolf A. Hanel of the Laboratory for Planetary Atmospheres has received the 1973 John C. Lindsay Memorial Award "for his initiative and leadership in developing infrared Michelson interferometer spectrometers and employing them to achieve outstanding results in studies of the earth and planets." The award was presented during the annual Lindsay Memorial Lecture on June 8.

Lecturer for the combined Scientific Colloquia and award ceremony was Dr. Philip Morrison, of the Physics Department at the Massachusetts Institute of Technology who spoke on "Two Universes: The Thermal and the Ordered." Dr. Morrison also presented two special lectures earlier in the week.

The John C. Lindsay Memorial Award is presented annually to a member of the Goddard staff who has made an outstanding contribution to science and technology.

Dr. Hanel came to the U.S. in 1953 from Europe where he attended the Technical University of Vienna in Austria. He went first to the Signal Corps at Fort Monmouth, New Jersey, where he worked in the field of electronic acoustics.

He came here in 1959. He is presently Head of the Radiations Branch and Chief Scientist of the Laboratory for Planetary Atmospheres. At Goddard, he has worked on the Vanguard 2 infrared experiment, the TIROS radiometer experiment and the NIMBUS

(See Page 2)

Shock Symposium and Workshop

Goddard employees recently took part in a Shock Symposium and Workshop held at the Howard Community College in Columbia, Maryland, on June 7, 1973. The symposium, sponsored jointly by the college and the Chesapeake Chapter of the Institute of Environmental Sciences, was devoted to the understanding and application of the latest test, analysis and shock measurement techniques. The shock spectrum—a relatively new means of defining and simulating shock forces—was treated.

Coordinator of the symposium was Edmund Fitch of T&E's Structural Dynamics Branch. Goddard speakers were Edward J. Kirchman, Head of the Structural Dynamics Branch; John C. New, Chief of the Test and Evaluation Division; William F. Bangs, Head of the Applied Dynamics Section; W. Brian Keegan of the Applied Dynamics Section; Robert A. Dorian of the Applied Dynamics Section; and Lawrence L. Cook of the Test Operations Section.

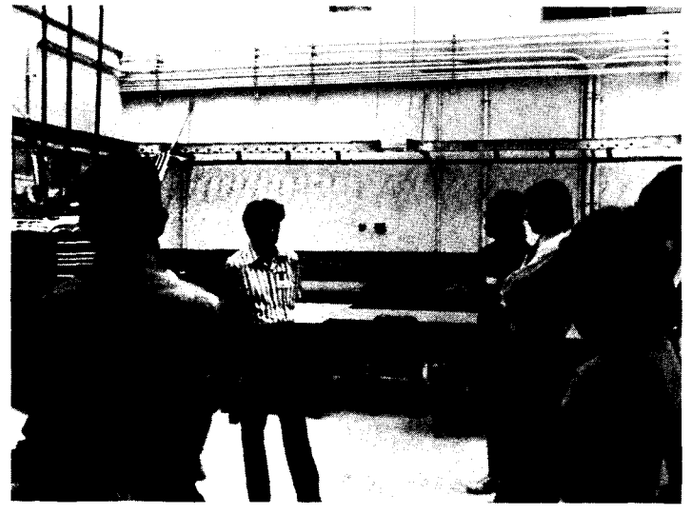
The proceedings of the symposium and workshop are available from the Chesapeake Chapter of the IES in care of Tom Hollingsworth, 3508 Wild Cherry Road, Baltimore, Maryland, 21207. The proceedings are collected in a 168-page book with papers related to shock spectra, shock pulses, derivation of test specifications and the measurement of shock. The price of the book is $5.00 and an additional charge will be made for orders that are not prepaid.

SHOCK SYMPOSIUM. Holding the proceedings of the Shock Symposium and Workshop held on June 7, are IES Fellows (from left) Tom Hollingsworth, Head of the Engineering Support Office; Edward Kirchman, Head of the Structural Dynamics Branch, John C. New, Chief of the Test and Evaluation Division; and Park Espenschade, Manager of the Training and Education Division of the IES.

PLANNERS of the Shock Symposium and Workshop are (from left, seated) P. Espenschade, D. Allwein, E. Schell, E. Fitch and H. Caruso. Standing are T. Hollingsworth, D. Merrill, V. Marone, N. Block, J. New, W. Bangs, W. Elsen, B. Dorian, D. Orbock, D. Shipley, H. Johnson, and E. Kirchman.

LINDSAY AWARD ... From Page 1

HRIR. He then developed the Infrared Interferometer Spectrometer (IRIS) that was the first such experiment successfully flown on a satellite. He was principal investigator for both Nimbus 3 and Nimbus 4 IRIS experiments. The Nimbus experiments were followed by the highly successful IRIS flown on Mariner 9. Dr. Hanel is also principal investigator for the IRIS instrument to be flown on the Mariner-Jupiter-Saturn mission.



JOHN SHEA (center) Goddard Project Manager of the Radio Astronomy Explorer-B, outlines major objectives of the RAE program at a recent press briefing in Hanger S at Cape Kennedy. At left is an engineering model of the Goddard-built satellite. Scheduled to fly on a Delta rocket on June 10,RAE-B will study low frequency radio signals from an orbit around the moon. To be called Explorer 49 in orbit, the satellite is the last scheduled U.S. flight to the moon.

TAP Workshop Meets

A workshop meeting of the newly formed Technical Advisory Panel (TAP) on scintillation met at Goddard during the week of June 4 to 8, 1973, bringing together a panel of experts on ionospheric scintillation from most U.S. government agencies active in space communications and navigation. The TAP also includes engineers skilled in the design of space systems and program managers responsible for system operating requirements and goals.

The workshop was organized in four specialized working groups: the Theoretical Working Group, headed by Professor K. C. Yeh of the University of Illinois; the Data Requirements Working Group, headed by Dr. Edward Fremouw of Stanford Research Institute; the Instrumentation and Facilities Working Group, under Richard Grubb of the NOAA Environmental Research Laboratory; and the Data Processing and Dissemination Working group under Keith McDonald, Executive Secretary of the Defense Navigation Planning Group.

Tom Golden and Dr. Edward Wolff of Goddard were co-chairmen of the panel. The panel operates under the aegis of the Interdepartmental Radio Advisory Committee (IRAC).

FIRE ALERT ... From Page 1

California where it is processed by computer and sent to Forestry headquarters in Sacramento in a useable form. In the Sunol experiment, the fire index information is passed to Sacramento on a daily basis, but it could be made available within an hour after an ERTS pass if need be.

The sensing unit in the Sunol area has been operating successfully for several weeks and the experiment has been termed by the CDF "highly successful." The Ames center has assigned a team of experts to study the design of a network of the sensing units which would cover several critical fire areas.

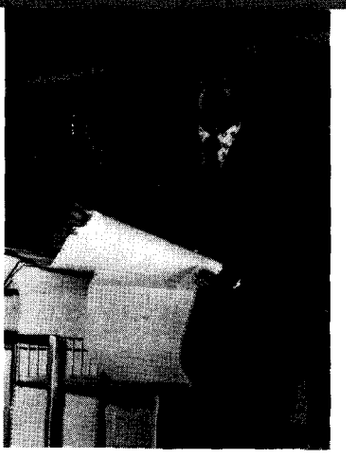
The success of the project is also sparking interest in the possibility of using the system to monitor air pollution.

The fire index project is an example of a continuing program at Ames to identify problems of public interest and concern and help local agencies find practical solutions through aerospace technology.

Heading the joint effort for the California Division of Forestry is William Innes, research meteorologist. Henry Lum, Jr., research scientist, at the Ames Research Center is the NASA project manager.

INTERESTING PEOPLE

John Kaskaske Helps Indian Youth



John Kaskaske, a mathematician in the Operational Orbit Support Branch, is a full-blooded American Indian who divides his time between his job at Goddard and helping young Indians cope with the modern environment.

At Goddard, his work in orbit determination has helped insure the success of two Orbiting Astronomical Observatories and two Interplanetary Monitoring Platforms. Off the job, he is Assistant Scoutmaster of American Indian Intertribal Boy Scout Troop 110, the only Indian troop in the Washington area and one of the few in the country. The troop, in existance for a little over a year, has been so successful that Mr. Kaskaske's wife Janice has started a similar club for girls.

Mr. Kaskaske, who is Kickapoo and Potawatomi, was born in Harrah, Oklahoma, but spent his early childhood on an Indian reservation in Mexico. When he was nine, his family returned to Oklahoma so that he and his brothers and sisters could attend school. At this time, he says "my biggest problem was learning the English language. In first grade, I couldn't understand what the teacher was saying, but I understood the arithmetic on the board. I think that is one reason I leaned toward math."

From this beginning, Mr. Kaskaske went on to earn his B.S. degree in mathematics and physics from Central State in 1965. He had a job for about a year at the Aeronautical Chart and Information Center in St. Louis, Missouri, before coming east to Goddard in May 1966.

Today, Mr. Kaskaske's interests in Indian culture include not only his Scouts but making the Indian point of view known to the outside community. He is an active member of the American Indian Society of Washington, D.C., and a special consultant in Indian affairs to the National YMCA. In this capacity, he helped in the development and adoption of a comprehensive resolution called "A Guide for Local YMCAs" for nation-wide utilization in working with the American Indian People. He and John Parker, Scoutmaster of Troop 110, have traveled extensively to give lectures on Indian life and problems to civic groups across the country.

Yet, his primary interest is still the children. "Young Indians today," he says, "are torn between the old ways and the new."

The Kaskaskes are attempting to teach their Indian scouts about tribal philosophy. Most of the young people are children of Government workers who once lived on reservations. Most of the children had knowledge of the Indian culture, but have lost some of it because of lack of contact with other Indians. Scouting could be a catalyst by which these young boys and girls can be brought together to give them a better understanding of what it means to be an "Indian."

ADDITION

We regret that in last month's article on SAS-2 the name of the thermal engineer, Archie Fitzkee, was unintentionally omitted from the list of principal engineers. The very good temperature characteristics of SAS-2 in orbit show clearly that she did her job well.

BOY SCOUTS of American Indian Intertribal Boy Scout Troop 110 chat with Scoutmaster John Parker (right) and Assistant Scoutmaster John Kaskaske.

Tele-Communications Group Meets Here

The forty-first semi-annual meeting of the Tele-Communications Group (TCG) of the Inter Range Instrumentation Group (IRIG) was hosted by Goddard on May 15 to 18, 1973.

The IRIG was established in 1952 by the various missile ranges to exchange information on common instrumentation and for the standardization of instrumentation systems and equipment. The TCG, among other activities, prepares and dissiminates recommended standards within the Department of Defense and other government agencies for precision frequency and time synchronization systems, command control-systems, and communication and data transmission systems.

The Goddard Data System Requirements Committee (DSRC), chaired by Dr. Robert J. Coates, has members within the various IRIG groups who actively participate in the writing of equipment standards for the missile ranges and satellite tracking stations.

William Hocking, Head of the Data Handling and Display Branch welcomed the thirty representatives from the missile ranges and Goddard. Robert McLellan, of the Atlantic Fleet Weapons Range in Puerto Rico, is Chairman of the IRIG-TCG. Attending the meeting were Clark Wardrip, Chairman of the TCG Timing Sub-Committee and Mort Foxe.

ATTENDEES at the recent IRIG-TCG meeting pose for a group portrait in Goddard's Management Conference Center.

Goddard Wildlife

You may not think of Goddard as a natural habitat for wild animals, but for many species that is exactly what the center is. Goddard's formerly wooded grounds were once home for animals such as deer, and they can still be seen in nearby fields and woods.

A recent project to return parts of Goddard's grounds to nature (GODDARD NEWS, April 1973) is helping to gradually increase the number of animals that can live on center. If you look carefully, you might spot several species without going beyond your parking lot.

The man responsible for much of Goddard's conservation effort is Charles Dupree, Building and Grounds Manager. He and his team from the Plant Operations and Maintenance Division have been working closely with the Department of Agriculture Soil Conservation Service in the project to grade, mulch and reseed selected tracts to return them to a more natural state. He also directs a volunteer team of Goddard employees that has set up 50 bird nesting boxes on fences throughout the center.

"The boxes," reports Mr. Dupree, "have been up for about a year and have attracted bluebirds, chickadees, Carolina wrens and titmice. We hope eventually to place 200 boxes at Goddard."

Each box is checked weekly during the nesting season and a report is sent to the Audubon Naturalists Society for use in maintaining statistics on bird life in Maryland. Goddard employees who have volunteered their spare time to conducting the checks are: Dan Endres, John Pearl, Fred Gordon, Don Henderson, Dave Suddeth, Betty White, Elizabeth Clark, Hattie Sweihart, Ethel Mesler, Winnie Podmostko, Helen Perry and Felice McNeece.

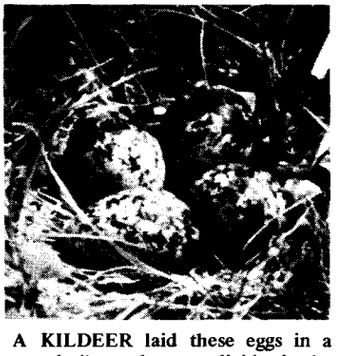
Also interested in land use at Goddard is the Environmental Studies Group headed by Stuart Jordan of the Laboratory for Solar Physics. The group is dedicated to increasing ecological awareness through a series of lectures that focus on environmental problems both at Goddard and in the adjacent community. A recent group meeting included a talk by Dr. Lawrence Zeleny, past President of the Maryland Ornithological Society, and Wayne Everett, of the Soil Conservation Service, on nesting boxes and conservation efforts at Goddard. There was also a field trip to inspect the natural areas being formed around the lake in back of Building 26.

CHUCK DUPREE, Goddard Building and Grounds Manager, points out the settling pond used to reduce sediment going into the lake in back of Building 26. The occasion was a recent field trip sponsored by the Environmental Studies Group. People (from left) are Howard Galloway; Wayne Everett of the Soil Conservation Service; Stuart Jordan; Howard Caulk; Charles Dupree; Dr. Alexander Zeleny, Past President of the Maryland Ornithological Society; Nancy Mengel (partly hidden); Elizabeth Clark; Julie Saba and Winnie Posmostko.

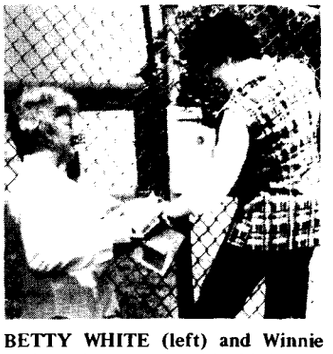
For people who enjoy animal watching, birds are the most numerous animals on center. Besides the birds using the nesting boxes, there were many kildeer nesting on the grounds this spring, including a mixed-up couple that built a nest in the middle of the Building 21 parking lot. Animal watchers have spotted five kinds of hawks here as well as Canadian geese, ducks and purple martins by the lake, tree swallows, kingbirds, quail, pheasant, wrens, nuthatchers, warblers, sand pipers, rufous-sided towhees, woodpeckers, flickers, cardinals, bluejays, red-winged blackbirds, crows, cowbirds, robins, wood thrushes, mockingbirds, catbirds and thrashers.

Other animals include foxes, skunks, raccoons, opossums, squirrels, chipmunks, rabbits, groundhogs, and pilot, black, blue racer, banded-water, king, and hog-nosed snakes. There are muskrats and a huge snapping turtle in the settling pond near the NTTF. The deer crossing signs on roads near Goddard are no joke; many Goddard employees have seen deer on their way home at dusk, and a few have even been seen inside the fence. Mr. Dupree says early morning and evening are the best time for spotting animals.

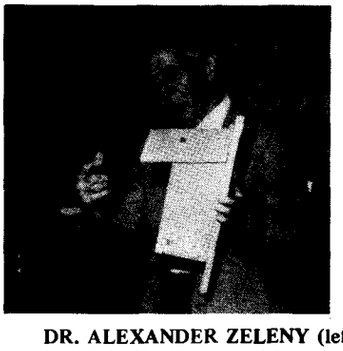
Future efforts to interest more people in land use at the Center are planned. The Environmental Studies Group and the Building and Grounds people have discussed several possibilities, including the development of nature trails, and an open meeting is planned at which these ideas will be presented and a volunteer effort solicited.

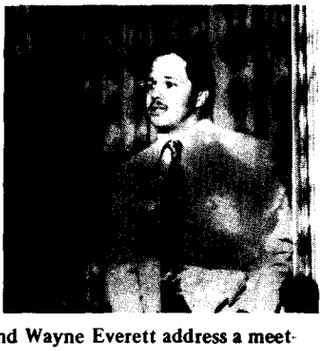


A KILDEER laid these eggs in a nest built on the grass divider in the middle of the Building 21 parking lot.

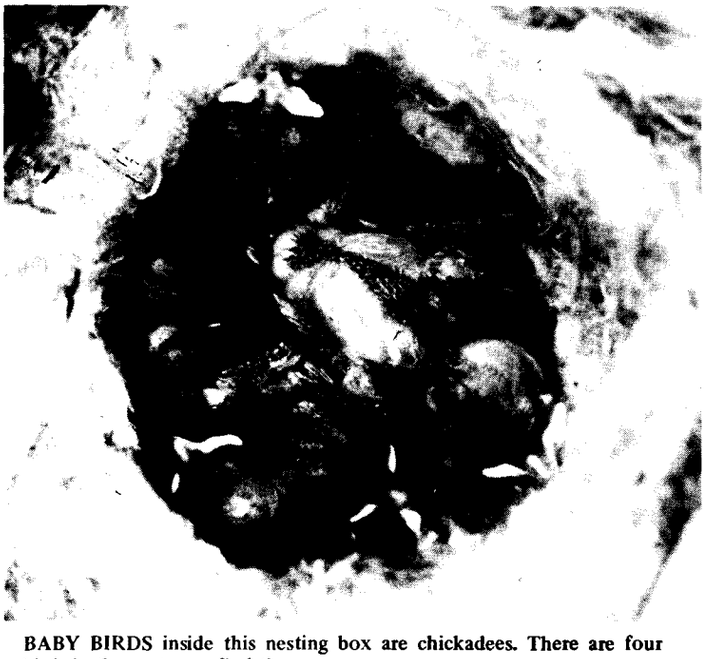


BETTY WHITE (left) and Winnie Podmostko survey a bluebird nesting box.





DR. ALEXANDER ZELENY (left) and Wayne Everett address a meeting of the Environmental Studies Group.



BABY BIRDS inside this nesting box are chickadees. There are four birds in the nest; you find them.

Practical Applications of ERTS

In less than a year in orbit, the world's first Earth Resources Technology Satellite (ERTS-1) has repeatedly viewed some 75 percent of the surface of this planet and most of the United States.

On these pages is a brief run-down of the present status of the ERTS system and data processing plus reports on some of the results from the ERTS-1 data use investigations. Much of the information on ERTS applications is based on presentations made at the *Symposium on Significant Results Obtained from ERTS-1* held on March 5-9, 1973.

Goddard's ERTS team is headed up by Stanley Weiland, ERTS/Nimbus Project Manager; John H. Boeckel, Deputy Project Manager; Dr. William Nordberg, Project Scientist; Luis Gonzales, ERTS Data Handling Manager; and John Y. Sos, Head of the Image Data Processing Branch. Dr. Stanley C. Freden, Assistant Chief of the Laboratory for Meteorology and Earth Sciences, was Chairman of the recent ERTS Symposium.

Post Launch Report on the ERTS System

By John H. Boeckel
Deputy ERTS/Nimbus Project Manager

ERTS-1, launched July 23, 1972, carries two imaging systems, the Multi-Spectral Scanner (MSS) and Return Beam Vidicon Camera (RBV). These two remote sensors take "photos" in three nearly identical bands, two in the visible (red and green) and in the infrared (invisible to the human eye). The MSS also includes a fourth band further in the infrared.

The satellite also carries a Data Collection System (DCS) which acquires messages from remote electronic platforms distributed over North America, for ultimate transmission to Goddard. The platforms measure such parameters as water quality, rainfall, snow depth and seismic activity in remote and frequently inaccessible sites.

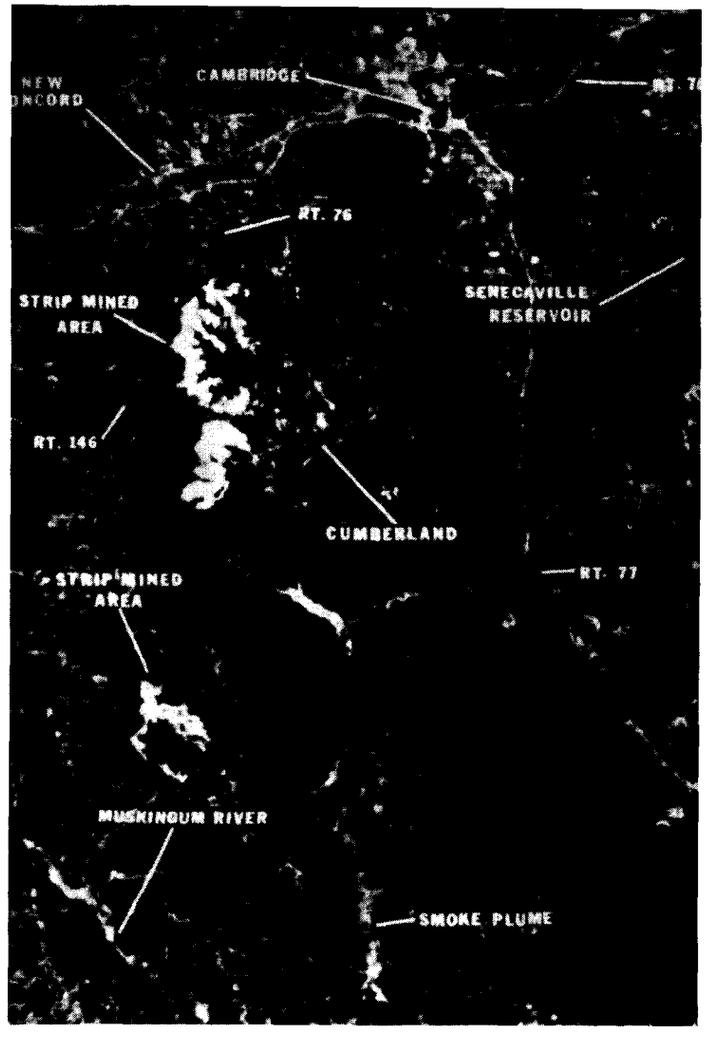
Only one of the two sensors, the MSS, is currently being operated. The other sensor, the RBV, was turned off in August of 1972 when one of the spacecraft's two tape recorders failed and the power supply circuitry for the RBV cameras experienced an anomaly. Although it is possible to activate the RBV through a revised command sequence, it has been decided to restrict operations to the MSS only for the present time. The second tape recorder has recently experienced some technical difficulties but much of the recorded data being returned is still useful. This tape recorder is not required when ERTS is within range of the United States ERTS receiving sites because data are transmitted directly or in real time.

The ERTS system includes the observatory, receiving sites in Alaska, California, and Goddard; an initial image generation system, photographic production laboratory and distribution system at Goddard; and a group of some three hundred scientific investigators scattered around the world.

By mid-May 1973, ERTS-1 had completed over 4,200 orbits or sixteen 18-day whole-earth coverage cycles. During this period an average of approximately 190 scenes were acquired each day. Cumulative statistics for the period are: Scenes acquired, 57,893; black and white images shipped, 540,684; precision and color images shipped, 19,250.

The average time interval between the acquisition of a scene and the shipment of the image to an investigator is between four and five weeks. However, in response to emergency situations such as the flooding of the Mississippi this spring, a four-day turn-around was achieved.

(Next page, please)



STRIP-MINED AREAS and other natural and man-made geographical features are shown on this section of an ERTS-1 image of Ohio taken on August 1, 1972.

Environment Surveys

By Dr. Stanley C. Freden
Laboratory for Meteorology and Earth Sciences

ERTS-1 images are being used to monitor water pollution in rivers, lakes, and in the oceans, and also to monitor land pollution. Efforts are also being made to determine if air pollution, such as aerosols, can be monitored using ERTS-1 images. An ERTS-1 image of Lake Champlain is being used by the state of Vermont in a law suit against the state of New York. The contention is that the effluent from a paper mill on the New York side above Fort Ticonderoga is being carried over to the Vermont side and polluting the entire lake. An ERTS-1 image of the New York harbor area clearly shows the remains of acid waste and sewage sludge dumped into the harbor. In Ohio and Pennsylvania vast areas of the land are being stripped in order to obtain the coal lying near the surface. These areas are readily seen on ERTS-1 images and are being monitored and inventoried. When reclamation efforts are made, ERTS-1 imagery will monitor the rate of revegetation.

Other areas of important concern for environmental monitoring are the wetlands along the coasts which are responsible for spawning much of the biological productivity required for human consumption and recreation. These wetlands areas are under constant pressure from pollution and from cultural pressures because of their obvious recreational advantages. ERTS-1 imagery is being used to monitor these areas along the Chesapeake and Delaware Bays and along the Texas Gulf Coast as well as in several foreign countries.

AGRICULTURAL LAND USE PATTERNS are shown in this ERTS-1 image of the Yuma, Arizona-Blythe California area. Note the irrigated agriculture along the Colorado River (center), the Gila River (bottom right), and a portion of the Imperial Valley in California (bottom left). Imperial Valley agriculture is augmented by the All American Canal which is visible as it crosses the Algodones sand dunes located in the lower left corner of the image.

Agriculture, Forestry and Range Resources

By Dr. Harold L. Mathews
Earth Survey Sciences Office

Investigators in agriculture, forestry and range resources are enthusiastic about the potential uses of ERTS-1. Imagery is already yielding practical returns in such areas as crop and vegetation identification, timber and range resources surveys and the construction of soil association maps.

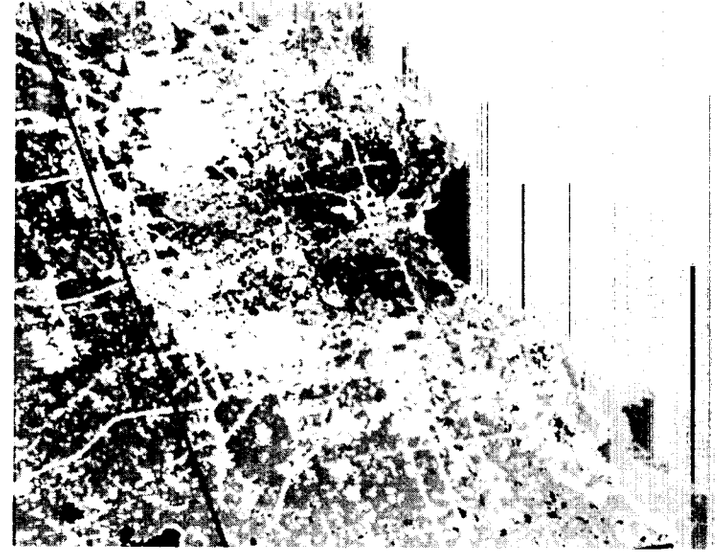
The spacecraft is providing results which indicate crop type at an accuracy level which may eventually enable agricultural workers to make operational acreage and yield estimates using satellite data. Crops readily identified from ERTS-1 imagery include corn, soybeans, popcorn, winter wheat, rice, safflour, asparagus, and cotton.

Detection of field conditions (growing crop, plowed fields, harvested fields, etc.) could be accomplished for fields as small as 10 acres in the Imperial Valley of California using enlarged (1:62,500) color composites. The ability to determine agricultural land use from ERTS-1 imagery will enable government agencies to more accurately assess the damage to agriculture caused by such disasters as this spring's Mississippi River flood.

In the area of timber and range resource survey and classification several investigators reported significant results. One investigation reported the observation of growth rate of annual grasslands in California and the use of ERTS imagery to forecast potential fire hazards caused by lush growth of these grasses.

Photo interpretation of a color composite of the Seward Peninsula, Alaska required only 10 man-hours to delineate seven vegetation types, whereas only four types had been known before. Significantly more detail in distribution of these vegetation types is available from ERTS-1 imagery than is available on existing maps. Various ages of old burn areas and the rate of re-vegetation of these scars were also identified. Successful mapping of wildland vegetative resources even to a relatively broad scale allows some judgement to be made as to how the area should be managed for a watershed wildlife habitat, livestock grazing, recreation and for development. This broad based information becomes even more valuable in remote and sparsely populated areas such as Alaska and Nevada.

Soil association maps have been derived from ERTS imagery. One investigator in Columbia, South America used existing reconnaissance soil maps and successfully extrapolated into an unknown area using ERTS imagery in conjunction with sample strips of aerial photography. Work in South Dakota and Tennessee indicates that generalized soil map accuracy can be improved using 1:500,000 enlargements of MSS imagery.



MILWAUKEE land use classifications are shown in this digital display image. The black line is the boundary of Milwaukee County.

Land Use Classification

By Dr. William Finch
Earth Survey Sciences Office

ERTS-1 imagery for the classification of land use in urban areas is well demonstrated by an image of Milwaukee that was produced on the LARS, Purdue University digital imaging display. Four general land use classes and five classes of water are identifiable in the Milwaukee scene.

The Central Business District appears as a white area at the core of major converging traffic arteries of the city. Immediately surrounding the Central Business District and appearing in black on the photograph is the Inner City residential area, consisting mainly of bungalow or two-flat types of structures. Several industrial districts appear in white and occur in ribbon fashion strung out along river valleys or major streets and highways. The third and outermost of the concentric ring pattern of land use in Milwaukee consists of suburban development appearing as white or gray. Land use in the suburban area includes residential, recreational, institutional, and open space areas which were mapped from the ERTS computer compatible tapes as three land use types—Suburban, Grass, or Wooded Suburb. At least ten satellite municipalities which serve as bedroom communities for the metropolitan area were mapped as Suburban land use in this classification. Four areas of Wooded Suburb were mapped. Open areas mapped in the Grass land use category consist mainly of parks, golf courses, and cemeteries.

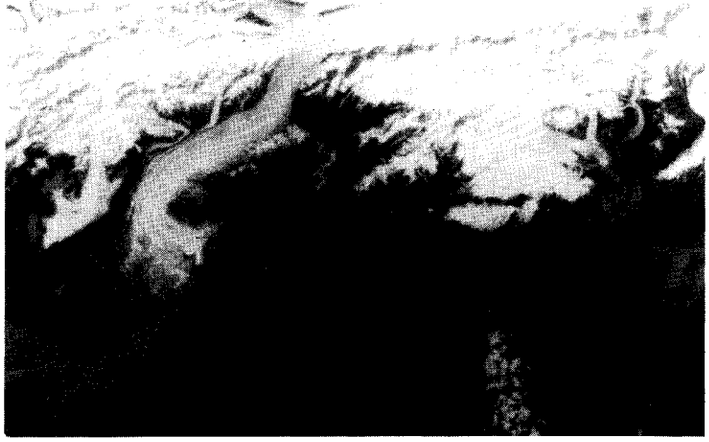
JOHN BOECKEL Continued

The performance of the system has exceeded expectations. Registration of the Multi-Spectral Scanner images in different spectral bands is within about 55 meters or one third of the prelaunch prediction. Long linear features such as roads less than 50 meters wide can can easily observed if the contrast is sufficiently high.

To date the ERTS system has produced high quality images of every major land mass, Including the polar regions. The North American Continent has been covered 10 times. Copies of these pictures are available to all citizens of the world through the EROS Data Center, Sioux Falls, South Dakota 57198, or the National Climatic Center, Federal Building, Ashville, N. C. 28801.

The prime contractor for the ERTS spacecraft, Ground Data Handling System and Data Collection System is the General Electric Company. Other prime contractors are Hughes Aircraft for the Multi-Spectral Scanner; RCA for the Return Beam Vidicon Cameras and wide band tape recorders; and McDonnell Douglas Astronautics for the Delta launch vehicle.

Federal agencies participating with NASA are the Departments of Agriculture, Commerce, and Interior, the Army Corps of Engineers and the Environmental Protection Agency.



THE BERING GLACIER in Central Alaska shows characteristics that are typical of surging glaciers in this image taken by ERTS on September 22, 1972. The surging glaciers are distinguished in ERTS imagery from their non-surging counterparts by the wiggly or folded morains that are shown near the southern portion of the glacier. Note also the large sediment plumes resulting from snow and ice melt that extend tens of kilometers into the Gulf of Alaska.

Hydrology

By Dr. Vincent V. Solomonson
Earth Survey Sciences Office

Hydrologically relevant features have proven to be quite observable in ERTS-1 data. In the 0.8-1.1 micrometer spectral region, unfrozen surface water and areas with relatively high soil moisture are clearly delineated by low reflectance (darker tones in imagery) in contrast to dry soils and vegetated surfaces. Surface water bodies as small as two acres have been observed easily from ERTS-1.

The most topical application that has been made of this capability to date concerns the mapping of areas inundated by floods. This kind of application has been accomplished for the area of the East and West Nishnabotna Rivers in Iowa following a flood in September 1972. Similar results were obtained for the flooding of the Upper Gila River in Arizona in October 1972 and during the spring floods of the Mississippi River this year.

Snow and ice covered areas stand out clearly in the 0.5-0.6 μm and 0.6-0.7 μm observations. This can be used to study glaciers such as the Bering Glacier in South Central Alaska. The Bering Glacier is the largest glacier in continental North America. It is also a surging glacier which means it remains stationary for several years and then unexpectedly will move relatively large distances (several kilometers) in a season. The ability to locate and monitor surging glaciers has practical importance because the glaciers often advance and block off large quantities of melt water that eventually are released very rapidly and cause flooding. By knowing where this potential exists proper precautions can be taken.

Using ERTS-1 data, investigators can repeatedly observe the extent of snow cover and relate changes to expected runoff. In the relatively remote and mountainous regions of the western United States, most of the snow cover is difficult to observe and measure by conventional means, but nevertheless constitutes a large fraction of the runoff and available water supply.

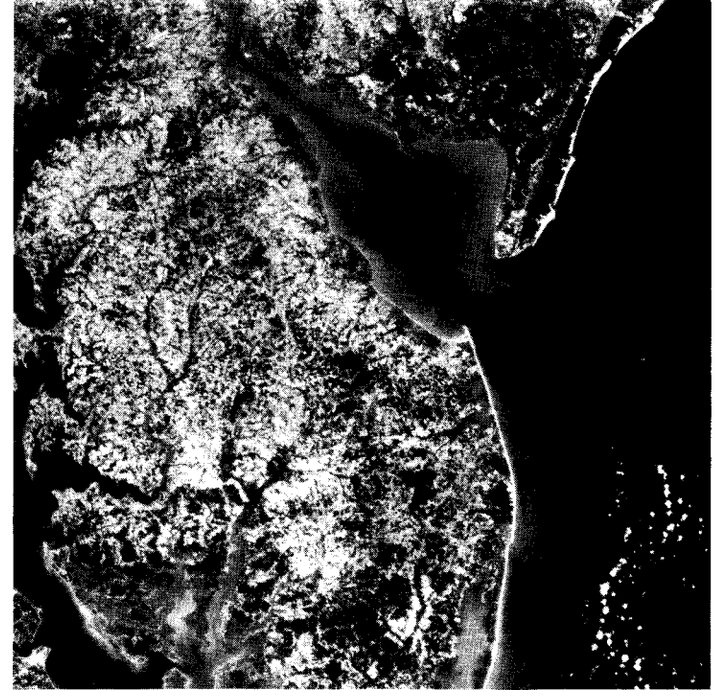
Wetlands, shorelines, erosion, fields under irrigation, circulation patterns, algal blooms, and other surface water hydrology features can be monitored from ERTS-1.

Oceanography

By James R. Greaves
Meteorology Branch

Although not specifically designed for ocean measurements, the ERTS-1 data have been successfully applied to a number of oceanographic disciplines. These include coastal and oceanic circulation, bathymetry, fisheries resources and sea ice surveillance.

In coastal areas, sediment acts as a tracer allowing circulation and dispersion patterns to be monitored. In the 0.6-0.7 μm band imagery of Delaware Bay, recorded on 10 October 1972, the suspended sediment patterns are clearly visible. These patterns were confirmed by ship and aircraft data acquired on the same day. Such imagery may



DELAWARE BAY image by ERTS-1 shows the circulation patterns of suspended sediment.

be used in environmental analysis, pollution monitoring and near shore construction planning.

The status of available hydrographic charts for the 130,000 km of world coastline is generally inadequate. ERTS-1 has shown that the synoptic and repetitive coverage provided by satellite-borne sensors may provide us with the tools to generate, for the first time, accurate, up-to-date hydrographic charts of the world's coastal waters and shallow seas.

As part of a cooperative program, government and industry scientists are examining the roll which satellite sensors might play in fisheries management. The menhaden fishery in the Mississippi Sound portion of the Gulf of Mexico has been selected for the initial studies. The menhaden is an ocean-going fish used largely for fish meal and fish oil. Qualitative correlations have been established between high radiance levels in the 0.6-0.7 μm band data and the location of menhaden fish schools as determined by major fish catches on the day of the satellite overflight.

In recent years, the economic development of Arctic Alaska has become of particular national interest. Economic development will require an increased understanding of the region's natural character and the processes operating to maintain or change that character. Ice is perhaps the most important agent affecting these processes. Despite the importance of adequate ice information, the harsh and remote polar environment has required the use of slow and costly methods for data acquisition. ERTS-1 data have already been used to track ice movements, map ice boundaries and to determine ice type, size and concentration.

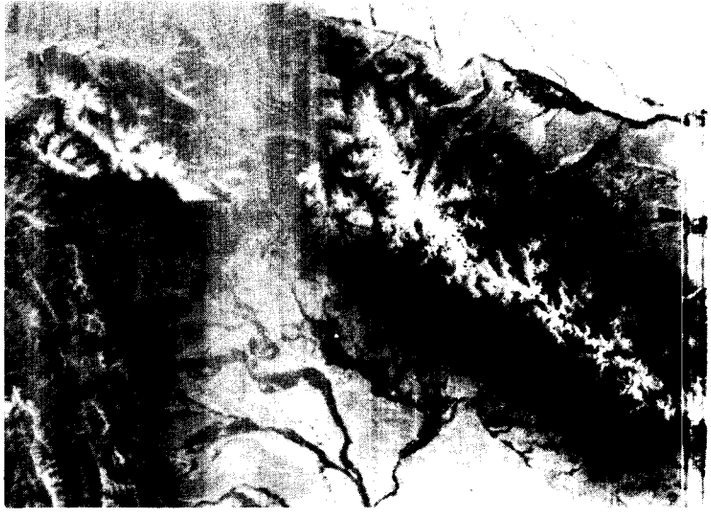
Geology

By Dr. Nicholas M. Short
Earth Survey Sciences Office

The largest number of ERTS-1 investigations concern geology. Investigators interested in new sources of structural and geomorphic information are finding ERTS-1 invaluable because of its synoptic coverage of most of the Earth. Other investigators concerned with dynamic real-time phenomena, such as volcanism, sedimentation, erosion, stream shifts, delta growth, shoreline changes, glacial movement, and mass wasting, can now monitor them on a continual basis. Geologists working in petroleum, ore, and non-metals exploration, engineering and environmental problems, and field mapping of areas lacking good small-scale maps are utilizing the worldwide coverage of ERTS-1 for many new applications.

ERTS-1 images in vegetation-sparse regions reproduce the surface expressions of complex geological features. A South African ERTS-1

(Next page, please)



THE WIND RIVER MOUNTAINS IN WYOMING as seen in ERTS imagery on August 6, 1972, demonstrate the observatory's potential for monitoring the extent of snowpack and giving geologists an excellent tool for mapping linear features. Monitoring snowpack helps in the management of water resources in the west. Mapping linears using ERTS helps scientists study the geological history of remote regions such as Wind River.

image was used to examine the exceptional exposures of the ancient greenstone-granite cratons of Rhodesia. Another image of South West Africa was used to prepare a map superior to any other available of that district in the southern African metamorphic shield. Better portrayal of several intrusives, at least one of which contains nickel-copper deposits, shows the promise of ERTS-1 for ore prospecting.

Volcanologists will find a storehouse of exciting information in the ERTS images. Flows, vents, cone fields, and domes are sharply defined in images from the western U.S., Italy, Africa, Indonesia, and Japan.

By far the most frequently cited use of ERTS-1 in geology has been its ability to highlight linear features both in rock exposures and in alluvial-filled basins. Even in well-mapped regions, the number of linears observed by ERTS-1 usually exceeds those shown on large- or small-scale maps. Exposed linears were traced in the Adirondacks where fractures and known to exert strong control on topography. Of 561 linears seen in ERTS-1 images, 329 represent new or anomalous ones; field checking, however, demonstrates many to be other than geological in nature.

ERTS-1 has an obvious potential for rapid mapping of linears in regions of difficult access. A geologist in Wyoming has been working for years on a lineaments map of the Wind River Mountains in Wyoming through arduous field reconnaisance supported by aerial photo-interpretation. Prior to ERTS-1 less than 15% of the terrain had been mapped but the remaining 85% was completed in less than 3 hours using ERTS-1 alone.

To date, no mineral deposits as such have been discovered through direct use of ERTS-1 data. It is too soon to expect any major finding but ERTS does focus on some likely areas that deserve prospecting by conventional techniques. Several investigators alluded to the association of linear intersections and a tendency for mineralization to concentrate around such points or along the linears themselves. Mercury deposits in California appear to cluster around intersections, some of which are now pinpointed for the first time from ERTS-1. Attempts to recognize geochemical ore guides by looking for telltale surface discolorations is also meeting with limited success.

How ERTS Pictures Are Made

By Bernard Peavey
Image Processing Branch

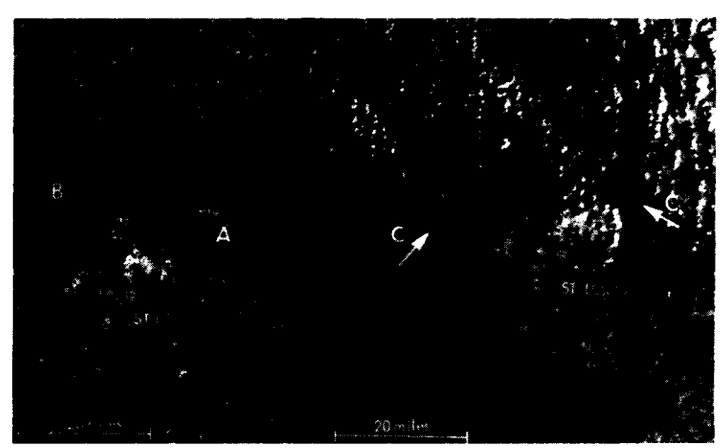
ERTS-1 picture making begins with the video to film conversion whereby 5×10^7 bits (electrical signals) per image are transformed into shades of gray on photographic film. Auxiliary data describing satellite position, attitude, and image annotation is generated separately on the NASA Data Processing Facility's computer, and is furnished on magnetic tape to be used in conjunction with the corresponding video tapes. The auxiliary data tapes are used by the DPS

PHOTOGRAPHIC LABORATORY in the NASA Data Processing Facility in Building 23.

central computer to generate control signals for the EBR (electron beam recorder), while the image data from video tapes finds its way to the EBR through appropriate interfaces and control devices. As the special EBR film moves continuously in the EBR vacuum chamber, the electron beam, whose position and intensity are controlled respectively to within 12 micrometers and 5% at any instant of time, strikes the film emulsion and exposes it in the form of scan lines similar to television. After printing 2.6×10^3 such lines an ERTS image is reconstructed and exposed on film. Rolls of this 70mm film, containing 150-200 images per roll are forwarded to the photo lab.

In the photo lab, the latent images exposed on the archival film are developed and processed. What comes out is the first generation (archival) 70 mm positive roll of high quality B&W images. At this point, every image is inspected for defects and cloud cover, and is given a quality rating. Following this image assessment the archival film is then used to make master negatives and enlargements from 70 mm to 9.5 inch. The 9.5 inch images provide a 1:1,000,000 map scale. B&W prints are then made from the enlarged master negatives. Third and fourth generation positive and negative transparencies are produced from the second generation negatives.

Color prints and transparencies are made from selected B&W 9.5 inch negatives. Three of the four bands are required to produce color products. Presently, only green (0.5-0.6 μm), red (0.6-0.7 μm) and one of the two IR bands (0.8-1.1 μm) are used. In order to make color composites, the master transparencies must be registered with respect to each other, which is accomplished by punching holes through precision registration marks. These holes are then used as printer loading guides, since color printing must take place in total darkness. Each set of three B&W transparencies is printed on a special printer in a prescribed sequence, and with blue, green, and red print-through filters.



THE ST. LOUIS MISSOURI AREA as seen by ERTS-1 shows extreme flooding along the Illinois, Missouri, and Mississippi Rivers. In the photograph at left, taken October 2, 1972, the Missouri River joins the Mississippi River at point A, and further upstream the confluence of the Illinois and Mississippi Rivers is noted by letter B. The photograph on the right was taken over the same region on March 31, 1973. It clearly shows areas under water (letter C) as a result of the flooding.

BOWLING CHAMPIONS. This is the fourth consecutive year for the Phantom-Five team to reign as champions of the Goddard Wednesday Night Men's Bowling League. Members with their trophy are (from left) Bill Hawkins, Glen Sites, Jim Rohacs and Ron Lowery. Missing is Bob Brillante. Both Glen Sites and Bob Brilliante have been members of the team for all four years, with Bill Hawkins and Ron Lowery having been members for three years. Two of the members also received individual awards this year—Bill Hawkins for High Average 177 and Bob Brillante for Second High Scratch Game 259.

Outputts by Maceo Leatherwood

A Busy Small Business Week

Small Business Week, on May 14 to 18 was a bustle of activity sponsored by the Office of Small Business Specialists in the Procurement Division. Under the direction of Robert Warren, Small Business Specialist, the staff, composed of Liz Castaldo, Nancy Collins, Doris Ann Fleming, Albert Glorioso, and Arthur Wolter, used the theme "Crusade for Small Business" to bring together a variety of activities ranging from the design of a sign at the main entrance gate to the visit of Congressman Paul W. Cronic (R-Mass) of the House Science and Astronautics Committee. Congressman Cronin visited the Center to view the industrial demonstrations in Building 26.

CLIP AND SAVE

This is the third of a series of articles by Earl D. Ellis on plating, protective coatings and electrochemical processes available from Goddard's Experimental Engineering and Fabrication Division. For further information, Mr. Ellis can be reached on extension 4870.

Chemical and Electrochemical Treatments of Magnesium and Magnesium Alloys

Pure magnesium because of its poor mechanical properties finds little use in Aerospace Applications. However, there are certain alloys of magnesium which have wide applications in flight and ground support equipment. Magnesium and its alloys require chemical or electrochemical treatments to protect their surfaces.

Surface conversion coatings to provide corrosion resistance or durable paint base undercoatings include anodizing, chromate coatings, and stannate coatings. Other requirements such as emissivity, conductivity, solderability, or other electrical or optical properties may be obtained by electroplating the magnesium alloy with a suitable deposit such as copper, gold, back nickel, etc.

The alloy most suitable for electrochemical treatment is AZ31B. This is a high strength, low density, alloy possessing excellent machining, forming, and welding properties. After proper stress relief treatment the alloy also has good long term stability. This alloy is commercially available in sheet, plate, and extrusions. As with all magnesium alloys, this alloy must undergo surface treatment for corrosion resistance.

The next issue will delineate the types of surface treatments and their applications.

STANLEY GALLAGER of the Small Business Administration presents a citation to Dr. John F. Clark, Goddard Director, in recognition of Goddard's excellence in enhancing the Small Business Set-Aside Program. Looking on is Jim Hollis of SBA.

←

CONGRESSMAN PAUL CRONIN discusses Small Business Week with William E. Mathis, Chief of the Procurement Division; Dr. George Pieper, Director of Space and Earth Sciences; and Samuel Keller, Director of Administration and Management.

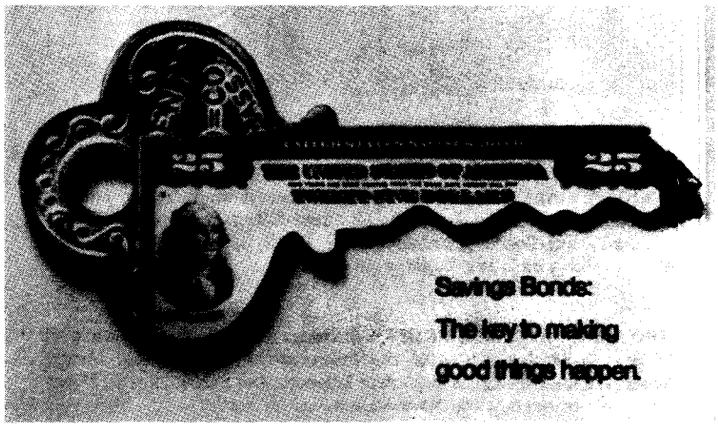
GODDARD AROUND THE WORLD

Vanguard Protocol Visits

THE VANGUARD TRACKING SHIP was host to over 1500 special guests—including technical, military, civil officials and American Embassy personnel—during a protocol visit to Buenos Aires, Argentina on April 17 through 23. Some of the visitors at an official luncheon held on board the ship are (from left) Admiral D. Gonzalo Bustamante, the Senior Naval Officer present; Dr. Myron B. Kratzer, Science Consular for the U.S. Embassy; Otto W. Thiele, NASA Station Director; Captain Emiddio Massa, U.S. Naval Attaché at the U.S. Embassy; Dr. Enrique Cantilo, Senior Civilian, Argentine Space Commission; U.S. Ambassador John Davis Lodge; and General Fernando E. Zappino, Chief of CNIE, the Argentine Space Commission. The USNS Vanguard, the only tracking ship in Goddard's Spaceflight Tracking and Data Network, is presently stationed in Mar del Plata, Argentina, in support of the Skylab mission.

DURING A BRIEFING for VIP's and the press aboard the Vanguard at Buenos Aires on April 17 U.S. Ambassador John Davis Lodge, Captain J. J. Cullen, Ships Master; and Otto Thiele, Station Director; answer questions about the U.S. space program.

IN MAR DEL PLATA, the Vanguard's temporary home port for the Skylab mission, about 600 guests toured the ship during her first week in port. Here, during a luncheon reception on April 27, are heads of local universities, the Mayor-Elect of Mar del Plata, the present Mayor's representative, and chiefs of Army, Air Force and Navy commands in the Mar del Plata area.



HONEYSUCKLE CREEK, AUSTRALIA. Apollo 17 Lunar Module Pilot Dr. Harrison (Jack) Schmitt talks to Laurie Turner, Supervising Technician, in the operations room at the station. Dr. Schmitt (right) was in Australia for Coral Sea Week celebrations and took the opportunity to visit Honeysuckle Creek during this visit to Canberra. During the Apollo 17 mission, Laurie had a short chat with Dr. Schmitt when a breakdown in communications between MCC and HSK occurred.

CORPUS CHRISTI, TEXAS. The STDN station recently received a Silver Campaign Award for participation in the local Corpus Christi United Fund Campaign. This award is presented to organizations exceeding their assigned goal. Displaying the award here are Lloyd White (right), NASA Station Director; J. P. MacDonald (left), Assistant M&O Supervisor; and campaign committee co-chairmen (left to right) M. H. Heim, P. T. Carter, R. R. McClanahan and W. W. Rockett. Not present for the picture was Mrs. Carolyn Yarborough, the fifth member of the campaign committee.

GODDARD NEWS is published monthly by the Public Affairs Office of the Goddard Space Flight Center, National Aeronautics and Space Administration, Greenbelt, Md. 20771. Deadline for contributions is the last Thursday in the month.

Editorial Staff

Nancy Mengel Jim Kukowski

Mrs. Patricia Ratkewicz, Ext. 4141