goddard news

December 1973 Vol. 21, No. 9

Successful ITOS Turned Over to NOAA

On November 29, Goddard turned over the nation's newest operational weather satellite (NOAA-3) to the National Oceanic and Atmospheric Administration. The spacecraft, one of the Imroved TIROS Operational Satellite (ITOS) series, was launched by NASA for NOAA on November 6 from the Western Test Range in Lompoc, California.

Goddard is responsible for technical management, launch and checkout of the spacecraft for the weathermen. RCA Corporation, Princeton, N.J. designed and built the satellite under GSFC's technical direction.

Project Manager Jack Sargent said the spacecraft is returning excellent data from its 1312 kilometer (820 mile) circular polar orbit. This includes visible and infrared imagery as well as vertical temperature measurements which are for the first time being made available to countries other than the United States for preparation of local weather forecasts.

The imagery and temperature profiles from sea level to 20 miles above Earth are taken over the entire planet on a daily basis. In addition, sea surface temperatures are determined by the satellite for delayed transmission (placed on tape recorders) to NOAA's National Environmental Satellite Service in Suitland, Md., for world distribution.

NASA ADMINISTRATOR Dr. James C. Fletcher presents a model of Dr. Goddard's first liquid fueled rocket to Dr. Charles G. Abbot, a pioneer in solar activity research, during a recent symposium here at Goddard. Dr. Abbot, who is 101 years old, as Secretary of the Smithsonian, funded Dr. Goddard's pioneering research on liquid fueled rocket engines. (See story on page 2.)

Goddard's Cosmic Ray Telescope on Pioneer-10

A MODEL of the Cosmic Ray Telescope aboard Pioneer-10 is the center of attention for (from left) Experiment Engineer Donald Stilwell, Principal Investigator Dr. Frank B. McDonald, and Co-Investigators Bonnard Teegarden and James Trainor. The compact instrumentation of the Goddard/University of New Hampshire Experiment weighs only seven pounds and uses 2.3 watts of power.

Scientists from Goddard and the University of New Hampshire were on the alert early this month as the record-breaking Pioneer-10 spacecraft made its closest approach to Jupiter. Their Cosmic Ray Telescope is one of 11 scientific instruments aboard the Pioneer designed to give man his first close-up look at the solar system's largest planet.

Pioneer-10, launched on March 2, 1972, made its closest pass of about 81,000 miles from Jupiter on December 3. Pioneer's 60-day encounter with the planet is extending from November 4 through January 3. If all goes well (The *Goddard News* is going to press during the most critical days of the mission) the flight of Pioneer-10 will give us our first close-up color pictures of Jupiter and its inner moons, and provide information on its turbulent atmosphere and cloud currents, its bizarre Red Spot, its murky interior, and the surrounding magnetic, electrical and radiation environment.

Many of the Pioneer experiments, including the Goddard Cosmic Ray Telescope, have been in operation for much of the spacecraft's long journey and have already returned a wealth of information about regions of space beyond the orbit of Mars. Pioneer-10 is the first spacecraft to pass the orbit of Mars, the first to cross the asteroid belt, and will become the first man-made object to escape the solar system.

Frank B. McDonald, Principal Investigator for the Cosmic Ray Telescope and head of Goddard's Laboratory for High Energy Astrophysics, reports that data from the experiment so far has been good and includes indications of a new component of galactic cosmic rays. The Pioneer mission offers science its first real opportunity to study the spectrum of cosmic rays in regions beyond the screening effect of the Sun's magnetic field and the solar wind. If the space-

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Scientists Discuss Sun's Effect on Earth's Weather

Do solar events affect weather here on earth? This was the prime topic of a symposium held here on November 7 and 8 in the Building 3 Auditorium.

The symposium on "possible relationships between solar activity and meteorological phenomena" was sponsored cooperatively by NASA, the University Corporation for Atmospheric Research (UCAR) and the American Meteorological Society. The 200 participants included meteorologists, aeronomers, solar and plasma physicists and astrophysicists from the United States, England, Australia, the Netherlands, Germany and the U.S.S.R. They discussed some intriguing theories and evidence that solar activity does effect earth's weather and went on to discuss the type of measurements needed to determine the nature of solar-meteorological relationships and the physical mechanisms that could cause them.

In his welcome and opening remarks, Dr. James C. Fletcher, NASA Administrator, dedicated the symposium to Dr. Charles Greeley Abbot, for his pre-eminent pioneering work in the measurement of the solar constant and the search for solar-meteorological relationships. Dr. Abbot, who in 1972 celebrated his one hundredth birthday, accepted from Dr. Fletcher a model of Robert H. Goddard's first liquid-fueled rocket which flew in 1926. Dr. Abbot was a strong supporter of Goddard's early rocket research, as well as a strong long-time advocate of solar activity influences on weather.

Some of the evidence discussed that solar activity influences weather was:

- The recurrence of droughts in the high plains of the U.S. seems to be related to the double sunspot cycle of 22 years.
- Glacier advances and other indicators of cold climate in late glacial and post-glacial time occurred during intervals of weak solar activity, and a similar percentage of glacier recessions and warm climate indicators occurred with high solar activity.
- In some regions of the globe the atmospheric pressure increases after geomagnetic storms, whereas in other places the pressure decreases. The reaction time is about three days and tends to increase with decreasing latitude.
- High latitudes show higher average pressures at sunspot maximum than at minumum and at high solar activity there is a mass displacement of air toward high latitudes.

Some Goddard people who took part in the symposium were Dr. Stephen P. Maran and William R. Bandeen, both members of the steering committee; and H. G. Mayr, Donald F. Heath, Robert G. Roosen, Dr. James P. Heppner, and Dr. William Nordberg, who presented papers or took part in the discussions.

DR. MORRIS TEPPER of NASA Headquarters chairs the Symposium discussion panel. Dr. William Nordberg of Goddard and other world renowned scientists participated in a stimulating discussion to wind up the two day symposium.

Goldwater's Evening at Goddard

SENATOR BARRY M. GOLDWATER operates a 20 meter position during a dual ceremony—the inauguration of the Goddard Radio Club's new station facilities and beginning of commemoration transmissions for Skylab IV with the special call sign WS3SKY. From left are: Karl R. Medrow, W3FA, station trustee; Dr. John F. Clark, W3GYH, GSFC Director; Hugh A. Turnbull, W3ABC, President; and Senator Barry M. Goldwater, K7UGA.

By H. Wade Stonesifer

During the evening of November 15, 1973, members of the Goddard Amateur Radio Club were pleased to have as their guest the honorable Barry M. Goldwater, K7UGA. He has been active in Amateur Radio activities for many years. After a brief welcome from Dr. John F. Clark, W3GYH, Senator Goldwater received a short tour of the Center which included the museum in Building 1, followed by the Operations Control Center, Computer Complex, NASCOM, and Network Support Team areas in Building 14.

Because the Goddard Amateur Radio Club was inaugurating a new club station and commemorating the Skylab activities by using the special call sign of WS3SKY, Senator Goldwater consented to do the "ribbon cutting" honors and operate the station. Little time was required to create a "demand" to talk with the Goddard Station.

Following a buffet dinner attended by the club members and their guests, Senator Goldwater was the principal speaker to a standing room only crowd of members and guests from local area Amateur Radio Clubs, in the Building 3 Auditorium. His topics ranged from Amateur Radio and Communication Legislation, to the energy crisis, future of NASA, current politics, and even how to communicate with your elected representatives. A candid question and answer session followed.

After the discussion was concluded, Dr. Clark presented our distinguished guest with a model of Dr. Robert Goddard's first rocket and an ERTS photograph of Arizona in the vicinity of Scottsdale.

From "over the air" comments received by the Goddard Amateur Radio Club the following morning, the evening was enjoyed by all.

THE SENATOR (from left), K7UGA, and Hugh A. Turnbull, W3ABC, present certificates of appreciation to Lawrence J. Williams, WA3RVU, Ricky Maeda, WN3VKF, and George Maeda, WA3TWA. The three teenagers, who have all completed their instructions and earned novice or general licenses, are the youngest members of the Goddard Amateur Radio Club.

Comet Kohoutek 1973: A Rare Visitor in Space

Comet Kohoutek 1973f, which makes its closest approach to the sun on December 28, has sparked the most exhaustive comet watch in history. Since it was discovered last March by Lubos Kohoutek of Germany's Hamburg Observatory, astronomers and space scientists have had time to prepare comet studies that will employ instruments ranging from telescopes on the ground to satellites in space.

According to Dr. Stephen P. Maran and Dr. Robert W. Hobbs of Goddard's Operation Kohoutek Special Office, Kohoutek "will travel through the inner solar system during a unique period in the history of the space program – when Skylab and Mariner Venus-Mercury are in operation and the new C-141 Airborne Infrared Observatory is ready for flight."*

Comets orbit the sun at varying distances, some taking a few years to make one revolution, others taking thousands of years. We know very little about where they come from, what they are made of or when and how they were formed – in spite of the fact that recorded observations date back to 467 B.C. Many scientists think that comets consist of the original material from which the solar system was formed, and Kohoutek – a long-period comet – may be in a purer state than comets with shorter orbits.

Operation Kohoutek, a cooperative effort between NASA and scientists from organizations across the country, will attempt to:

- Identify the original substances or "parent molecules" of the gases or "daughter products" observed in comets. As comets approach the sun, frozen gases in the nucleus evaporate and the re sultant vapors are disassociated and ionized to produce the daughter products that have been detected spectroscopically in comets. If scientists can determine the composition of the parent molecules, they will have a valuable clue to the origin of comets and the solar system.
- Study transient events in the comet to determine their relationship to solar and interplanetary phenomena.
- Measure the velocity of the solar wind in the inner solar system. Since the plasma of a comet's "tail" is always pushed away from the sun by the solar wind, its behavior can be used to study the solar wind itself.
- Search for helium, deuterium, molecular hydrogen, and other substances that have not yet been found in comets.

To achieve these goals, Operation Kohoutek will study the comet from all possible angles using: Skylab-4, Mariner Venus-Mercury, Pioneer 6 and 8, Copernicus, OSO-7, sounding rockets, an airborne infrared observatory and Lear-jet, a far-infrared balloon program, and ground-based observatories. GSFC's ATS-3 may also help.

Skylab will perhaps offer the most unique opportunity to study the comet. It will be the first time men in space will have had a chance to observe and photograph a comet. The astronauts will use a Far Ultraviolet Electronographic Camera designed at the Naval Research Laboratory to record the comet many times as it approaches, passes and recedes from the sun. Viewing the comet from space, the astronauts may also have a better chance to record transient events in Kohoutek as they happen.

Space probes such as the Mariner Venus-Mercury and Pioneer-8 and 6, transmitting from deep space, will help give scientists a three-dimensional view and data on solar plasma near the comet.

Copernicus (OAO-3) will be used to study hydrogen atoms in the comet, measure their temperature characteristics, and detect hydroxyl radicals.

One of the OSO-7 Kohoutek studies will involve the use of Dr. Werner M. Neupert's spectroheliograph to attempt to map the comet in the EUV spectral range.

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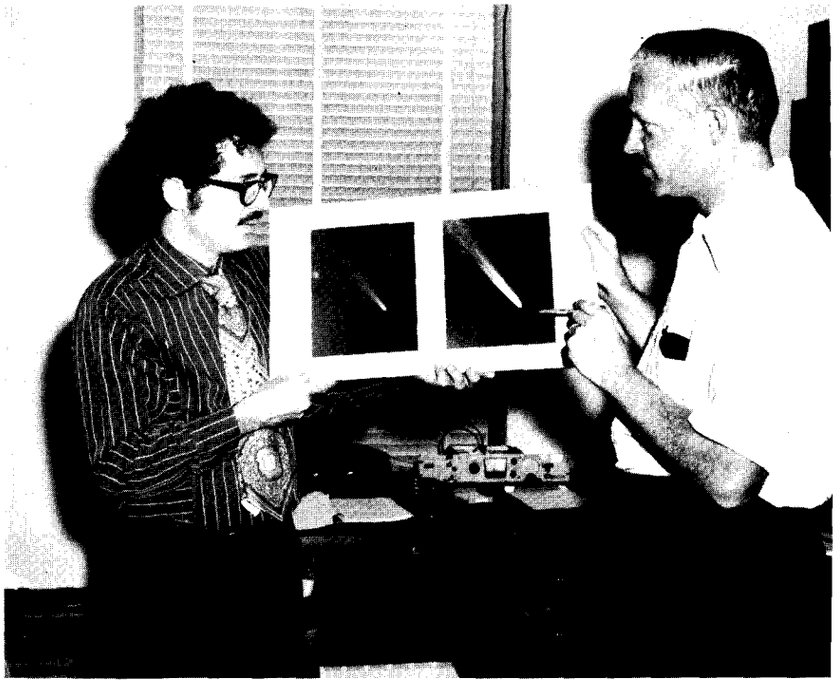
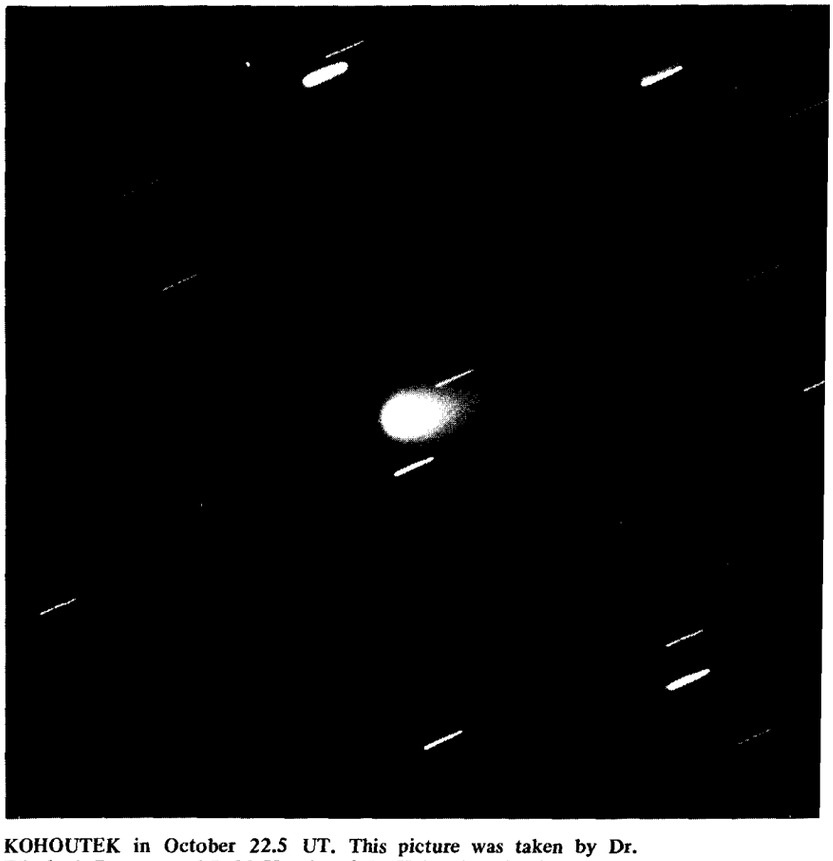
*This quote and much of the material in this article were taken from an article by Dr. Maran and Dr. Hobbs in the October 1973 issue of *Astronautics & Aeronautics.*



DR. STEPHEN P. MARAN, Manager of Operation Kohoutek, and Dr. John C. Brandt, Chief of the Laboratory for Solar Physics, inspect comet photos taken in 1970 with Goddard's 14-28 inch Schmidt telescope. The telescope has just been relocated to South Baldy Mountain, New Mexico.



KOHOUTEK in October 22.5 UT. This picture was taken by Dr. Elizabeth Roemer and L. M. Vaughn of the University of Arizona using the 90-inch reflector at the Steward Observatory on Kitt Peak. In the original, a tail about ten arc minutes in length extends slightly north of west from the nucleus.

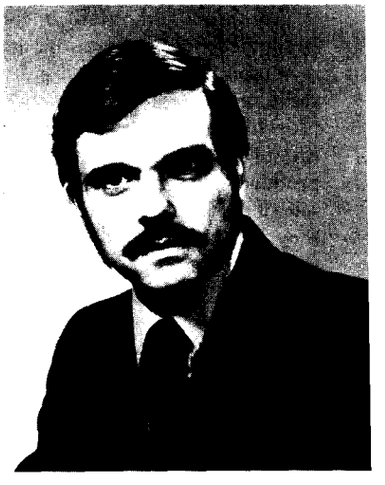
KOHOUTEK . . . From Page 3

The five sounding rockets launched from New Mexico to study the comet will include one experiment by Dr. Donald West of Goddard.

The many, many ground based studies will include some by Goddard's Dr. John C. Brandt and Dr. Robert G. Roosen at a new observatory, the Joint Observatory for Cometary Research, in New Mexico.

By the end of February when Kohoutek streaks out of the inner solar system, we may have some of the answers to some puzzling questions about comets. Are they "dirty snowballs" composed of ice, methane, ammonia and dust particles as Dr. Fred L. Whipple of the Smithsonian Astrophysical Observatory theorizes? If so, were they formed in the vicinity of Jupiter's orbit as the solar system evolved? Or are they formed of more complex substances that have been detected in galactic clouds and regions where stars may have been formed as A. G. W. Cameron of Harvard suspects? If so, were comets formed outside the solar system?

AT AN OPERATION KOHOUTEK STAFF MEETING are (from left) Tim McAfee, a day-shift communications operator from the Bendix Corporation in the Operation Kohoutek Information Center; Bonnie Slaughter, project secretary; Edward Rothe, technical officer; Frank Liberatore, project coordinator; Dr. Stephen P. Maran, Manager of Operation Kohoutek; Dr. John C. Brandt, Chief of the Laboratory for Solar Physics; Irene Jenkins, assistant project secretary; and Bonnie Noble, scientific mailing list coordinator. In the picture at right is Dr. Robert W. Hobbs, Assistant Manager of Operation Kohoutek.



How to Photograph Kohoutek

By Dr. Robert D. Chapman

Between early December and early February, Comet Kohoutek will be a naked-eye object. The following material describes how to photograph the comet during this time period. Exposure times listed are given as guides and not as hard and fast rules. Once you pick an exposure time, you will want to experiment with a range of times around this value and choose the best results on the basis of your initial photographs.

If you have never tried to photograph a celestial object before, we recommend that you wait until January 7 or later when the comet will be an obvious object in the evening sky. Begin your exposure while the sky is still twilit, but some stars are visible.

Guiding your Camera. Because of the rotation of the earth, the stars seem to move slowly across the sky. In any long exposure, the camera will have to be guided to compensate for this motion or the stars and comet will be smeared on the film. For further information consult a reference such as the *Amateur Astronomer's Handbook* by J. B. Sidgwick.

If you use a 35-mm camera with a standard 50-mm focal length lens, stationarily mounted on a sturdy tripod, no smearing due to the earth's rotation will be apparent for exposures of 15 seconds or less. In addition, the smearing will not be excessive even for a one minute exposure, while any longer exposure will product obvious smearing. With a telephoto lens or small telescope, the earth's motion is magnified along with the comet's image and shorter exposures may show smearing.

An additional factor to consider is the motion of the comet itself. If you use a telescope to photograph the comet, you may have to guide on the head of the comet to compensate for its motion among the stars. With a 35-mm camera and the standard 50-mm focal lenth lens, the comet's motion in one hour would not be noticeable. However, with a telephoto lens the motion could be appreciable in one hour. On any exposure under 1 minute the comet's motion can be ignored, with any instrument, however.

The f/number. In photographing an extended object such as a comet, the exposure time is proportional to the square of the f/ratio of the lens, and is independent of the aperture. This means you can get comparable pictures whether you use a 35-mm camera or a giant telescope.

The history of cometary photography is relatively long. One photographer succeeded in photographing Donati's comet in 1858

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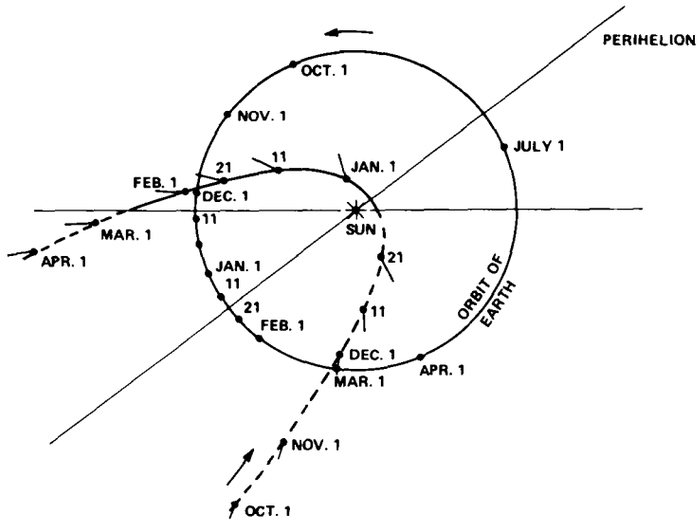


RELATIVE POSITIONS of the earth and Comet Kohoutek between October 1, 1973, and April 1, 1974. The dashed portion of the comet's orbit is below the plane of the earth's orbit.

1,000,000 ERTS Images Produced by NDPF

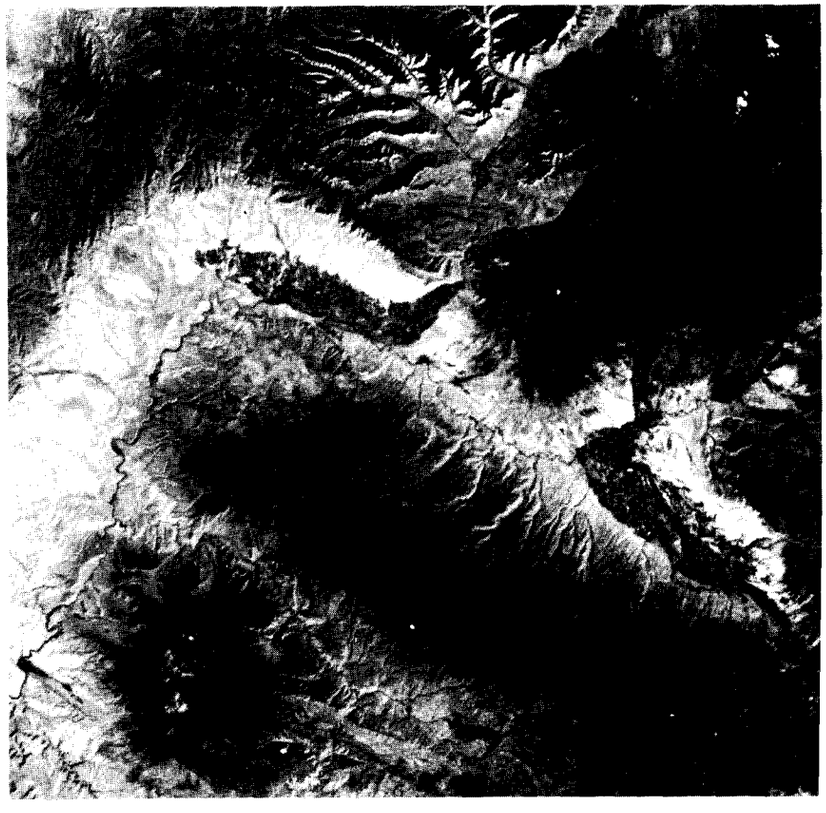
On November 9, Goddard's NASA Data Processing Facility (NDPF) passed a major milestone with the processing and shipment of its one millionth film product. The image, a photograph taken by the Earth Resources Technology Satellite (ERTS) of the Grand Junction area of Colorado, was sent to Dr. Daniel H. Knepper, Jr. of the Geology Department of the Colorado School of Mines.

The NDPF, which is responsible for processing high quality data from ERTS, converts the telemetry data recorded on station tapes into images on film and computer tapes. Black and white copies and enlargements, color composites, and copies of computer compatible tapes are produced within the facility and distributed to investigators on a world-wide basis.

The photo lab consumed over 14,000 rolls of film in the generation of these pictures, and the shipping department prepared approximately 75,000 packages in 14 months of operation. The one million pieces of film shipped from the facility, if placed end to end, would extend over 87 miles. Furthermore, the facility has supported data processing from 218 ground-based Data Collection System (DCS) platforms, handling 383,000 messages and forwarding 129,310 punched cards and 9,750 computer listings.

In addition to the 330 principal investigators being served, several U.S. Government agencies are receiving a total of 40,000 images per week from the NDPF. From this material, these agencies produce products within their own facilities and distribute them to their own customers. Agency products were not included in the count of one million mentioned above.

Located in Building 23, the NDPF is a part of the data processing responsibility of the Information Processing Division. The facility is managed and operated by 23 government staff members and 215 Computer Sciences-Technicolor Associates (CSTA) employees who are supported by personnel from General Electric, Bendix, Ampex and Xerox.



THE ONE MILLIONTH IMAGE from ERTS-1 shows the state of Colorado centered near Grand Junction.

STANLEY WEILAND, ERTS Project Manager, drops the one millionth photo product, a picture of Colorado taken by the ERTS-1 multispectral scanner, into the mail for delivery to Principal Investigator Dr. Daniel H. Knepper, Jr. of the Colorado School of Mines. Dr. Knepper will study the color composite photo for its mineral and water resources information. From left are William Webb, Data Processing Facility Operations Manager; Richard Holmes, NDPF Users Services Manager; and Mr. Weiland.

The project is managed by the Image Processing Branch under the direction of Branch Head John Sos, Operations Manager William Webb, and CSTA Assistant Project Manager Richard Overmyer. "The success of the project," says Mr. Sos, "is the direct result of the team effort generated by all employees associated with the task."

Managers of the various NDPF sections are as follows:

Section	NASA	CSTA
• Image Generation	P. Heffner/R. Powless	J. Fritz
• Photo Processing	A. Schulman/H. Paull	R. Davis
• Data Systems	W. Watt	P. Walsh
• Operations Control & Scheduling/Shipping	J. Tinsley	D. Marquis
• User Services	R. Holmes/R. Feinberg	L. Littman
• Quality Assurance	B. Peavey/R. Hermann	T. Mackin
• Logistics	B. Moss	L. Littman

General support is provided by the following branch members: V. Thomas and L. Brown, both responsible for software; G. Grebowsky, systems analysis; E. Connell, and J. Eck, engineering; W. Alford, J. Billingsley, R. Wagner, and F. McCaleb, SRT; and M. Isham, Branch Secretary.

The ERTS is at present scanning in four color bands about 150 scenes (185 km x185 km areas) of the earth daily. Once it arrives at the NDPF, the data is processed as follows:

Image Generation. All imaginery data received at the NDPF is processed by Image Generation. Data is accepted in the form of video tapes and converted to film imagery using an electron beam recorder.

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ERTS IMAGE . . . From Page 5

Photo Processing. Film from Image Generation is developed and transferred to Photo Processing where, after processing, multiple copies are made for distribution to investigators. The facility is capable of producing 70mm and 9-1/2 inch black and white imagery, 9-1/2 inch color imagery, and 16mm microfilm.

Data Systems. A central computer system, utilizing a comprehensive data base and information storage and retrieval capability, provides control of NDPF operations. The NDPF utilizes a Xerox Sigma 5 computer and provides the capability for production control, management reporting, data storage and retrieval, services to users, and preparation of digital products.

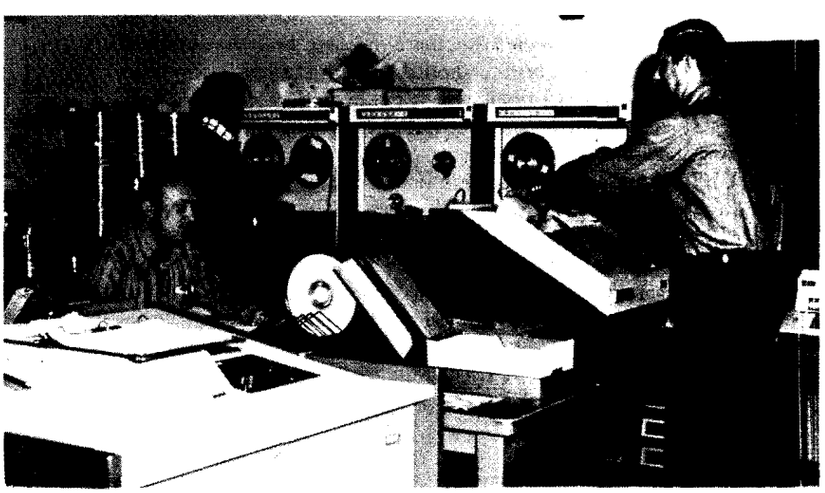
Operations Control and Scheduling/Shipping. This section is responsible for directing the receipt and processing of imagery into the ERTS data base; scheduling completion of requests for ERTS imagery; and shipping completed products to the user. Shipping currently distributes these products to over 200 investigators within the U.S. and to 100 investigators outside of the U.S.

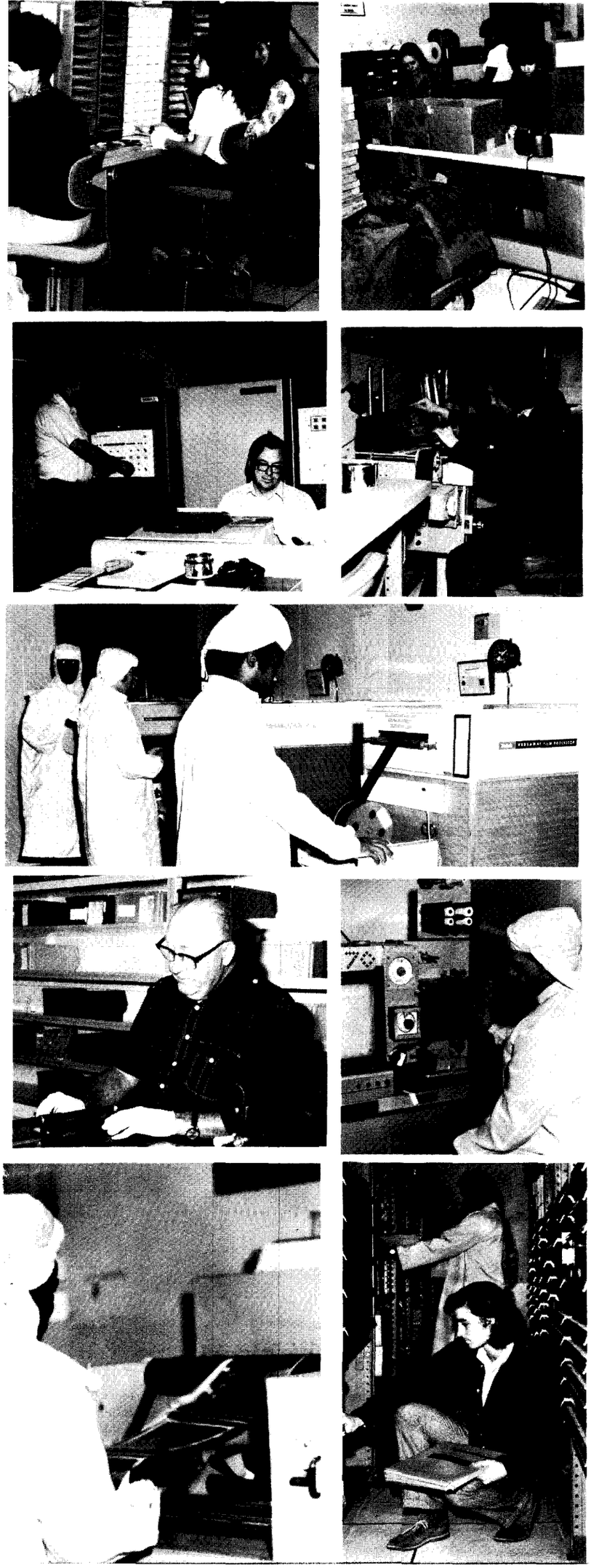
User Services. User Services functions as the single NDPF point of contact for all investigators and user agencies on all matters relating to ERTS data products. The group provides a full range of activities including: catalogs, a comprehensive data retrieval system, microfilm services, dissemination of all imagery and DCS data, image descriptor maintenance, and a data ordering system.

A Browse Facility is also maintained within User Services where all of the ERTS images are available for viewing. The Browse Facility is used extensively by earth scientists from the Washington, D.C. area and is also popular with visitors from outside the area and from abroad, especially from the developing countries. The Browse and the NDPF itself has been visited by several Ambassadors, Government Ministers, one Head of State, and numerous U.S. and foreign dignitaries.

Quality Assurance. Quality Assurance performs quality checks and cloud cover assessment on all ERTS imagery; incoming material inspection; mixed chemistry evaluation; conducts performance audits of all operating functions; and performs equipment failure analysis. In addition, total system performance statistics are maintained.

Logistics. Logistics furnishes all expendable supplies, and utilizes extensive software in the initialization, procurement, analysis, and provision of materials.





Goddard Spacecraft May Have Detected 'Black Hole'

A team of British scientists, using Goddard's Copernicus satellite (Orbiting Astronomical Observatory), say they have established that the previously predicted black hole in space is no longer theoretical. It's a fact.

The scientists at London's University College, under the direction of Dr. R. L. F. Boyd with direct observations and data reduction by Dr. Peter Sanford, have tied the binary super giant star system, HDE 226868, to the X-ray source, Cygnus X-1, and have detected evidence of the structure of the visible star's gas clouds swirling around and into the X-ray source or black hole.

Cygnus X-1 emits intense X-rays, representing a million times more energy than the total energy output of our own Sun. The X-rays, coming from the immense gravitational field on the edge of the black hole, compress the visible star's atmosphere prior to its complete disappearance into Cygnus X-1.

This black hole, located in our Galaxy, is estimated to be three times the mass of our Sun, but less than 1/50th of its size.

A black hole is a dying star which has collapsed on itself. Neither light nor matter can escape because of its intense gravitational field. The star's material is so densely packed that a spoonful of material from the center would weigh more than a billion tons. Although it is invisible, the black hole's presence can be detected by X-rays emitted from the extremely hot gases falling into the black hole after being pulled off the visible super giant star. The visible star could eventually disappear altogether down the black hole leaving no trace of its former existence.

By observing the way X-rays are absorbed as they pass through the visible star's atmosphere, the scientists have concluded that the X-ray object is very small. The mass of the black hole, more than three times that of our Sun, is known by the way the visible star moves in its orbit. Such a great invisible star, points to only one conclusion, says Dr. Sanford: "It's a black hole."

Cygnus X-1 is 2 to 3 kiloparsecs or about 6000 light years (the distance light travels at 186,000 miles per second in a year) from Earth, and is orbiting its visible star every 5.6 days.

The British astronomers, using Copernicus, have also observed extended X-ray sources identified with clusters of galaxies such as those in the constellations of Perseus, Coma, Virgo, and Centaurus. In general, the nature of the emission is still unknown, but studies of the Perseus cluster show that there is X-ray emission in the exploding Seyfert Galaxy, NGC 1275. The experimenters believe that enormous upheavals are taking place in its nucleus, and that it is affecting the whole Perseus cluster of several thousand galaxies. (There are about 100 billion stars in our own Milky Way galaxy). They believe the X-rays may be associated with what is called the inverse Compton effect in which high velocity electrons traveling near the speed of light collide with radio and optical photons. Their conclusions suggest that X-rays originate in the most active galaxies of the cluster.

The "Black hole" theory of X-ray stars is accepted by many astronomers, although positive proof is difficult to put forward. No satisfactory alternative theory of X-ray stars exists, however.

The 2200-kilogram (4900-pound) Copernicus was launched from Kennedy Space Center, Fla., August 21, 1972, carrying an ultraviolet telescope designed by Princeton University Observatory and X-ray telescopes provided by University College London.

Goddard is project manager for the spacecraft and Grumman Aerospace Corporation, Bethpage, L.I., New York, is prime contractor.

Pioneer . . . From Page 1

craft continues to transmit data as it passes beyond Jupiter, we will gain further looks at cosmic ray components that cannot reach us within the inner solar system.

One of the missions of the Cosmic Ray Telescope and related instruments aboard Pioneer-10 is to study a different planetary magnetosphere and to measure the effects of hard radiation on spacecraft instruments during the closest pass to Jupiter to determine if Pioneer-11 can safely approach even closer to the planet when it makes its fly-by a year from now. Pioneer-11, launched last spring, is a sister mission to Pioneer-10 and will continue many of the studies being conducted by the present mission.

Other objectives of the Goddard/University of New Hampshire experiment are, in brief: to measure the energy spectra and isotopic composition of galactic and solar cosmic rays; to measure the flow patterns of energetic solar and galactic particles separately in the interplanetary field; to measure the time variations of the differential energy spectra of electrons, hydrogen and helium nuclei over the corresponding energy intervals both during flare events and quiet times; to provide information on the energetic particle distribution surrounding Jupiter; and to try to determine the extent of the solar cavity, the energeticles phenomena occurring at its interface and the cosmic density in nearby interstellar space.

To achieve these objectives, and to meet the weight and power requirements of the Pioneer mission, Goddard teams designed an experiment package that is three times lighter than comparable systems aboard IMP-I and H. Weighing in at a mere seven pounds, the system contains three solid-state telescopes that measure the flux of protons and electrons at high, medium and low energy levels. Weight and power saving techniques used in the package include the use of aluminum honeycomb for the baseplate and top plate, stacking the circuitry in a sandwich-like construction and the use of MOSFET devices in the data system. This data system contains over 50,000 transistors, weighs less than one-half kilogram and uses less than 0.75 watt. The entire experiment package uses only 2.3 watts of power.

The Cosmic Ray Telescope teams are directed by Dr. Frank B. McDonald, Head of the Laboratory for High Energy Astrophysics. Co-Investigators from Goddard are Bonnard J. Teegarden and James H. Trainor. Co-Investigators from the University of New Hampshire are William R. Webber and Edmond C. Roelf. Donald Stilwell is the Experiment Engineer.

Pioneer-10 is a project of NASA's Ames Research Center.

TEAM MEMBERS responsible for the Cosmic Ray Telescope data processing and analysis are (from left) Joyce Scanlon, Dr. Nand Lal, and Charles Dickman.

MECHANICAL DESIGN of the experiment package was the responsibility of (from left) Adam Thompson, Frank Shaffen, and Henry Trexel.

FABRICATION TEAM MEMBERS for the Cosmic Ray Telescope are Elijah Tankisley (left) and Earl Ellis.

HOSEA WHITE (left) and John Thomason help design the MOSFET data system that contains over 50,000 transistors.

Sue Prevost Appointed Branch Head

NEW BRANCH HEAD. Sue Prevost was appointed head of the Tracking Operations and Systems Reliability Branch on November 11. In her new post, she is responsible for providing personnel management support for the Systems Reliability, Mission and Data Operations, and Networks Directorates. Mrs. Prevost first came to Goddard in August of 1960 from the Naval Ordnance Laboratory in White Oak, Maryland.

KOHOUTEK . . . From Page 4

using a short focus portrait lens, while another failed to photograph the same comet with a 13-inch f/9 telescope. One of the most spectacular comets of all time appeared in 1882. After perihelion passage, when the comet was visible after sunset, David Gill, H.M. astronomer at the Cape, took several excellent photographs using an f/4.5 portrait lens with only 2-1/2 inch aperture, that he borrowed from a photographer and mounted on one of the observatory's telescopes. Gill's photographs are comparable to results to be had with modern equipment. So don't hesitate to try a photograph because you don't have a big telescope. It does not matter!

Films. Eastman-Kodak recommends a fast Panchromatic film such as Tri-X pan or Plus-X pan for photography of comets. In principle the film sensitivity is proportional to the ASA rating. Thus Tri-X at ASA 200 is 2.5 times more sensitive than Plus-X at ASA 80, and the exposure on Tri-X would be 1/2.5 times as long. A film such as Panatomic-X (ASA 32) is slower than the above, but finer grained and would be adequate.

Black and white films by other manufacturers are, of course, equally acceptable. The GAF equivalent to Tri-X Pan is Super Hi-Pan, for example.

For color photography one must decide on the film to be used after determining the exposure time. If the exposure time is under 10 seconds, the ordinary daylight color films are the best choice. However, if the exposure exceeds 10 seconds, the color rendition on the negative will not be correct. In this case, one should use either one of the commercially available "low light level" color films, such as Ektacolor L, or Kodachrome X.

A center has been set up to study amateur observations of Comet Kohoutek. Send copies of your better pictures with full particulars (time, day, film, f/stop, etc.) to Dennis Milon, 378 Broadway, Cambridge, Massachusetts 02139.

The following tables can be used to estimate the nominal exposure time beginning with the basic exposure time and correcting it for a different magnitude, different film and different f/number. Not taken into account are many other effects not enumerated here. Therefore, experimental exposures at: ½ the estimated exposure, the estimated exposure, 4 times the estimated exposure, and 16 times the estimated exposure should be made. This should be a sufficient range to give you at least one good picture.

The basic exposure for a comet of magnitude 0, with a focal ratio of f/2 and using an ASA 100 film is 10 seconds.

Photographic Tables

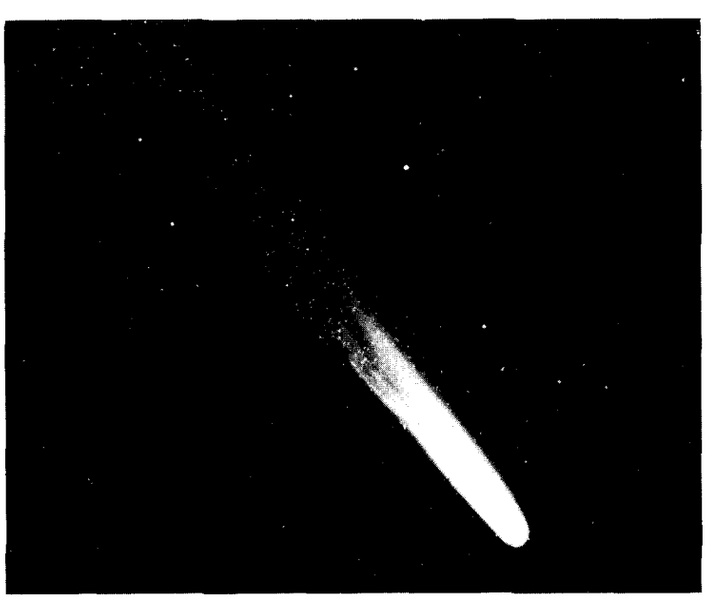
Date 1973-74	Magnitude of Comet	If your f/ratio is	Multiply your Exposure by
Dec. 14	+2.7	f/2.5	1.5
Dec. 24	-1.0	f/3.8	3.6
Jan. 3	-0.7	f/4.5	5.0
Jan. 13	+2.2	f/5.6	7.8
Jan. 23	+3.9	f/6.3	9.9
Feb. 2	+5.3	f/8	25.
		f/12	36.
		f/16	64.

If the Magnitude of the Comet is Between	Multiply Your Exposure by	If Your Film is ASA	Multiply Your Exposure By
-5.62 & -6.37	1/256	10	10.0
-4.88 & -5.61	1/128	25	4.0
-4.12 & -4.87	1/64	32	3.1
-3.38 & -4.11	1/32	64	1.6
-2.62 & -3.37	1/16	80	1.2
-1.88 & -2.61	1/8	100	1
-1.12 & -1.87	1/4	200	1/2
- .43 & -1.11	1/2	400	1/4
- .42 & + .42	1	600	1/6
+ .43 & 1.11	2		
1.12 & 1.87	4		
1.88 & 2.61	8		
2.62 & 3.37	16		
3.38 & 4.11	32		
4.12 & 4.87	64		
4.80 & 5.61	128		
5.62 & 6.37	256		

Example:
The magnitude of the comet is -2 and you have a f/4.5 lens and are using ASA 400 film. Then the exposure time is

10 second	x	1/8	x	5	x	1/4
basic time		magnitude factor		f/ratio factor		ASA factor

Exposure time is 50/32 second or about 2 seconds, therefore experiment with exposures of length, say 1/2 sec, 2 sec, 4 sec, 8 sec.



TWO RECENT COMETS. Comet Bennett was recorded on April 16, 1970 by John C. Brandt, Robert G. Roosen and Sarma Modali using a f/2 Schmidt telescope here at Goddard. Note the division of the tail into two parts. Comet Tago-Sato-Kosaka was recorded on January 11, 1970 by F. D. Miller of the University of Michigan. Both comets were surrounded by huge hydrogen clouds that could not be seen from earth.

(See Page 10)

Visibility of Comet Kohoutek in Washington, D.C.

Comet Kohoutek should become a naked eye object early this month. The actual brightness of the comet will depend on viewing conditions in your area.

Comet Is a Morning Object

Local Standard Time (a.m.)

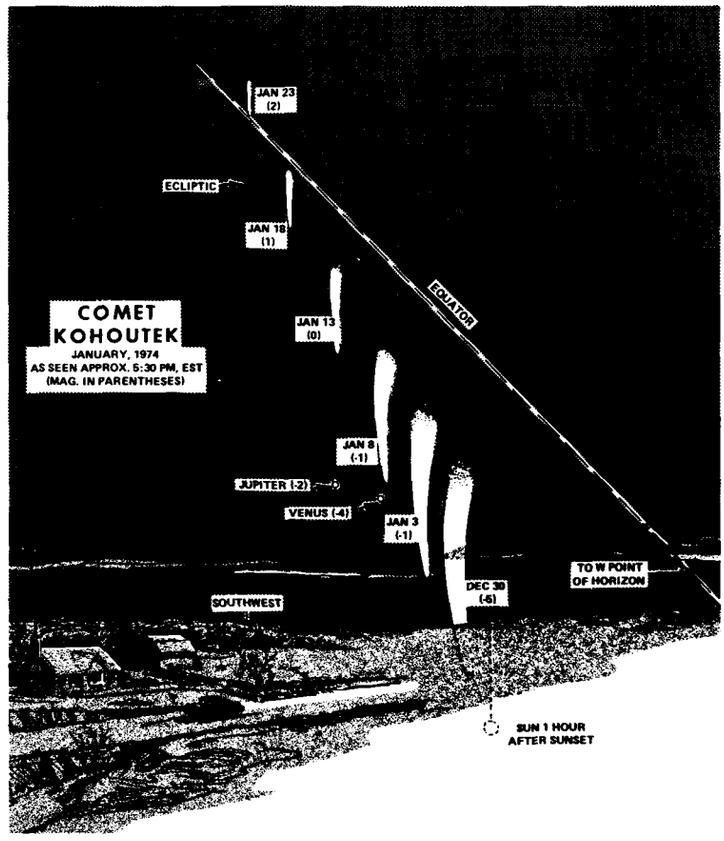
Date	Comet's Head Rises	Twilight Begins	Sunrise	Comments
Dec. 16	5:45	5:43	7:21	Comet visible in early phase of morning twilight.
Dec. 20	6:18	5:45	7:23	Comet should be visible in early SE morning twilight.
Dec. 24	6:52	5:46	7:25	Comet visible west of sun in morning twilight. From Dec. 24 through Dec. 31 it is within 10 degrees of sun.

Comet Is an Evening Object

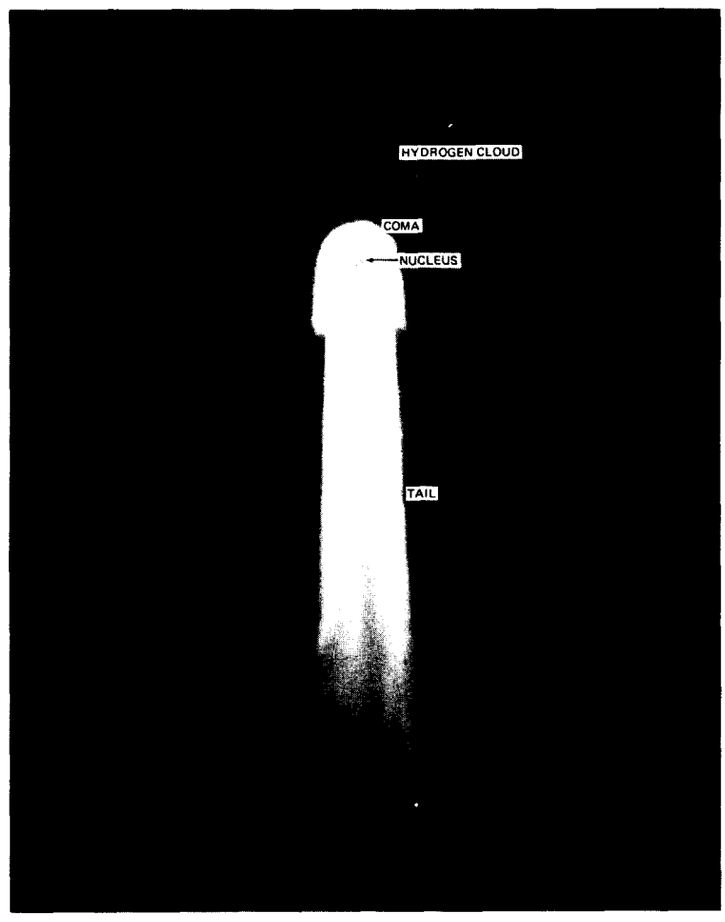
Local Standard Time (p.m.)

Date	Sunset	Twilight Ends	Comet's Head Sets	Comments
Dec. 28	4:53	6:27	4:53	Comet passes closest to sun. It rises and sets approximately with sun.
Jan. 1	4:56	6:30	5:53	Comet tail visible on SW horizon after sunset.
Jan. 5	4:59	6:33	6:38	Comet bright in WSW in twilight and after. Jupiter, and Venus nearby.
Jan. 9	5:02	6:36	7:22	Nearly full moon rises in east; comet in WSW. Tail shortens and dims with each passing day.
Jan. 13	5:07	6:40	8:06	Jan. 10 through 20 best for photography as comet is higher above the horizon after twilight and moon is waning.
Jan. 17	5:11	6:43	8:48	
Jan. 21	5:15	6:47	9:25	Comet still may be naked eye object in twilight and after.
Jan. 25	5:20	6:51	9:58	
Jan. 29	5:25	6:55	10:25	Comet tail shortens and head grows dim.
Feb. 6	5:34	7:03	11:00	Binoculars and small telescopes needed
Feb. 14	5:43	7:11	11:18	Comet reaches highest altitude at mid-month.

This chart is based on information drawn up by Dr. Donald Yeomans of the Computer Science Corporation in Silver Spring, Maryland.



PREDICTED APPEARANCE OF KOHOUTEK AFTER SUNSET on various dates in late December and January, based on a sketch by William Liller of Harvard College Observatory.



ARTIST'S concept of a typical comet.

FED CHRISTMAS SALE. Three checks of $100 each were mailed to the Salvation Army Christmas Fund, the White Oaks Children's Center, and the John Lamb Foundation (for the Appalacia Fund) from proceeds of the Facilities Engineering Division annual White Elephant Sale on November 6. Many Goddard employees attended the sale in Building 5. The girls of the division were in charge, rotating their duty hours in the preparation of the sale and on the sale day. Samuel Keller, Director of Administration and Management, was on hand during the sale to draw winning numbers in the raffle while Doris Yates held the bowl of chances (below). Deborah List won the first prize of a hand-made afgan and pillow. Sale participants are (from left, above) Romona Hobar, Bonnie Fabien, Marge Landstreet, Ed Yates, second prize winner of two tickets to the Barrister Inn in Annapolis, Sam Keller, Doris Yates, Ellen Lingebach, Ginny Villa, Diane Bryant, Silvia Green, and Betty Pena. Eileen Lingebach won the third prize beauty kit.

GIDEP Award

DR. JOHN F. CLARK (left), Goddard Director, presents an award recognizing Goddard as the outstanding Government agency participating in the Government-Industry Data Exchange Program (GIDEP) to Winslow Womack (center) our GIDEP Representative, and Herman E. LaGow, Director of Systems Reliability. Dr. Clark first accepted the award during the annual GIDEP workshop on October 17. The GIDEP was organized to further the exchange of technical data which the various agencies and industries generate. By so doing, many dollars are saved by eliminating duplicate qualification testing or uncovering a previously known part or material fabrication or processing problem. The Goddard Parts and Materials people, the Flight Projects and many of our major contractors use these data in the selection and testing of parts and materials and in resolving parts problems. During the November presentation by Dr. Clark, Mr. Womack accepted the award in behalf of all the people who made possible Goddard's outstanding participation in the program.

EEO Bulletin—Precomplaint Counseling

Employee Coverage

An applicant or an employee of NASA who believes that he/she has been discriminated against because of race, color, religion, sex, or national origin may consult with an Equal Employment Opportunity Counselor.

Time Limits

1. Complainant (or organization filing for aggrieved person with written consent) must consult with the EEO Counselor within 30 calendar days of the date of the matter causing belief of discrimination, or if a personnel action, within 30 calendar days of its effective date.

2. The Counselor shall attempt to resolve the matter within 21 calendar days after the date on which it was brought to his/her attention.

3. If the matter has not been resolved in 21 days, or a resolution has failed before the expiration of 21 days, the Counselor shall advise the complainant, in writing, of the right to file a formal complaint of discrimination. Resolution attempts may continue past the 21-day period if all parties agree.

Informal Resolution Attempt

1. The Counselor shall make whatever inquiry is necessary and appropriate in order to seek a solution to the complaint.

2. The Counselor shall advise the complainant concerning the issues of the complaint.

3. Resolutions effected during the pre-complaint counseling stage need not be in writing, but may be so at the request of any party involved. The purpose of the counseling stage is to resolve EEO related problems informally in a short period of time.

Representation

Complainant has the right to be accompanied, represented and advised by a representative of his/her choice. A written authorization from complainant and the representative, if any, shall be required. Complainant and complainant's representative shall be allowed a reasonable amount of duty time to pursue the complaint. Employees with EEO programatic responsibility, including counselors and part-time coordinators, should not serve as complainant representatives. NOTE: The provisions of this paragraph apply to all stages of the precomplaint and formal complaint process.

Confidentiality

Complainant has the right to remain unidentified to all parties, except the Counselor, during the pre-complaint process. However, complainant should understand that identification may be necessary in most cases if a resolution is to be accomplished.

GODDARD AROUND THE WORLD

Mojave Observes 10th Anniversary of First Trans-Pacific Telecast

Today, as nightly news programs routinely feature "Via Satellite" reports from correspondents around the world, it is hard to believe that only ten short years ago satellite transmission of live video was just a flickering experiment.

It was November 22, 1963 when the NASA Mojave 12.3 meter (40 foot) dish antenna was pointed west to intercept the path of the Relay-1 Satellite. Far across the Pacific Ocean a 20 meter dish looked east to the same point in space from Ibaraki, Japan. As the satellite entered this region of space, television viewers in both the United States and Japan witnessed the first live Trans-Pacific telecast. The program was seen in the USA on NBC and in Japan via the government operated NHK. The timing of the program had to be precise since the satellite was only visible to both stations for only about 20 minutes.

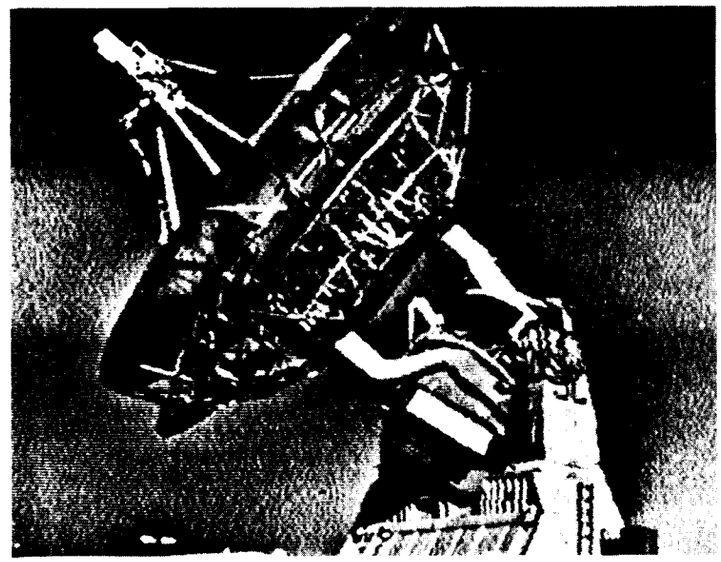
The potential of satellites for bringing live images of news events into the homes of people throughout the world was vividly demonstrated in the succeeding days. As technicians were dismantling the microwave relay links into the Mojave Station which had been installed for the special inaugural telecast, the news came. John F. Kennedy had been shot! The microwave link was quickly restored and the Mojave Station relayed live coverage of the events of the succeeding days to the Japanese audience whenever the Relay-1 Satellite was in the correct position for mutual visibility. In these few days the world became noticeably smaller as people in Europe, North America, and Japan shared "Via Satellite" a common sense of loss.

The NASA Mojave Station is located about 50 miles north of Barstow, California and has been operated continuously since 1961 for NASA by the Bendix Field Engineering Corporation. The Japanese Station, located 140 kilometers northeast of Tokyo, was operated by Kokusai Denshin Denwa Co., Ltd. (Japanese Overseas Radio and Cable System) for the Japanese Ministry of Posts and Telecommunications.

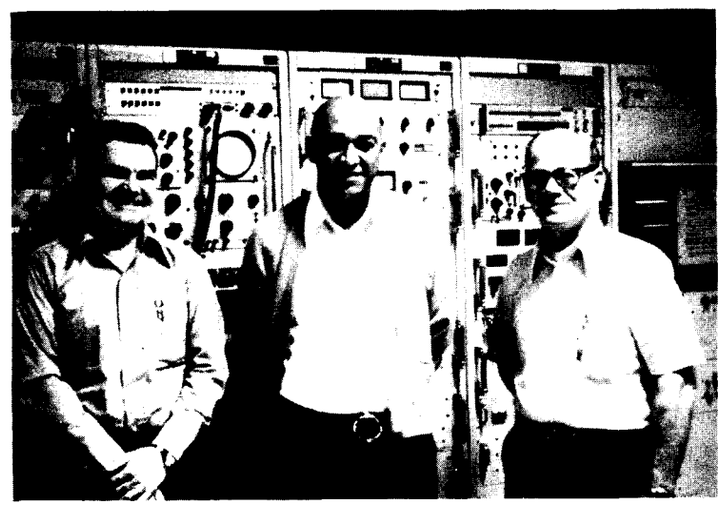
It is written that, "East is East and West is West and ne'er the twain shall meet". That old saying isn't heard much these days and the personnel of the NASA Mojave Tracking Station are proud of the part their station has played in the furthering of the technology which has brought together the twain.

Today the Mojave Station continues to support experiments designed to improve satellite communications and increase the ways in which satellites can serve mankind.

THE RELAY-1 SATELLITE as seen by the Japanese Audience at the beginning of the historic telecast.



FROM THIS ANTENNA in the Mojave Desert north of Barstow, California, the first live trans-Pacific television pictures were sent via Relay-1. The picture is from a Japanese television monitor and was taken during that historic telecast.



THREE PRESENT Bendix Field Engineering Corporation members of the staff of the Mojave Tracking Station were at the station during the Relay-1 telecast in 1973. From left are Joe Hasten, C, L, and S-Band Transmitter Technician; Carl Hutto, Operations Manager; and Pierce Smith, Operations Supervisor.

GODDARD NEWS is published monthly by the Office of Public Affairs at the Goddard Space Flight Center, Mail Code 202, National Aeronautics and Space Administration, Greenbelt, Maryland 20771. Deadline for contributions is the last Thursday in the month for publication the following month.

Nancy Mengel, Editor
Patricia Ratkewicz, Secretary, Phone Extension 4141

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