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Gehrels, Moseley Discover Explosive Nucleosynthesis in 1987A



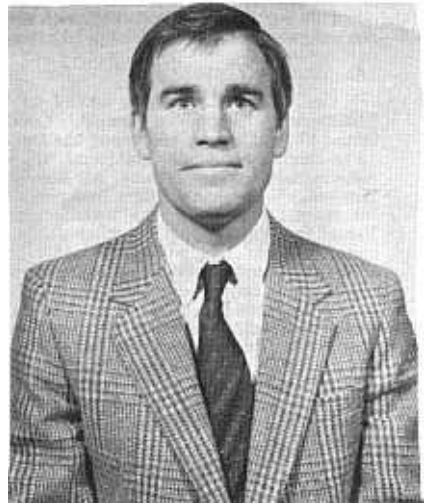
DR. GEHRELS

Drs. Neil Gehrels and Harvey Moseley, NASA Goddard Space Flight Center, will report their new findings from recent behavior of Supernova 1987A, at the February 4 colloquium of National Capital Astronomers in the National Air and Space Museum.

Gehrels and Moseley have been observing 1987A in Australia, New Zealand, and Chile, where their coordinated infrared and gamma-ray observations have disclosed explosive nucleosynthesis for the first time.

Their recent work has generally confirmed much of the theory, discovered nucleosynthesis induced in the stellar envelope by the supernova shock wave, a process not previously observed, confirmed some models and predictions, and has increased understanding of the nucleosynthetic processes.

Neil Gehrels received his Ph.D from the California Institute of Technology in 1981. An astrophysicist in the Gamma-Ray Astrophysics Branch, he has received a number of NASA awards for his contributions. His many involvements include Study Scientist, Nuclear Astrophysics Explorer; Project Scientist, Space Station Small Attached Payloads Working Group; Local Organizer, Workshop



DR. MOSELEY

on Nuclear Spectroscopy of Astrophysical Sources; and many other services. He has authored many journal papers in the field, and, with others, a book, "Nuclear Spectroscopy of Astrophysical Sources." He is a member of the American Physical Society, the American Geophysical Union, and The American Astronomical Society.

Harvey Moseley, Jr., received his Ph.D. from the University of Chicago in 1979. An astrophysicist in the Infrared Astrophysics Branch, he previously was a Teaching Assistant, Research Assistant, and Research Associate at the University of Chicago. In 1979-80, he was a National Research Council Resident Research Associate at Goddard Space Flight Center. His major responsibilities, projects, and activities include: Principal Investigator, Kuiper Airborne Observatory 20- 60-micrometer spectrophotometry; Co-investigator, Cosmic Background Explorer (COBE); Co-investigator, AXAF X-ray Spectroscopy Experiment; Space Infrared Telescope Facility (SIRTF), Instrument Scientist for Infrared Array Camera (IRAC); Principal Investigator - RTOP, "Thermal Detectors for Infrared Detection from Orbiting Telescopes." He has authored many journal papers, and is a member of the American Astronomical Society.

FEBRUARY CALENDAR — The public is welcome.

- Friday, February 3, 10, 17, 24, 7:30 pm — Telescope-making classes at American University, McKinley Hall basement. Information: Jerry Schnall, 362-8872.
 - Saturday, February 4, 5:45 pm — Dinner with the speaker at the Smithsonian Restaurant, 6th and C Streets, SW., inside the Holiday Inn. Reservations unnecessary. Use the 7th Street and Maryland Avenue exit of the L'Enfant Plaza Metrorail station.
 - Saturday, February 4, 7:30 pm — NCA monthly colloquium in the Einstein Planetarium of the National Air and Space Museum, Seventh Street and Independence Avenue, SW. Enter Independence Avenue side. Drs Gehrels and Moseley will speak.
 - Tuesday, February 7, 14, 21, 28, 7:30 pm — Telescope-making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 362-8872.
 - Friday, February 10, 17, 24, 8:30 pm — NCA 14-inch telescope open nights with Bob Bolster, 6007 Ridgeview Drive, south of Alexandria off Franconia Road between Telegraph Road and Rose Hill Drive. Call Bob at 960-9126.
 - Saturday, February 18, 7:30 pm — Discussion group with Bob McCracken on NCA publications. See page 36.
- For other organizations' events of interest see elsewhere in this issue.

JANUARY COLLOQUIUM

Dr. Larry H. Brace, Chief of the Planetary Atmospheres Branch, Goddard Space Flight Center, addressed the January 1989 colloquium of National Capital Astronomers at the National Air and Space Museum. He presented data and results of his recent studies of the interactions of Venus' ionosphere with the solar wind.

Study of the planets, with their individual combinations of parameters, often yields improved understanding of the interrelations of effects in the Earth complex. Being closer to the Sun than is the Earth, Venus is exposed to a greater intensity of solar wind. Furthermore, Venus has little or no intrinsic magnetic field to interfere with the direct action of solar wind on its atmosphere. The action is similar to that on a comet. Evidence of the existence of the solar wind was first seen in the ion tails of comets.

Study of Venus' ionosphere is therefore of great interest, particularly at this time of rapidly increasing solar activity.

Most of our knowledge of Venus' solar-wind-ionosphere interactions has been derived from the NASA Pioneer-Venus Mission, which carried a series of entry probes and an orbiter. The latter is Brace's experiment.

Instruments on board measure electron density and temperature, neutral atmosphere gases, plasma-wave disturbances, magnetic fields, ion mass spectra, neutral gas mass spectra, ion retarding potential to determine ion density, temperature, and flow velocity in the ionosphere, solar wind density, temperature, and velocity, and make remote measurements, photographs, and radio occultations to determine ionospheric height profiles.

Injected into a highly elliptical Venus orbit on December 4, 1978, the craft penetrates to an altitude of 150 km. The 24-hour orbital period carries it to 12 Venus radii. Because the solar wind raises the periapsis, fuel was expended for the first 18 months to retain the deep penetration. It was then allowed to rise. Because the orbital plane is approximately fixed in inertial space. Venus' annual

motion has repeatedly swept the periapsis through all local times at progressively higher altitudes, mapping the ionosphere as it slowly spiraled outward. The orbit is expected to decay again and enter Venus atmosphere in 1992.

The ionosphere is generated by solar extreme ultraviolet irradiation of the neutral gases in the upper atmosphere of the planet. For example, carbon dioxide, the main neutral component in Venus atmosphere, can absorb photons of specific energy levels to form several ionic species, and an electron in each case: CO^+ , C^+ , O^+ , O_2^+ , CO_2^+ , depending upon the energy, $h\nu$, of the photon.

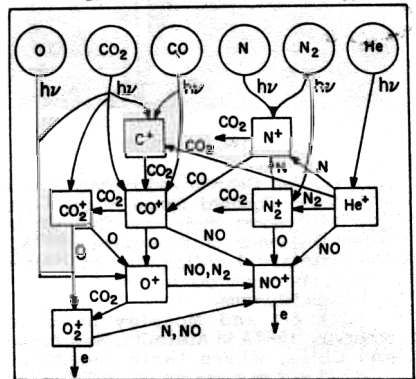


Fig. 1. Ionospheric theory and models.

Other neutral gases are similarly ionized by photons of other specific energies. These interact in many ways through charge exchange to produce new ions, while some are lost by recombination. Figure 1 shows some of the many possibilities.

The reaction rates are sufficiently well known that given a knowledge of the constituents of the atmosphere, the equilibrium distributions of ions can be calculated. The neutral gas spectrometer measures these gases. The ion spectrometer also measures the products.

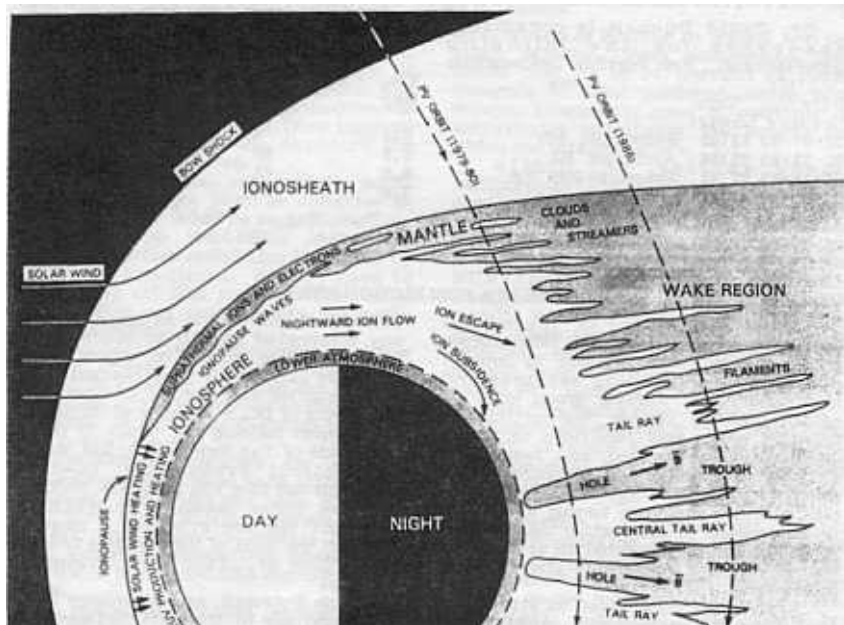


Figure 2. Interaction of solar wind and Venus' ionosphere.

thus to confirm the theory.

The foregoing only describes production and loss of ions. Time variation of ion density results from unequal variations in production and loss rates.

Thus formed by irradiation in extreme ultraviolet, the ionosphere, unprotected by an intrinsic magnetic field, is subjected to the solar wind. The solar-wind pressure exerted on the ionosphere is the resultant of solar-wind magnetic pressure, temperature, density, and velocity. The latter term is the major one. The solar wind encounters the opposing ionospheric temperature-density pressure. At the equilibrium the ionopause is formed as a sheath along which the solar wind flows around the planet. Venus has sufficient atmosphere to form an ionopause. Mars may not have.

The Earth's ionosphere is well shielded from the action of the solar wind by the Earth's intrinsic magnetic field. Unlike the close-in solar-wind bowshock of Venus, the Earth's bowshock is held off far beyond the magnetopause.

Above Venus' ionopause, through a mechanism not yet fully understood, some of the cold ions and electrons from the planet's ionosphere are accelerated to suprathermal velocities by the solar wind's flow over the ionopause. These ions are swept away and lost to the planet, a process of atmosphere loss. The iono-

sheath above Venus' ionopause is composed of solar-wind ions.

Lack of an intrinsic magnetic field allows nightward ion flow. The ionopause is quite wavy, as seen in figure 2, becoming very irregular and forming streamers on the night side. Venus also loses atmosphere by detached streamers and clouds of ions being carried downstream by solar wind. The deep holes and troughs on the night side apparently are caused by solar-wind magnetic field that penetrates the planet and accelerates plasma to escape velocity at times of high solar-wind pressure. A quantitative mathematical model of this mechanism has not been done. This atmosphere-loss process is suspected of being a significant factor in changing the atmosphere of Venus during the planet's history.

Mars has a much thinner atmosphere than Venus, is much farther from the Sun, has much less gravity, and its magnetic properties are not well known. Comparing Venus with Mars, Brace indicated the importance of the Mars Observer, which will measure Mars' magnetic properties, and a Mars Aeronomy Observer similar in function to Pioneer Venus.

Brace described many other new discoveries by the work and expects many more. Pioneer Venus is so prolifically generating data that Brace says, "Most of what we learn from Pioneer Venus is in the future."

Robert H. McCracken

OCCULTATION EXPEDITIONS PLANNED

Dr. David Dunham is organizing observers for the following occultations. For further information

call the NCA-IOTA Information Line: (301) 474-4945 (Greenbelt, MD).

UT	Time	Place	Vis Mag	Pent Sunlit	Cusp Angle	Min Aper
Grazing Lunar:						
02-07-89	23:09	Beltsville, MD	7.3	4	11S	8 cm
02-13-89	05:34	Andover, NJ	5.9	52	7N	5 cm
02-16-89	07:43	Jennersville, PA	6.9	82	09N	10 cm
03-02-89	10:12	Falmouth, VA	7.0	34	6S	5 cm
Asteroidal:						
02-06-89	02:30	Central America	9.1	0.6	(3) Juno	10 cm
02-19-89	10:47	Colombia, SA	7.5	5.0	(19) Fortuna	5 cm

DISCUSSION GROUP TO CONSIDER NCA PUBLICATION SERVICES

The February 19 (Saturday) discussion group will examine NCA's future publication activities needed to support our broadly expanding services and involvements. A working group is to be established to survey the activities, identify areas and functions in which publications are needed, and recommend actions to expand and enhance NCA's usefulness through appropriate publications. Everyone having knowledge or experience in publication management or production is requested to attend. Of course you are welcome if you are only interested.

Everyone is encouraged to attend and feel free to participate, whether to contribute technically or simply to listen and learn.

NCA discussion groups are multipurposed. They serve not only to unite those who are technically involved in

the subject, but also as an opportunity for any interested person to learn at any level. Working groups on support areas often are initiated by these discussions.

The group will meet at 7:30 pm at the University of DC, in Building 42, Room A06, just behind Building 44, which is on the north side of Van Ness Street, just west of Connecticut Avenue, NW, near the Metrorail Red Line Van Ness-UDC station.

Park under Building 44. (Tell the attendant you are attending a meeting.) Walk out the back of the garage a few feet to building 42. Take the elevator one floor up.

From Metrorail, as you emerge to the sidewalk, go to the left between the columns to the stairway on the left, up four short flights to the elevated walk to building 42. A06 is on the same floor.

For further information, call National Capital Astronomers, 320-3621.

NCA WELCOMES NEW MEMBERS

Charles E. Arnold
3007 Kramer Street
Wheaton, MD 20902-2210

Ellen M. Brinsko
14305 Vivaldi Court
Burtonsville, MD 20866

Lee N. Foster
7689 Morningside Drive, NW
Washington, DC 20012-1556

SCIENCE FAIR ASSISTANT VOLUNTEERS NEEDED

The annual National Capital Astronomers Science Fair Awards recognize superior high school science fair projects in astronomy and related sciences in the District of Columbia and the contiguous counties. Winners are awarded Junior NCA memberships, including all publications, for one year.

Volunteers are needed for judging

and assisting. If you can accept this privilege of contributing a little of your time to this valuable and gratifying service to encourage these young people who represent tomorrow's leadership, please call one of the following persons: District of Columbia, Jerry Schnall, 362-8872; Maryland, Jay Miller, 530-7942; Virginia, John Lohman, 820-4194.

AIR AND SPACE MUSEUM OFFERS PROGRAMS

The following free, public programs will be held in the National Air and Space Museum during February:

Saturday, February 4, 9:30 am -- "Venus Revealed," Dr. Jeff Goldstein, Astrophysicist in NASM's new Laboratory for Astrophysics. Presented in the Einstein Planetarium. Safe telescopic viewing of the Sun will follow, weather permitting.

Wednesday, February 8, 7:30 pm -- In the Exploring Space Lecture Series, "Other Suns, Other Worlds," Dr. Bruce Campbell, University of Victoria, British Columbia, will present "A Search for Planets," in the Langley Theater. Telescopic viewing of the sky will follow the program, weather permitting.

ASTRONOMY AND PERSONAL COMPUTERS Joan B. Dunham

Bomb Detection — We may soon see neutron bombardment used to detect explosives in checked airline luggage, in hopes of preventing further tragedies like the Pan-Am bombing of last December. In this technique, emissions from luggage exposed to neutrons are examined for indications of explosives.

When this is done, any magnetic media inside the luggage, such as diskettes or computer tapes, would be exposed, and any information on the media destroyed. Undeveloped film would also be ruined by exposure to neutrons. We may need to hand carry all film and diskettes when flying. Then we must be sure the media are not X-rayed.

I recently had a discussion with a security officer at O'Hare Airport on the subject of X-raying diskettes and portable computers. "Are you sure it would damage anything? It looks like it should be OK to me," is what she said.

Symbolic Manipulators are software packages which allow us to do algebra on a computer. This field has been an active one, with two scholarly journals on the subject, and papers on results obtained from symbolic manipulators appearing in journals in many scientific and engineering fields.

A number of problems previously done by hand have been redone by symbolic manipulators. Some of these have been for the purpose of demonstration. For example, one way manipulators are compared with one another is to use them to solve the two-body problem in astronomy with a technique known as the f- and g-series. They have also been used to generate the integrals presented in

$y = \text{year (4 digit) and } m = \text{month (3-12) if after February,}$

or

$y = \text{year -1 and } m = 13 \text{ (January) or } 14 \text{ (February)}$

$B = 2 - \text{int}(y/100) + \text{int}[\text{int}(y/100)/4].$

Here, $\text{int}()$ means "the integer part of the quantity inside the (), so $\text{int}(2.2) = 2$, and $\text{int}(3/2) = \text{int}(1.5) = 1$.

$JD = \text{int}(365.25*y) + \text{int}[30.6001(m + 1)] + \text{day} + \text{hour}/24 + 1720994.5 + B$

The Meeus method is from *Astronomical Formulae for Calculators*, Willmann-Bell, 1982.

HIGH SOLAR ACTIVITY PEAK PREDICTED

Several years ago, Ken Schatten of Goddard Space Flight Center had predicted this solar cycle, which started in the fall of 1986, would be particularly high. Recent sunspot and radio observations suggest that cycle 22 may be a record, and the next four years may be very exciting. The last very active cycle was in 1957, before the space program began, so now there will be an opportunity to study the very active Sun from space for the first time.

Effects we can expect from an active cycle are frequent and numerous sunspots, solar flares intense enough to disrupt radio, TV, and telephone communications, good auroral displays in the north,

integral tables familiar to anyone who has taken calculus. Such comparisons have found that 7- to 20 percent of listed integrals in older published tables have errors, frequently ones of omitting or incorrectly specifying the ranges for which the integral exists.

Within the last few years, manipulators have been developed for PC's, mostly by conversion of systems running on large computers. A review of the field in the January-February issue of *Computers in Physics* suggests to consider REDUCE or MUMATH-83 when selecting a symbolic manipulator to use on a PC. Another system, MAPLE, may soon be available for PC's. There are others which, for a given situation, may be equally useful. I was amused to see a system I run on a 80386-based PC, which we find very useful, described as "quite obsolescent."

Computers in Physics is a very useful journal, available for \$25 for six issues, from American Institute of Physics, 335 East 45th Street, New York, NY 10164-0462.

Correction — I made several mistakes in my comments on computing the Julian date in the November issue of *Star Dust*. The reference for the first Van Flinders method should have said 1968, not 1986. The full, correct reference is: *Communications of the ACM*, Vol II, No. 10, Oct. 1968, p. 10.

I left out a key step adjusting the year and month for January or February in the Meeus method. The corrected algorithm is as follows:

For dates after October 15, 1582, given a year, month, day, and hour, then

potential damage to spacecraft electronics, and possibilities for exposure to hazardous radiation for astronauts and aircraft passengers.

The active Sun also indirectly shortens the life of Earth-orbiting spacecraft. The atmosphere is heated so that it rises more than when the Sun is quiet. Then spacecraft experience more atmospheric drag, causing their orbits to decay more rapidly, so that they reenter months or more earlier than anticipated.

The irony is that spacecraft which could observe the Sun may have their usable lifespans cut short by the very activity we want them to observe.

Joan B. Dunham

WASHINGTON ACADEMY OF SCIENCES CAREER SEMINAR SCHEDULED

On Thursday evening, February 16, in the Mary Graydon Center, American University, The Washington Academy of Sciences presents "Trends and Careers in Statistics," by Dr. R. Allen, President, Washington Statistical Society, and Deputy Administrator for Programs for the

National Agricultural Statistical Service.

A 6:30 pm reception will be followed by dinner at 7:00, and the lecture at 8:00. Reservations (\$15) must be received by Robert McCracken, 320-3621, by Monday, February 13, but are not required for the lecture only.

OPTICAL SOCIETY DINNER LECTURE ON IR BACKGROUND, MIRROR TESTINGS

Wednesday, February 15, at 6:00 pm, The National Capital Section of the Optical Society of America monthly dinner meeting will be held at the Sir Walter Raleigh Restaurant, 8011 Woodmont Avenue, Bethesda, Maryland. At 7:30 pm, Dr. H. John

Wood, NASA Goddard Space Flight Center, will present "The Diffuse Infrared Background Experiment," including a description of new methods of in-process mirror testing. For information and reservations, call Mary Tobin at (202) 394-2046 (Office).

NASA GODDARD COLLOQUIUM, SEMINAR SCHEDULED

The following colloquium and seminar will be held at 3:30 pm at Goddard Space Flight Center, Greenbelt, Maryland. Coffee and tea will be served from 3:00. Enter the main gate and obtain a visitor's pass from the guard. Call Tracy Parlate, 286-8543, for further information. Scientific Colloquia in Building 3 Auditorium: Friday, February 17 - "New

Findings from Helioseismology," Kenneth Libbrecht, California Institute of Technology

Laboratory for Atmospheres Seminar in Building 21, Conference Room 183: Tuesday, February 28 - "Solar Periodicity," Charles Wolff, Goddard Space Flight Center.

U.S. NAVAL OBSERVATORY COLLOQUIUM SCHEDULED

On Thursday, February 9, at 3:00 pm, the U.S. Naval Observatory Colloquium will hear "Search for Planetary Companions to Solar Type Stars," by Dr. Bruce Campbell, University of British Columbia. The colloquia are held in Building 52, Room 300. Parking is available behind the

building.

NCA members are welcome. Enter the main gate at Massachusetts Avenue and 34th Street, NW, where the guard will require some form of identification and provide directions. For further information call the Scientific Director's Office: 653-1513.

U.S. NAVAL OBSERVATORY TOURS IN FEBRUARY

The Monday night public tours of the Naval Observatory begin at 7:30 pm (EST). The next tours are scheduled for February 6, 13, and 27. Passes will be issued to the first 100 persons in line at the gate across from the British Embassy, at Massachusetts Avenue and the southeast side of Observatory Circle. Some form of photoidentification will be required. Parking is not allowed on the grounds for the tours except for the

handicapped; ample parking is available near the gate.

Visitors will see various observatory facilities and, weather permitting, appropriately selected celestial objects, with the historic 26-inch Clark refractor with which the satellites of Mars were discovered more than a century ago.

For details, call the taped Observatory message: (202) 653-1543.

UNIVERSITY OF MARYLAND OPEN HOUSE SCHEDULED

The Astronomy Program, University of Maryland, holds open house on the 5th and 20th of each month at the University's Observatory on Metzerott Road in College

Park. Talks and slide shows are presented, followed by telescopic sky viewing, weather permitting.

Sunday, February 5, 8:00 pm - "The Space Telescope," Dr. A.S. Wilson

The public is invited; there is no charge, and no reservations are necessary for individuals. Groups larger than ten

should call (301) 454-3001 at least 5 days prior to the program.



National Capital Astronomers, Inc.

is a non-profit, public-service corporation for advancement of the astronomical sciences. NCA is the astronomy affiliate of the Washington Academy of Sciences. For information, call NCA: (301) 320-3621.

SERVICES AND ACTIVITIES

A Forum for dissemination of the status and results of current work by scientists at the horizons of their fields is provided through the monthly NCA colloquia held at the National Air and Space Museum of the Smithsonian Institution. All interested persons are welcome; there is no charge.

Expeditions frequently go to many parts of the world to acquire observational data from occultations and eclipses which contribute significantly to refinement of orbital parameters, the coordinate system, navigation tables, and timekeeping. Other results of this work under continuing study include the discovery of apparent satellites of some asteroids, discovery of apparent small variations in the solar radius, and profiles of asteroids.

Discussion Groups provide opportunities for participants to exchange information, ideas, and questions on preselected topics, moderated by a member or guest expert.

Publications received by members include *Sky & Telescope* magazine and the NCA newsletter, *Star Dust*.

The NCA Public Information Service answers many astronomy-related questions, provides predictions of the paths and times of eclipses and occultations, schedules of expeditions and resulting data, assistance in developing programs, and locating references.

The Telescope Selection, Use, and Care Seminar, held annually in November, offers the public guidance for those contemplating the acquisition of a first telescope, and dispels the many common misconceptions which often lead to disappointment.

Working Groups support areas such as computer science and software, photographic materials and techniques, instrumentation, and others.

Telescope-Making Classes teach the student to grind and polish, by hand, the precise optical surface that becomes the heart of a fine astronomical telescope.

NCA Travel offers occasional tours, local and world-wide, to observatories, laboratories, and other points of interest. NCA sponsored tours for comet Halley to many parts of the southern hemisphere.

Discounts are available to members on many publications and other astronomical items.

Public programs are offered jointly with the National Park Service, the Smithsonian Institution, the U. S. Naval Observatory, and others.

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NOTE: If you already subscribe to *Sky & Telescope*, please attach a recent mail label, or indicate expiration date: _____ . A prorata adjustment will be made.

Make check payable to National Capital Astronomers, Inc., and send with this form to: Patricia B. Trueblood, Secretary, 10912 Broad Green Terrace, Potomac, MD 20854.

The following information is optional. If you would like to participate actively in NCA affairs, please indicate briefly any special interest, skills, vocation, education, experience, or other qualifications which you might contribute. Thank you, and welcome!

EXCERPTS FROM THE IAU CIRCULARS Robert N. Bolster

1. December 24 - University of Tasmania radio astronomers detected a change of period during all-day monitoring of the Vela pulsar. The period shortened by 0.16 microsecond during an interval of less than 2 minutes.

2. December 29 and January 21 - Tetsuo Yanaka, Motegi, Japan, discovered two comets; the first (1988r) of 9th magnitude in Ophiuchus with 15-cm binoculars, and

the second (1989a) of 11th magnitude in Bootes with 25 X 150 binoculars.

3. January 2 - E. and R. Helin, B. Roman, and R. Crockett discovered a comet (1989b) of 15th magnitude near the Praesepe cluster in Cancer with the 46-cm Palomar Schmidt telescope.

4. January 6 - W. R. Bradfield Dernancourt, Australia, discovered a comet (1989c) of 12th magnitude in Telescopium.

COMETS GALORE!

With their 16th comet discovery, Carolyn and Eugene Shoemaker have tied Bernard's list. Having the 46-cm Palomar Schmidt surely helps, but their practiced scrutiny of the plates is much to be credited.

Tetsuo Yanaka's discovery In Motegi,

Japan, of two successive comets, the last in one year (1988r), and the first in the next (1989a), may be a record. See **Excerpts from the IAU Circulars**, item 2.

Six comets were discovered in January alone, the most in any one month.

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