



## Cole to Describe New Washington Fundamental Catalog



DR. COLE

**D**r. Carl S. Cole, astronomer at the U.S. Naval Observatory, will apprise National Capital Astronomers of the progress of the Observatory's program to develop the new Washington Fundamental Catalog (WFC), at the January 6 NCA colloquium at the National Air and Space Museum.

The program will result in a new

fundamental catalog of approximately 40,000 stars and a data base of observations made in an absolute sense. This catalog will establish a dynamical reference frame of stellar positions and proper motions based on conventional values of astronomical constants and a new analysis of solar system observations incorporating corrections to current planetary theories. The catalog will also provide a more direct connection between the optical and radio reference frames by combining the current fundamental stars (FK5) and fainter reference stars into a single fundamental system.

This effort will involve ab initio discussions of absolute observations made in the 20th century. An effort is being made to identify and eliminate systematic catalog errors which can be attributed to physical causes. The time scale of this program will be long enough to include the results of the current USNO transit circle programs in Washington and Black Birch, the Hipparcos astrometric satellite and the USNO optical interferometer.

Carl S. Cole was graduated from the University of Florida with a Ph.D. in astronomy and a minor in statistics. He is a member of the International Astronomical Union and the American Astronomical Society, and is currently an astronomer at the U.S. Naval Observatory.

### JANUARY CALENDAR — *The public is welcome.*

Tuesday, January 2, 9, 16, 23, 30, 7:30 pm — Telescope-making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 362-8872.

Friday, January 5, 12, 19, 26, 7:30 pm — Telescope-making classes at American University, McKinley Hall basement. Information: Jerry Schnall, 362-8872.

Friday, January 5, 19, 26, 8:00 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, January 6, 5:45 pm — Dinner with the speaker at the Smithson 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, January 6, 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. Dr. Cole will speak.

The February NCA colloquium will be held on February 3.

For other organizations' events of interest see elsewhere in this issue.

## DECEMBER COLLOQUIUM

Mr. James W. Ryan, of the recently established Space Geodesy Branch of NASA Goddard Space Flight Center, addressed the December National Capital Astronomers colloquium in the Einstein Planetarium of the National Air and Space Museum. He described the currently active application of Very Long Baseline Interferometry (VLBI) with quasars to measure tectonic plate motions.

A joint National Aeronautics and Space Administration - National Oceanic and Atmospheric Administration project, the technique is now yielding measurements of plate motions within a centimeter in the San Francisco region.

While the techniques of VLBI are, of course, routine to astrometers, we have heard surprise expressed by some of the uninitiated public that astronomy goes underground! Isn't it interesting that we can use the farthest observable objects in the universe to measure underground motions to within a centimeter!

In the usual radioastronomy applications, the purpose of VLBI is to measure celestial objects' positions with great precision. To attain the desired resolution, however, it is necessary to know the baseline with high accuracy - a geodetic problem. As a corollary, very precise geodetic measurements are made of the baseline between the VLBI radiotelescopes by observing the same celestial object by both (or all). In both uses, the small time-of-signal-arrival differences between the radiotelescopes are measured with extreme accuracy using atomic clocks. Measurement of the distance between the radiotelescopes to an accuracy of 1 centimeter requires a time accuracy of 33 picoseconds (trillionths of a second) - the time required for the radio signal to travel 1 cm (0.4 inch).

Ryan discussed a list of the effects which are necessarily included in modelling VLBI data to be processed: quasar (source) position and structure extent, polar motions (precession, nutation, Chandler motion, etc.), solid tides, ocean loading, antenna deformation and axis offsets, special and general relativity effects of time dilation and of the solar mass on the velocity of light, statistical characteristics of the hydrogen maser clocks, atmospheric refraction at the S- and X-band frequencies used (2.3 and 8 GHz), where zenith delay is about 7 ns, or more than 2 meters. The latter is

often the limiting effect because of meteorological and source angle variability.

Ryan told of his association with the evolution of VLBI. In 1963 he applied the Project Mercury data, used for determining the position of the astronauts, to better determination of the positions of the ground stations. He corrected some of the island station coordinates by as much as a quarter of a mile. He described the progress from accuracies of hundreds of meters in the early 1960's to about 1-meter in the late 60's, to the present accuracy of better than 1 centimeter. He mentioned a present project commitment to the 1-millimeter level, a goal he said probably would not be achieved before he retires.

The joint project uses both fixed and mobile units to facilitate deployment at critical locations in the study of plate tectonics. The 6-meter antenna dish and the accompanying equipment van can be set up in a half day. Now in California, they have also been used in Alaska and elsewhere.

Ryan showed results of a series of measurements made from July 1981 to January 1988 between Sweden and Massachusetts. Europe and North America are moving apart along the North Atlantic ridge at more than 1 centimeter per year. There are three stations in Europe, in Sweden, Germany, and Italy.

Movements in the Pacific are much larger. The Pacific area is well instrumented. In addition to the mobile units, there are four fixed stations in California: in the Mojave Desert, the Owens Valley telescope, the Hat Creek Observatory, and the Vandenberg station. There are also stations in Kawaihae, Hawaii, an instrumented military antenna in Kwajalein, and a station in Japan.

The boundary between the Pacific plate and the North American plate is the San Andreas fault. Relative to eastern end of the North American plate, the Vandenberg site is moving 47 millimeters per year northwestward, Hawaii, 81 millimeters per year approximately toward Japan, and the western Pacific, 86 millimeters per year. The Pacific plate is thus seen to be rotating.

The Pacific plate is diving under the North American plate in the Alaskan region, and also near Japan, which is also apparently on the North American plate, but possibly the Eurasian plate. In this

subduction region along the Alaskan coast, an action called terrain docking is occurring. Pacific islands, upon encountering this subduction, are literally wiped off the plate, and are added to the Alaskan coast. Alaska is thus being slowly built up.

Previous estimates of the plate motions were based mainly upon magnetic striping of the Pacific floor. As late as the mid 1970's, some geologists were not convinced that the plates were still moving. The best estimates prior to VLBI, however, were about 10 percent larger than the current VLBI measurements. Later refinements of the early models, however, have brought the early estimates into close agreement with current measurements.

To study the considerable activity along the Alaskan coast and in the Aleutian chain, sites were instrumented at Fairbanks, in central Alaska, and a series of sites from Sand Point in the Aleutians, along the southern coast of Alaska at Kodiak, Sourdough, and Yakataga, and at Whitehorse, British Columbia, Canada. These are sites of seismic gaps, where earthquakes are expected.

Data from July 1984 to 1988 showed Yakataga moving toward central Alaska at 39 millimeters per year, but no transverse motion was recorded. Sand Point and Kodiak are likewise moving. At Sourdough, however, the absence of motion indicates the building of stress. Upon returning to Alaska in the summer of 1988, the first episodic motion was recorded. A transverse difference of 8 centimeters in the motion of Yakataga had occurred since the previous summer. After a thorough check for errors, the sudden motion was confirmed in the summer of 1989. It then continued in the previous direction.

Prior to the 1989 Loma Prieta earthquake, extensive measurements had been made at many sites in California, using the mobile units and the four fixed

stations. The data show Vandenberg, Fort Ord, Presidio, and Point Reyes moving northward at the expected rate for the Pacific plate. In Southern California, however, near the plate boundary the full plate rate is not seen. Sites west of the San Andreas fault show some, but not all of the plate motion. East of the fault, on the North American plate, some motion is seen. The entire field of motions indicated geological deformation which was building up pressure to be released in a tremendous earthquake.

These motions were referenced to the eastern United States, taken as fixed. The western end of the North American plate, however, showed a northwesterly motion, indicating a 10- to 14-millimeter per year spreading of the plate. The Nevada mountains have resulted from this pulling apart of the plate, unlike the usual case of mountain formation by collision of the plates. California is moving away from the rest of North America.

This was the picture before the San Francisco earthquake. The earthquake occurred on a Tuesday. By the following Friday, equipment was installed and making measurements at the Presidio. By the next week, equipment was in operation at Monterey, then at Point Reyes, recording aftershocks, and the data were processed.

Post-quake measurements show that the Presidio and Point Reyes sites were shaken, but not moved from their pre-quake positions. Fort Ord, near Monterey, however, was moved northward 5 centimeters beyond the position projected from pre-quake motion. These results are in good agreement with the seismologists' expectations. The continuing measurements are recording subsequent motions.

Rban indicated an agreement of about 1-milliarsecond between the VLBI quasar positions obtained by the NASA geologists and others.

Robert H. McCracken

#### NASA GODDARD COLLOQUIA SCHEDULED

The following colloquia will be held at 15:30 in Building 3 Auditorium at Goddard Space Flight Center, Greenbelt, MD. Coffee and tea will be served from 3:00. Enter the main gate and obtain a visitor's pass from the guard.  
Friday, January 12 - "Deuterium in the Solar System: A Clue to the Origin and

Evolution of Planetary Atmospheres," Tobias C. Owen, SUNY at Stony Brook.  
Friday, January 19 - "Planetary Magnetospheres," Donald Gurnett, University of Iowa. Stop at the main gate guardhouse and request a guest parking permit.  
For further information, call 286-8543

#### U.S. NAVAL OBSERVATORY TOURS IN JANUARY

The next Monday night public tours of the Naval Observatory are scheduled to begin at 7:30 pm EST on January 8, 15, 22, and 29.

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, at the end of the circular road. Some form of photoidentification will be required. Parking for the tours is not

allowed on the grounds 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 further information call 653-1541.

**OCULTATION 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	Place	Vis Mag	Pent Sunlit	Cusp Angle	Min Aper	
Date	Time					
Grazing Lunar:						
01-16-90	07:16	Aberdeen, MD	7.7	74	14S	20 cm
01-23-90	11:25	Columbia & Severn, MD	9.2	11	13S	20 cm
01-28-90	23:14	Frederick, MD	7.9	5	10S	10 cm
Total Lunar occultation of (1) Ceres in DC (1.5-sec fade):						
01-09-90	08:41	Time in Washington, DC	7.3	95	68S	15 cm
Asteroidal*:						
		Star Mag	Delta Mag	Name		
01-08-90	05:03	Texas & Cuba	9.1	3.5	(404) Arsinoe	6 cm
01-15-90	10:44	Southern Texas	9.4	3.6	(566) Stereoskopia	6 cm
01-22-90	01:25	Pennsylvania	12.3	2.4	(951) Gaspra	20 cm

\*Apulse to be observed for possible satellites or path shifts.

**NCA WELCOMES NEW MEMBERS**

Dr. John O'Keefe, Code 681  
NASA Goddard Space Flight Center  
Greenbelt, MD 20771

Robert R. Kastner  
16428 Tomahawk Drive  
Gaithersburg, MD 20878

Douglas Hillmer  
610 Mississippi Avenue  
Silver Spring, MD 20910

**NCA DIMINISHED**

Members of National Capital Astronomers are deeply saddened as we express our sincere sympathy to the families of the following departed members:

**Stanley G. Cawelti**, NCA Trustee, recent President, former Secretary and Vice President, Chairman of the Smithsonian Docent council, and a dedicated, energetic leader to whom NCA has looked for much guidance in its future evolution, died at age 55 on December 28 of cancer in Georgetown University Hospital.

**U. Sherman Lyons**, Co-founder (with Stephen Nagy) of National Capital Astronomers in 1937 at the U.S. Naval Observatory, and former astronomer at the Observatory, died

at 95 on December 2, 1989, at Palm Shores, Florida, where he has lived since his retirement from the Naval Observatory in about 1960. Captain Lyons served in the Signal Corps during World War II, and for many years actively promoted and otherwise served NCA in various positions.

**Hoy J. Walls** was NCA Vice President in the 1950's and, until he left Washington in 1968, was for many years chief instructor in telescope making (there were three classes in those days), and a mainsupport of NCA in many technical and other ways. We just received news of his death in a Costa Mesa, California nursing home on August 1 after a brief illness. He was 89.

**AIR AND SPACE MUSEUM OFFERS PROGRAMS IN JANUARY**

The following free public programs will be offered during January in the National Air and Space Museum:

Saturday, January 6, 9:30 am, Albert Einstein Planetarium — Monthly Sky Lecture: "Who Owns the Stars?" David H. DeVorkin, Curator in the NASM Space History Department, will trace the changing perspective of human culture from the naive ancient idea of a human-centered universe in which the stars and planets were believed to control human life, to present knowledge that this is not true. He will present a more modern, accurate perspective. Safe telescopic viewing of Sunspots with a specially

adapted telescope will follow, weather permitting.

Thursday, January 25, 8:00 pm, Samuel P. Langley Theater — Annual **Wernher Von Braun Memorial Lecture**: "ICBM's to SDI." Lt. General Bernard Schriever, USAF Ret., will trace the evolution of our space programs, both military and civilian.

From 1954, Schriever directed the development of the Thor, Atlas, Titan, and Minuteman missiles. He became commander of the Air Research and Development Command in 1954, and has been a consultant to both industry and government.

## ASTRONOMY AND PERSONAL COMPUTERS Joan B. Dunham

*Plotting* — I counted the ads in a recent issue of *Computers in Physics*. Most of them (8) were for graphics software, or graphics packages. Several additional ads for mathematical processing software specifically listed graphics as a major feature. There were more ads for graphics packages than for any other category, with one ad for languages (for FORTRAN), about four ads for hardware, and several ads for scientific word processors.

Why are there so many? There are so many because they are difficult to write, they are even more difficult to write well, and hope springs eternal. It's like diets. Why, if any given diet works, are there so many others? Because none of them works particularly well, and people keep trying different ones, hoping to find one that will do the trick. My own experience has been that I have found to hate every graphics package I have ever used. (Also true of diets.) They never quite do what I need, and it is never obvious that a given package will not be satisfactory until after the shrink wrap is removed and the software used.

What is in a graphics package? As a minimum, graphics packages transform the user's data into coordinates that are output on the plot hardware, incorporating the commands to tell the hardware to plot. Many of the packages, even very reasonably priced ones, have features such as menu systems for user specification of the plot parameters, data input from files in standard formats or even picking data from screen displays for other programs (such as spreadsheet displays), data processing, smoothing, scaling, and output to multiple types of hardware. The most widely used graphics package is the most minimal software that supports the Calcomp and Zeta plotters. This software, generally found on mainframes or mini computers, has few commands, requires that the user write a computer program in FORTRAN, C, Assembler, or perhaps other languages, and typically supports only one piece of output hardware per installation. Even worse, it is not standard from one installation to

another, so there is no guarantee that software written to generate contour plots on Zeta plotter A attached to machine B will work on a different Zeta plotter attached to a different machine.

Trying to write your own package can be a very educational experience. It can also be very frustrating. Sometimes it can be difficult to get the most important pieces of information — The specific commands for the printer, plotter, or display screen. Many manufacturers do not include that information in the users guide, and sell one or more separate references or programmers' guides. Those are not always easy to find. Once I persuaded the author of a printer reference manual to send me a Xerox copy of what he had written so far. He thought it would not be finished, because the printer was being replaced with a better one. Having the information is only the beginning, since it is not always obvious how the commands should be used. Also, while it may be easier to write the software in BASIC, that may be too slow for a display. It might be OK for dot-matrix printers which are not as fast.

I have noticed that people I know who write commercial plotting packages do a tremendous amount of work, have a lot of trouble with various combinations of computers and printers, and are not becoming particularly wealthy from their sales.

*Small* — The November issue of *Smithsonian* has an ad that shows an actual size new "palm-top" Atari computer. This one-pound marvel has a small keyboard which might take some practice to use, and no disks. Software comes on plug-incards. It looks like it might be very useful for writing notes and memos, especially if the user can connect it to a "real" PC for printing, storage, word processing, and so forth. We can expect to see other entries in this "sub-PC" class before long. The Atari is a direct competitor to top-of-the-line programmable calculators. It costs about the same, or even less, it can do more, and it is not very much bigger. I would be very surprised if the high-priced programmable calculator market survives.

## AMERICAN ASTRONOMICAL SOCIETY JANUARY PROGRAM ABSTRACT

The January 1990 meeting of the American Astronomical Society will be held January 9-15 at the Gateway Marriott Hotel in Crystal City, VA (not to be confused with the Crystal City Marriott across the street). For further information call the AAS at (202) 328-2010.

Tuesday, January 9, 12:00 - "Astronomer for a Day," a program for teachers; 2:00, Registration; 7:00, Reception.

Wednesday, January 10, Starting at 7:30 am - Registration; Astronomer for a Day; Welcoming Address; Job Center.

Session numbers and titles follow; each may include 10 to 15 papers. Many are concurrent. (D) = Display; (O) = Oral.

Wednesday (continued), from 8:30 am. - Session 1 (O): Russell Lecture. 2 (D): Education. 3 (D): Instruments, Reductions. 4 (D): CCD's, Spectrographs, Interferometers. 5 (D): IUE and SIRTf Instrumentation. 6 (D): HST, Astro, and Outer Space Instrumentation. 7 (D): Stellar Interiors and Evolution. 8 (D): Novae, Cataclysmics, Common Envelopes. 9 (D): Binaries. 10 (D): Young Stars, Outflows and HH Objects. 11 (D): Molecular Clouds and Star Formation. 12 (D): Radio Galaxies. 13 (O): Intrinsic Variables, Supernovae, Novae. 14 (O): HEAD I. 15 (O): Radio Emission from Active Galactic Nuclei (AGN's). 16 (O): Science Policy, Outlook for the Future.

12:30 - 2:00 Lunch Break. 12:30 - 4:00: HEAD Business Meeting; Preparation for WARC 92; Tour of NASA GSFC; Industrial Tour for Job Seekers.

2:00 - Session 17 (O): AGN's - High Energy. 18 (O): HEAD II. 19 (O): Stellar Activity, Evolution, and Nucleosynthesis. 20 (O): Very Young Stars. 21 (O): Invited Talks (3).

Thursday, January 11, 8:00 am - Session 24 (D): Sun I. 25 (D): Cool Stars / Atmospheres. 26 (D): Intrinsic Variables. 27 (D): Stellar Motions. 28 (D): The Local Galaxy. 29 (D): Galactic Structure and the Galactic Center. 30 (D): Spirals and Spheroids. 31 (D): QSO's. 32 (O): Evolution of Galaxies and Clusters of Galaxies. 33 (O): Astrometry. 34 (O): Instrumentation. 35 (O): Gamma Rays and Cosmic Rays. 36 (O): Warner Prize Lecture. 37 (O): Large Scale Structure and Streaming Motions. 38 (O): Public Policy Panel Discussion. 39 (O): Orion Nebula, Interstellar Medium. 40 (O): IR Galaxies and IR Emission. 41 (O): Small Bodies

and Solar Radio. 42 (O): Invited Talks (3).

Friday, January 12, 8:30 am - Session 43 (O): Invited Talk. 44 (D): Automated Telescopes. 45 (D): Sun 2. 46 (D): Solar System. 47 (D): HII Regions. 48 (D): AGN - Theory. 49 (D): Interstellar Media of AGN's. 50 (D): Star-Forming/Interacting Galaxies. 51 (D): Molecular Clouds/Interstellar Medium in Galaxies. 54 (D): Relativistic Astrophysics. 55 (O): Galaxies and Galactic Dynamics. 56 (O): Sun III. 57 (O): IR and CO Emission from Molecular Clouds. 58 (O): Relativistic Particles and Accretion Flows. 59 (O): WGAIT. 60 (O): Pierce Prize Lecture.

12:30 - 2:00 - Lunch Break.

200 - Session 61 (O): Astronomers and the Media. 62 (O): Sun IV. 63 (O): Molecular Clouds and Star Formation in Nearby Galaxies. 64 (O): The Galaxy and Galactic Halo. 65 (O): Invited Talks.

7:00 pm - Banquet.

Saturday, January 13, 8:30 am - Session 66 (O): Invited Talk. 67 (D): Low-luminosity and Degenerate Stars. 68 (D): Clusters and Associations. 69 (D): Hot Stars/Atmospheres. 70 (D): Planetary Nebula and Supernova Remnants. 71 (D): Pulsars. 72 (D): X-ray Binaries. 73 (D): Supernovae. 74 (D): Archaeo-history. 75 (O): Star-forming Galaxies. 76 (O): Masers, OH/IR and HII Regions. 77 (O): SN1987A and Beyond. 78 (O): Dark Matter and Galaxy Lensing. 79 (O): HAD I: Historical Astronomy. 80 (O): Heineman Prize Lecture.

1230 - 200 - Lunch Break

2:00 pm - Session 81 (O): Cosmic Background Radiation. 82 (O): Flare Stars, Cataclysmics, X-ray Binaries. 83 (O): Binaries, Stellar Winds. 84 (O): QSO's and AGN's. 85 (O): HAD II: 20th Century Astronomical History.

8:30 pm - Tour of U.S. Naval Observatory

Registration (At the meeting): AAS Members, \$110.00; Students (who are AAS Jr. Members) and AAS Emeritus Members, 30.00 (Includes all except banquet); Non-members, 125.00; Spouse/Guest (to attend social events only), 20.00

Credit cards will not be accepted. There are separate fees for tours, banquet, and special events; tickets are required to be ordered in advance.



**EXCERPTS FROM THE IAU CIRCULARS** Robert N. Bolster

1. November - Mauersberger, Sage, and Henkel, Max Planck Institute fur Radioastronomie, announced the discovery of methyl acetylene (CH<sub>3</sub>CCH) near the nucleus of M82. This is the most complex molecule detected outside the Milky Way galaxy.

2. November 16 - Kmit Aarseth, Volda, Norway, and Howard Brewington, Newberry, South Carolina, discovered a comet (1989a<sub>1</sub>) of 9th magnitude in Corona Borealis. Brewington made his observation

with a 40-cm reflector.

3. December 6 - Rodney R.D. Austin, New Plymouth, New Zealand, discovered a comet (1989c<sub>1</sub>) of 11th magnitude in Tucana. The orbital elements by Green indicate that Comet Austin will reach perihelion on April 9 at a distance of 0.35 AU.

4. December 18 - Douglas George, Kanata, Canada, discovered a comet (1989e<sub>1</sub>) of 11th magnitude in Vulpecula with a 40-cm reflector.

**HELP WANTED**

Part-time transit-circle observers, preferably experienced in transit-circle or related work. Call Ian Jordan, (202) 653-

1379, at the United States Naval Observatory, Washington, DC 20390.

*STAR DUST may be reproduced with credit to National Capital Astronomers.*



published eleven times yearly by NATIONAL CAPITAL ASTRONOMERS, INC., a non-profit, public-service corporation for advancement of astronomy and related sciences through lectures, expeditions, discussion groups, conferences, tours, classes, public programs, and publications. NCA is an affiliate of the Washington Academy of Sciences. President, Kenneth R. Short. *Star Dust* deadline 15th of preceding month. Information: (301) 320-3621. Material for publication: Robert H. McCracken, Editor, 5120 Newport Avenue, Bethesda, MD 20816.

WARREN, WAYNE H.  
BOOI BRETT PL.  
GREENBELL, MD  
20770



**FIRST CLASS**

