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## Lowman Proposes Lunar-Based Observatory Site

**D**r. Paul D. Lowman, Laboratory For Terrestrial Physics, NASA Goddard Space Flight Center, will present his recommendations for a lunar-based observatory at the November 4 National Capital Astronomers colloquium in the National Air and Space Museum.

A lunar observatory will probably be a major component of a manned lunar outpost should one be established early in the next century as proposed by President Bush. If only one site can be chosen, the northeast Orientale Basin at longitude 80W, latitude 0, appears to be a leading candidate for several reasons.

First, its latitude would provide access to the entire celestial sphere over a few months, and its longitude would provide convenient access by surface to the far side (desirable for low-frequency radio astronomy). Continual line of sight to Earth would also be possible, greatly easing the problem of communications, and in particular the problem of data return. Distance from Earth alone would greatly

diminish the problems of radio-frequency interference, and most radioastronomy studies could be carried out from the near side.

The Orientale Basin site is also within a few hundred kilometers of interesting geologic areas, such as the Marius Hills and Aristarchus Plateau, and the Basin itself is of great importance as the youngest circular mare basin.

In summary, an area centered on this side should be intensively studied, both for itself and to focus means of site evaluation.

Paul Lowman, a geologist, has been employed by Goddard Space Flight Center since 1959. Originally from Rahway, New Jersey, he has degrees from Rutgers and the University of Colorado. He has worked primarily in orbital remote sensing and comparative planetology. He is currently Exploration Program Scientist for Goddard Space Flight Center, and is engaged in planning manned lunar and planetary missions.

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

Friday, November 3, 10, 17, 24, 7:30 pm — Telescope-making classes at American University, McKinley Hall basement. Information: Jerry Schnall, 362-8872.

Friday, November 3, 17, 24, 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, November 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, November 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. \* \* \* \* \* (SPKR?)

Tuesday, November 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.

Saturday, November 18, 7:30 pm — Annual NCA public telescope selection seminar: "How to Select, Use, and Care for a Telescope." Room A06, Building 42, University of DC. The December NCA colloquium will be held on December 2.

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

Dr. Jordan A. Goodman, Department of Physics, University of Maryland, addressed the October NCA colloquium in the National Air and Space Museum. He reported the discovery and ongoing investigation of sporadic emission of strange, ultrahigh-energy particles from X1 Herculis.

Called the Cygnus Experiment, the project is a joint effort by the University of Maryland, George Mason University, Los Alamos National Laboratory, and the University of California at Irvine. The first source studied by the group was Cygnus X3, hence the name.

Although cosmic rays were discovered in 1908, they are still an enigma. Particles of unknown origin have been observed with energies as high as  $10^{20}$  eV. No sufficient acceleration mechanism is known. Because charged particles do not travel in straight lines, but are deflected by magnetic fields, they arrive from all directions, thus obscuring the direction of the source. If the sources also generate neutral emissions that are clearly associated with the charged particles, the sources can be located. Suspected sources include X-ray binary stars such as Cygnus X3 and Hercules X1. Accordingly, a correlation is sought between the variations in the cosmic rays and the gamma-ray emission from these and other likely sources;

Interaction of the high-energy particles with matter in or near their source will produce short-lived particles that immediately decay into gamma rays. These would disclose the direction of the source. Interaction upon high-energy impact of the atmosphere by either particles or gamma rays produces a cascade of other particles, some charged, some neutral, which in turn produce other particles. Such an avalanche is called a nuclear electromagnetic cascade, or simply an air shower. It is these particles that are detected at the surface of the Earth. Because some particles are so few, it is far easier to detect the air shower at the surface of the Earth than the primary particle above the atmosphere.

When a background hadron, proton or neutron, impacts the atmosphere, both neutral and charged pions are produced. Some of the latter decay into muons, which do not react further.

On the other hand, a gamma-ray or photon impact produces electron-positron pairs. These interact further with the atmosphere to produce more photons through bremsstrahlung radiation. The new photons produce more electron-positron pairs, and so on. Each gamma-ray photon thus produces an extensive electromagnetic cascade.

In principle, one can thus distinguish the background particle-induced air showers from those of gamma-ray photon

impacts. The cascade produced by particle impacts is accompanied by muons; that of the gamma-ray photons is not.

A few years ago West German researchers who were studying cosmic rays from all directions found an excess of gamma-rays from the direction of the highly variable X-ray source Cygnus X3. They observed a very high degree of correlation between the variations in the gamma rays and the rotation period of the star. This indicated not only that Cygnus X3 was indeed the gamma-ray source, but that the emissions were modulated by the rotation of the star. However, the air showers were unexpectedly accompanied by muons. These results were subsequently seen at extremely high energies by others in Britain and, in conjunction with a radio flare of X3, in the Soviet Union. The Cygnus Experiment, organized to investigate these phenomena, is also studying other sources: of present interest, X1 Herculis.

The X-ray pulsar X1 Herculis is a neutron-star component of a binary system. The pulsar rotation period, from X-ray observations, is very well known: 1.237792 seconds. The Roche lobe of the 2.2-solar-mass optical companion is nearly filled. The orbital period of the system is 1.7 days. A 35-day period of unknown origin, observed in X-rays, is tentatively ascribed to a wobble of the accretion disk.

On a mesa in New Mexico at an altitude of more than 8,000 feet, are about 100 high-energy gamma-ray detectors of the Cygnus Experiment. Many more are planned. In addition, particle detectors are buried about 40 feet underground to detect muons associated with air showers.

Using this array, bursts of air showers characteristic of those produced by extremely high-energy gamma-ray photons have been recorded from X1 Herculis. Although no significant number of muons normally are produced in photon-induced showers, a substantial number were recorded in these. Other strange aspects of these bursts were noted. A search for periodicity in these extremely high-energy bursts disclosed a 1.2357-second period, slightly shorter than the 1.2377-second X-ray pulsar period.

Researchers at other locations have confirmed these observations, including the anomalous difference between the gamma-ray and X-ray pulsar periods, at incredible energies of nearly 500 TeV.

The narrow pulses, hence, near-simultaneous arrival times of the particles (photons?) indicates small mass; more massive particles would travel slower and be distributed in time. A mass much greater than that of an electron, but very much less than that of a proton or pion is indicated. Interaction of this extremely high-energy radiation with the atmosphere seems different from that expected of

high-energy photons.

Are these actually not gamma rays? Independent observations by two other groups exclude fluctuations. They probably are not new particles, as everything this light should have been seen in accelerators. Perhaps gamma-ray photons would interact this strongly at these extremely high energies. Or, they may represent a new transition whereby photons start to behave more like strongly interacting hadrons than electromagnetically. Could it be that at extremely high energies the internal structure of neutrinos could exhibit such mass and interactive behavior?

If this is a real particle, it must be a long lived one to make the trip. To transit the magnetic field undeflected, it must be neutral, and yet very interactive to create the air showers.

A proposed explanation of the anomalous period at extreme energies invokes a less-dense, gamma-transparent irregularity in the otherwise highly absorptive accretion ring. Alignment of

such window would pass a burst of gamma-rays generated by radiation interactions within the window region of the disk. During a burst, radial motion of the window within the ring would cause a doppler difference in the rate of pulses observed during the burst. Basic calculations seem reasonable.

In addition to a further search of presently unreduced data, plans include observation of other sources for these phenomena, and installation of many more detectors. A new project, the Maryland-Irvine-Los Alamos-Gamma-Ray Observatory (MILGRAO), is proposed, to use scintillation detectors for lower energies, in a 5,000-square-meter pool at an altitude of 8,500 feet. Others are building large arrays, including a very large one at Dugway, Utah. Among the advantages of simultaneous observations will be better statistical resolution and further confirmation of events. Dr. Goodman suggests that there may be some new physics to be learned from this project. Robert H. McCracken

#### NASA, NOAA USE PORTABLE VLBI WITH QUASARS TO MEASURE QUAKE MOTION

The National Aeronautics and Space Administration and the National Oceanic and Atmospheric Administration have deployed the mobile Very Long Baseline Interferometer (VLBI) to the San Francisco Bay area to measure crustal motion associated with the recent earthquake.

Since 1983, NASA has used mobile radiotelescopes, atomic clock timing, and the emissions from quasars (because they are the farthest detectable sources) to measure relative arrival times of the emissions, hence relative crustal motions, of sites many miles apart in the Mojave area to

within a centimeter.

At the time of the Quake, a three-month program of observations in Europe and the United States was just completed, and the equipment was being returned to Mojave. They will measure points at Presidio, Fort Ord, and Point Reyes, California, relative to points sufficiently distant to be unaffected. The results will be coordinated with other systems, including the satellite Global Positioning System (GPS) in a NASA-NOAA-California Institute of Technology-National Science Foundation program to track crustal motions in detail.

#### AMERICAN ASTRONOMICAL SOCIETY TO MEET IN WASHINGTON IN 1990

The 175th meeting of the American Astronomical Society will be held in Washington, DC during January 9 - 13, 1990. As usual, the AAS meeting will include papers on a wide variety of astronomical topics in all spectral ranges on astrometry, astrophysics, solar physics, software development, imaging, observatory automation, education, and everything else in the universe.

Other features include members of congress on science budgetary outlook, prize lecturers, tours, child care, special discounts for hotel and parking. American Airlines is offering a 40 percent discount for registrants (some restrictions apply).

A conference of this size involves many activities; volunteers can offer services in lieu of registration fees. Some of our NCA/AAS members are on the Local Organizing Committee. More are needed. If you are not a member of AAS, there is still plenty of work for you. Call Bob McCracken at NCA: (301) 320-3621 to discuss it, or for registration information. George Kaplan, USNO, (202) 653-1130 will coordinate volunteers.

Registration fees: AAS members before December 15, \$85; after, \$110; Nonmember before December 15, \$105.00; after, \$105. Spouse/guest, \$20; Student/emeritus, \$30.

## 12 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).

Date	Time	Place	Vis Mag	Pcnt Sunlit	Cusp Angle	Min Aper
Grazing Lunar:						
11-02-89	22:48	Germantown, MD	8.9	16	17S	20 cm
11-03-89	23:15	Hollywood, MD;	8.2	24	17S	10 cm
11-23-89	11:50	Warrenton, VA.	7.1	20	20S	10 cm cm
Asteroidal Appulses*:						
11-11-89	10:54†	California	10.5	0.08	(1) Ceres	20 cm
11-14-89	11:18	Greenland	8.8	4.0	(165) Loreley	10 cm
11-26-89	5:31	N. Canada	11.8	1.0	(146) Lucina	20 cm

\*Appulses to be observed for possible satellitesUNr path shifts. †Photometric

## AIR AND SPACE MUSEUM OFFERS PROGRAMS IN OCTOBER

The following public programs will be offered during October in the Albert Einstein Planetarium of the National Air and Space Museum:

Saturday, November 4, 9:30 am — Free Monthly Sky Lecture: James H. Sharp of the Einstein Planetarium Staff will teach

the beginner to identify the stars, constellations, and planets, and how to tell the seasons and time of night by positions of objects in the sky. Safe telescopic viewing of Sunspots with a specially adapted telescope will follow, weather permitting.

## UNIVERSITY OF MARYLAND ASTRONOMY PROGRAM COLLOQUIUM SCHEDULED

The University of Maryland Astronomy Program Colloquia are held each Wednesday at 4:30 pm at the UMD Computer and Space Sciences Building (CSS), Room 1113. For more information, call Dr. Roger Bell, Astronomy Program, (301) 454-3005.

1 November — "The Space Telescope Imaging Spectrograph," Dr. Bruce Woodgate, Goddard Space Flight Center.

8 November — "Latest Results on Voyager 2 at Neptune," Dr. Rudolph Hanel, Goddard Space Flight Center.

15 November — "Age-old Questions Concerning the Galactic Halo and Disc," Dr. John Norris, Mt. Stromlo and Siding Spring (Australia) Observatories.

25 November — "Declining Rotation Curves: The End of a Conspiracy," Dr. Stefano Casertano, University of Pittsburgh.

The colloquia are preceded by tea at 15:30 in CCS 0254, and followed by refreshments. Park at meters in the garage at the corner of Regents Drive and Stadium Drive, across the street from the Ccs Building.

## U.S. NAVAL OBSERVATORY TOURS IN NOVEMBER

The next Monday night public tours of the Naval Observatory are scheduled to begin at 7:30 pm EST on November 6, 13, 20, 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, 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 details, call the taped Observatory message: (202) 653-1543. Have a pad and pencil ready; there is much information.

## NASA GODDARD SEMINAR SCHEDULED

During the academic year, Goddard Space Flight Center at Greenbelt, Maryland, holds weekly colloquia on Fridays, biweekly seminars on alternate Tuesdays, on a wide variety of scientific subjects, frequently astronomy-related.

The following colloquium will be held at 15:30 at the Center. Coffee and tea will be served from 3:00. Enter the main gate and obtain a visitor's pass from the guard.

Friday, November 3 — Scientific Colloquium Series in Building 3 Auditorium:

"High Resolution Studies of Radio Galaxies with the Very Large Array," Richard A. Perley, National Radioastronomy Observatory Stop at the main gate guardhouse and request a guest parking permit.

For further information, call 286-8543

## IMAGING SCIENCE SOCIETY TO HEAR DAVID MORGAN, 3M CORP.

On Tuesday, November 29, Monthly meeting of the Society for Imaging Science and Technology (Formerly the Society for Photographic Scientists and Engineers, SPSE), in the University of Maryland Adult Education Building, University and Adelphi Roads.

"Recent Advances in Dry Silver Technology," David Morgan, 3M Corporation.

6:00pm, social hour and cash bar, dinner at 7:00, lecture at 8:00.

For information call Richard F. Myers, 763-1972 (Office), or 345-5074 (Home).

## ASTRONOMY AND PERSONAL COMPUTERS Joan B. Dunham

**Printers** — The second-most troublesome component to PC users is the printer. (Modems give the most trouble.) We can spend many frustrating hours glaring at that beige plastic case trying to understand why a printer refuses to do what the manual plainly says it can do.

Printers receive their commands through a cable connected to the computer serial or parallel port. Serial and parallel ports refer to two different communications standards, one (the serial) in which the bits that make up each command are sent one after another, the other (the parallel) in which the bits of each word are sent at the same time on separate wires. Even the physical connection to the computer can be a problem in some cases. Connectors come in genders, male and female (one look at the connectors should tell you why they are called that), and sometimes both the end of the printer cable and the PC outlet can be the same gender. Manufacturers may use a different type of connector from the standard, especially with a very small portable where small connectors may be used to save room. There are ways to overcome all printer incompatibilities, such as buying converters or special custom cables, but it is usually easier and cheaper to make sure a specific printer can work with a specific computer before buying the printer.

The commands to a printer are processed by what amounts to a small computer inside the printer. This interprets the data as they are received and separates what are controls to turn on or off features from what are characters to be printed. The printer's manual lists what these commands are. Many also give example BASIC programs on how to send these commands to the printer. Commands are usually distinguished from printable characters by starting with an escape control character, the ASCII character at 27, or by being one of the control characters that are below 32 in the ASCII table of characters. When learning how to use a printer, it is instructive to try some of the sample programs in the manual.

In line with the venerable tradition in PC's that software does not keep up with hardware, most printers have more features than the software we use will support. Part of this is because every printer, and often different models made by the same manufacturer, has a different set of commands from every other. Also, modern printers have a wide range of features with more added with each new model. Software authors just can't keep

up. Some of the features printers provide, though, may not be all that necessary. Word processors rarely use printer's commands for tabbing and margins, since it is more efficient to do it in code that will work for every printer than setting up hardware-dependent structures. But it still seems the software developers could do better. They tend to have too few options to support all the useful features of a printer and are reluctant to support the direct insertion in the text of the ASCII control characters to command the printer.

**Physics Education Software** — The American Institute of Physics has several reasonably priced education software programs of interest. One of them, *Orbits*, is a program that computes and plots the restricted three-body problem (a massless particle orbiting a binary star with components in circular orbits). You can obtain a catalog from Physics Academic Software, American Institute of Physics, 335 East 45th Street, New York, NY 10017, phone (800) AIP-PHYS. If you would like to submit software for publication, request submission guidelines from Dr John S. Risley, Editor, Physics Academic Software, Department of Physics, North Carolina State University, Raleigh, NC 27695-8202. If you think you have written a prizewinning educational software program, you can submit it to the Computers in Physics Education Software Awards for consideration for the \$500 grand prize. The contest deadline is February 1, 1990. Write Alison Drotman, Computers in Physics, 500 Sunnyside Blvd., Woodbury, NY 11797, for more information.

**Keyboards** — PC week recently reported that there are now more keyboards than workers that use them. In 1984, 40 percent of desk workers had no keyboards; now there is more than one keyboard per desk worker. "Keyboard" means just that — anything that has a typewriter-like keyboard, including manual and electric typewriters. It would be interesting to see if an average office has more keyboards than phones.

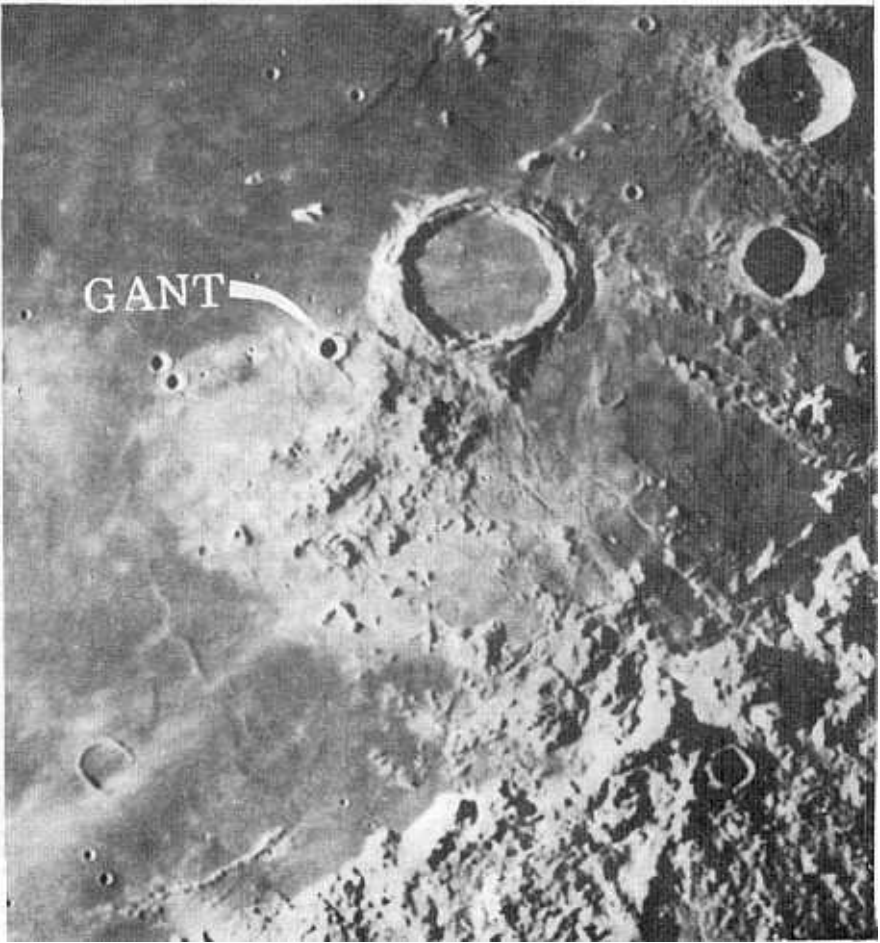
**Virus? What Virus?** — The Friday the 13th non-event was the non-collapse of all PC's from the Datacrime or Columbus-Day virus. Maybe the virus did hit some, maybe not. The examples shown on TV looked suspiciously like Drip, Melt, and Wipe, gag programs that show what looks like a spreadsheet or screen full of data slide to the bottom of the screen, or be wiped off by an invisible eraser. Amusing, but they are not viruses.

## OPERATIONS RESEARCH SOCIETY OFFERS EDUCATIONAL TAPE

Sharing our concern with the decline in science and mathematic enrollments, the Operations Research Society has had a video tape produced to develop interest in such pursuits among high-school and university students.

While the tape primarily encourages careers in operations research, the nature of the field is such that it should promote

a more positive attitude toward all scientific and technical vocations. The 19-minute color tape, "Operations Research and You, an Exciting Career," is available to all educational activities for \$7.99 from Operations Research Society of America, Mt. Royal & Guilford Avenue, Baltimore, MD 21202. (301) 528-4281. Fax (301) 523-8569.



### GANT'S CRATER

Small lunar craters near very large ones, if not specifically named, are designated by the name of the large neighbor followed by a letter. Near the large crater Archimedes in the Mare Imbrium region of the Moon is a small but prominent crater formerly known as Archimedes A. In 1955, the British Astronomical Society designated Archimedes A to be named for NCA's own Dr. James Quincy Gant, upon his demise, in recognition of his contributions to selenography. Lunar

craters are not named for living persons.

Dr. Gant passed away on September 2, 1989 (October issue, page 83); his crater is indicated on this photograph. Nearly central, at selenographic longitude 6°, it is deep and has high walls, making it clearly visible whenever it is illuminated, particularly near the quarter phases.

It is a fitting memorial for a dedicated physician, scientist, and humanitarian.

### ANNUAL NCA PUBLIC TELESCOPE SELECTION SEMINAR SET

The annual NCA free, public seminar, "How to Select, Use, and Care for a Telescope," will be held on Saturday, November 18, at 7:30 pm; in Room A06, Building 42, on the Van Ness Campus of the University of DC. Guidance will be provided, myths will be dispelled, and the uninitiated will be equipped to select and purchase wisely. After a basic presentation and discussion, hands-on experience with representative types will be offered.

By Metrorail, exit the UDC station (Red Line), turn left, go between the columns under the "4250," up steps at the left, three flights to the elevated walkway to Building 42. By Auto, park in garage under building 44, on north side of Van Ness Street a short distance from Connecticut Avenue. Continue to far (north) end of garage and building 42. Building 42 is immediately north of Building 44.



## EXCERPTS FROM THE IAU CIRCULARS

1. September 22 - Observations by Lutz and Gullixson, Lowell Observatory, with the 1.8-m Perkins Telescope showed that Jupiter's South Equatorial Belt was still detectable at the wavelengths of the methane bands at 619, 727, and 893 nm. These wavelengths sample higher in the atmosphere than the continuum.

2. October 1 - Helin, Roman, and Alu discovered a comet (1989v) of 14th

magnitude on the border between Pisces and Cetus with the 46-cm Palomar Schmidt.

3. October 2 - Helin, Roman, and Alu discovered another comet (1989w) of 17th magnitude 2 hours east of 1989v.

4. December 31 - A positive leap second will be added to UTC at the end of 1989 December 31.

## COMET OKAZAKI-LEVI-RUDENKO (1989r)

Dawn, Sun at -18 degrees.

Positions for Equinox 2000.0

UT	DATE	TIME	R.A.	Dec.	DELTA	r	h	Az	ml
1989	10	29	9 60	14 4.4	+25 40	1.079	.702	8 64	5.7
1989	10	30	10 1	14 2.5	+25 15	1.058	.693	9 65	5.6
1989	10	31	10 2	14 0.5	+24 47	1.038	.685	10 66	5.5
1989	11	1	10 3	13 58.5	+24 17	1.017	.678	11 68	5.4
1989	11	2	10 4	13 56.4	+23 44	0.996	.672	12 69	5.3
1989	11	3	10 5	13 54.3	+23 8	0.974	.665	13 71	5.2
1989	11	4	10 6	13 52.1	+22 29	0.953	.660	14 72	5.1
1989	11	5	10 7	13 49.9	+21 46	0.931	.655	15 74	5.1
1989	11	6	10 8	13 47.7	+20 59	0.908	.651	16 75	5.0
1989	11	7	10 9	13 45.4	+20 8	0.886	.648	16 77	4.9
1989	11	8	10 9	13 43.1	+19 13	0.864	.645	17 79	4.8
1989	11	9	10 10	13 40.7	+18 12	0.841	.643	18 81	4.8
1989	11	10	10 11	13 38.4	+17 7	0.819	.641	19 83	4.7

Moon begins to interfere.

1989	11	12	10 13	13 33.6	+14 38	0.775	.641	20 87	4.6
1989	11	14	10 15	13 28.7	+11 43	0.732	.643	21 92	4.5
1989	11	16	10 17	13 23.9	+8 19	0.690	.648	22 97	4.4
1989	11	18	10 19	13 19.1	+4 22	0.651	.656	22 103	4.3
1989	11	20	10 21	13 14.3	-0 11	0.615	.667	22 109	4.2
1989	11	22	10 23	13 9.6	-5 20	0.584	.680	21 116	4.2
1989	11	24	10 25	13 5.0	-11 6	0.557	.695	19 123	4.2

Moon interference ends.

1989	11	26	10 26	13 0.4	-17 25	0.537	.712	17 130	4.2
1989	11	27	10 27	12 58.1	-20 44	0.530	.721	15 133	4.3
1989	11	28	10 28	12 55.8	-24 9	0.524	.731	13 137	4.3
1989	11	29	10 29	12 53.5	-27 38	0.520	.742	11 140	4.3
1989	11	30	10 30	12 51.2	-31 9	0.518	.752	9 144	4.4
1989	12	1	10 31	12 48.8	-34 42	0.518	.763	7 147	4.4
1989	12	2	10 32	12 46.3	-38 13	0.520	.774	5 150	4.4

This ephemeris computed by Robert N. Bolster is tabulated for Universal Time (UT). (Subtract 5 hours for Eastern Standard.) The columns labeled h and Az are the altitude and azimuth of the comet at the beginning of morning twilight. The

comet will be visible to the unaided eye in dark sky during November, and will brighten to about 4th magnitude (column ml) by Thanksgiving. Note that the Moon will interfere during much of the time the comet is brightest.

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