The Mason-Dixon Astronomer

Westminster Astronomical Society of Maryland

December 1986, Vol. 3 No. 12

Stellar Evolution at December 17 Meeting

Because the last and next-to-the-last Wednesdays of the month are New Year's Eve and Christmas Eve, respectively, the next meeting of the Westminster Astronomical Society shall be held December 17 at 7:30 p.m., in the Dixon Room of the Westminster (main) branch of the Carroll County Public Library, 50 E. Main Street, Westminster.

This will be the WAS Christmas Star program for 1986, and will feature two 16mm movies. The first will be "Birth and Death of a Star" (30 min.), produced by KCET (KCET also produced the series "COSMOS"). The second movie is all about the "Crab Nebula" (90 min.), and was produced by the BBC. This movie is appropriate because the Crab is well placed for viewing this time of year. After the meeting let's go somewhere fun and get into the Christmas spirit!

WAS Welcome Wagon

Two new members have joined the WAS. Please welcome aboard Bill Smith and Henry Paul Henze. Bill Smith is a cousin of Mike Scalion, what a small world. Bill and Henry were previously acquainted and joined together at the November 19 meeting. Their addresses are:

Bill Smith
3741 Ridge Road
Westminster, MD 21157
635-6779

Henry Paul Henze
292 Hahn Road
Westminster, MD 21157
876-3196

President's Report

All I want for Christmas is some clearer weather. November and early December have been terrible, so let's ask Santa to bring us down a nice high pressure system when he comes south.

Those who came had a very good time at the December star party at Key Observatory, observing with the 17.5". I wrote a little summary of it somewhere in this issue. This was the first star party hosted by Blaine and Nancy since they were married, and they did an outstanding job. The next star party will be on January 2 at Dave Pessagno's, in Reisterstown. Dave also has a 17.5" telescope; his is a Coulter Odyssey.

A new feature certainly of great use to active observers will be appearing monthly in the newsletter. The lunar and solar almanacs are prepared by Ray and Charleen Sterner. Also this month is a directory of our past guest lecturers.

Our December 17 meeting will be at the Library. I hope you all can make it. The November meeting with Dr. A'Hearn was one of my favorites, and an in-depth summary of his lecture appears

at the end of the newsletter.

I will be returning to Nebraska for the holidays, but will pack a pair of binoculars in case I run into anybody from my old club. So come to the meeting on December 17, and I hope to see you next year at the star party on January 2.

Curt Roelle

New Year Star Party in Reisterstown

Start the new year off right at the next WAS star party, on the night of January 2 at Dave Pessagno's observatory in Reisterstown. Dave's address is 45 Franklin Valley Circle, and a map is enclosed. If you have any questions, call Dave at 526-5128.

New MDA Feature: Solar and Lunar Almanac

Ray and Charleen Sterner both work at the Applied Physics Laboratory, operated by Johns Hopkins University, where they enjoy access to several Vax computers. Beginning this month we are pleased to include two computer generated calendars prepared by the Sterners, featuring both lunar and solar almanacs.

The solar almanac gives local time (EST) for morning and evening twilight, sunrise, meridian passage or transit (high noon), and sunset for each day of the month. Twilight includes astronomical, nautical, and civil.

The lunar almanac graphically depicts the appearance of the moon at noon for each day of the month, and the moonrise, transit, and moonset times. Both calendars also give the sequential day number, December 25 for instance is day 359.

The Sterners and the editor hope that the useful information contained in both almanacs will help you to efficiently plan your observing sessions.

South Frederick Planetarium Schedule

Blaine Roelke has provided a schedule of shows for the planetarium at South Frederick Elementary School, in Frederick. The shows are on Thursday nights only at 7:30 p.m.; the doors open at 7:00. For more information or directions, call the planetarium at 1-694-1462. The remaining shows this season are:

Christmas Show	Dec. 4	11	18	
Tour of the Winter Sky	Jan. 8	15	22	29
The Hubble Space Telescope	Feb. 5	12	19	26
Springtime of the Universe	Mar. 5	12	19	26

If you know of events that would be of interest to the Society at large, please send them to the address on the cover.

Photographing This Month's Mars/Jupiter Conjunction

On the night of Thursday, December 18-19, Mars and Jupiter shall be 1/2 degree apart, about the angular diameter of the moon. Reprinted below, for those with simple equipment who would

like to photograph the event, are directions from the December Observer, the newsletter of our neighbors, the TriState Astronomers of Hagerstown, edited by Jim and Shirley Taylor:

> "Here are some suggestions for the relatively inexperienced astrophotographers among you: First, mount your SLR camera with normal (50mm) lense on a tripod. Set the aperture wide open (f/2 or faster); set the focal ring at infinity. Use a cable release to open and close the shutter. Expose the film for 20 seconds. You may want to expose again at a stop slower (f/2.8) to see if you get better definition. Also you may want to bracket the exposure times, say 15 seconds and 25 seconds. Much longer than the latter time and you will begin to get star trails, particularly if you want to enlarge the print. Secondly, while you still have the camera on a tripod, try a telephoto or zoom lense if you have one. The procedure is the same except that your exposures must be shorter to compensate for the magnification of motion in the sky; also remember that your field will be smaller. For a 75mm lense expose no more than 15 seconds; for 100 mm, 10 sec.; for 200 mm, 5 sec., for 400 mm, 2.5 sec. Bracket your aperture speed and exposure times as above; the uncertainties of light pollution and atmospheric conditions make this almost mandatory. Thirdly, a fun thing to do is to take the same series of shots as above, but with the focal ring set at 15 feet rather than at infinity. The images you get on the film will, of course, be enlarged and greatly out of focus but the color differences in the two planets will be astonishing. You may want to take similar snapshots of star fields, say Orion or Gemini; or the Hyades or the Pleiades. For the constellations use your normal 50 mm lense, for the clusters use your zoom lense. The results will be fascinating; for more information on this technique see the October 1986 issue of Sky and Telescope."

Although film type was not discussed above, the author of the S&T article cited at the paragraph's end used Ektachrome 200 film (which he then push processed to ISO 400). You could also try Ektachrome 400 or Fujichrome 400. All of these are slide films. Common print films include Kodak's VR series, Fuji's Fujicolor, and 3M. All are available at most area camera stores.

Astrocon Proceedings Available

The Proceedings of this August's Astrocon 86 convention held in Baltimore are now in print. If you have prepaid a copy, it should be on its way to you. The Proceedings were edited by former Astronomical League President Rolin P. VanZandt. Copies are still available for $12. If you want to buy one, call the Astrocon Proceedings Chairperson, Curt Roelle, at 848-6384.

A Successful Star Party in December

This month I am filling in for the "Eagle Eyed" observer, Steve Rice. For the first time since September 6, WAS managed to get its star party on a clear night. Indeed the clear skies encouraged several of us to "do it till the sun came up" at Key Observatory, behind the home of Blaine and Nancy Roelke.

A good crowd of enthusiastic observers were on hand, including observatory directors Mike Potter, Blaine, and Nancy. Others on hand were Todd Bonner, Dave Pessagno, Steve Rice, Curt Roelle, Carole Sakamoto, Mike Scalion, Bobby Sier Jr., new member Bill Smith, and probably others milling about in the dark. Besides the 17.5" reflector, other telescopes were a C8 and 4.5" rich-field brought by Bill, Steve's C8, and my Bausch & Lomb 4" SCT.

Lots of objects were observed as the temperature dropped. Everyone who wanted it got a turn with the 17.5". I spent about an hour searching for and observing a cluster of faint galaxies in Andromeda, the brightest member being NGC708 at mag. 13. Comets were "in" that night as well. Before coming to the star

party, Steve and Bobby viewed Comet Wilson from Frederick with the C8. At Key, Bill found Comet Sorrells with both his C8 and 4.5" RFT. I was proud of my little 4" Schmidt which easily showed five stars in the Trapezium in the Orion Nebula.

By the wee hours four remained, Todd, Steve, Bobby, and myself. While Todd slept a few winks, the rest were getting what may have been our final view of Halley's Comet with the 17.5". All four of us saw Halley's for the first time 14 months ago in September, 1985. On that night we were saying farewell to Giacobini-Zinner and hailing Halley. Together this night we were wishing Halley a bon voyage and greetings to Wilson and Sorrells.

With Halley out of the way and twilight dawning upon us we observed Venus and Mercury. The sun rose upon a whitened landscape; a thick heavy frost covered corrector plates, telescope tubes, and the silvery dome of the 17". (C. Roelle)

WAS Speaker Directory

In the 2 1/2 years that regular monthly meetings have been held, a number of guest astronomers have lectured before the society. Below is a listing of our guest speakers, including each name, date, organization, and topic. If you want more information, a telephone number or address, please contact me. (Curt Roelle -- Program Chairman)

DATE	SPEAKER	AFFILIATION	PAPER TITLE
29-AUG-1984	Mike Schaeffer	Fairchild Space Company	"Guide to Selecting a Telescope"
24-OCT-1984	Dr. Sten Odenwald	U.S. Naval Research Laboratory	"Astronomical Ballooning in the Infrared"
18-DEC-1984	Harrisson Gilmer	Retired	"A Newtonian Satellite Distance Formula: The Titius-Bode Law of Planetary Distances, Ammended"
27-FEB-1985	Dr. Laurence Marshcall	Gettysburg College	"Galaxies: The Biggest Things in the Universe"
24-APR-1985	Dr. Rodger Doxsey	Space Telescope Science Inst.	"The Hubble Space Telescope"
04-SEP-1985	Dr. Richard Griffiths	European Space Agency Space Telescope Science Inst.	"X-Ray Astronomy"
30-OCT-1985	Jim Trexler	U.S. Naval Research Laboratory National Capital Astronomers	"Deep Sky Observing / Cluster Validation Program"
04-DEC-1985	Fred Espenak	NASA Goddard Space Flight Center	"Solar Eclipses"
26-FEB-1986	Dr. John Brandt	NASA Goddard Space Flight Center International Halley Watch	"Halley and the Exploration of Comets"
26-MAR-1986	Dr. Gary Karshner	Gettysburg College	"Modern Radio Observational Techniques"
28-MAY-1986	Dr. Daniel Lufkin	Hood College, Frederick	"Comet Halley Wrapup"
27-AUG-1986	Dr. John Pearl	NASA Goddard Space Flight Center	"The Voyager 2 Flyby of Uranus"
19-NOV-1986	Dr. Michael A'Hearn	University of Maryland International Halley Watch	"Chemical Abundances and the Origin of Comets"

LUNAR ALMANAC
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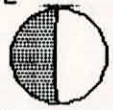
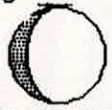
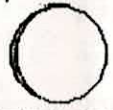
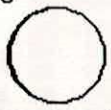
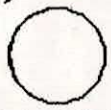
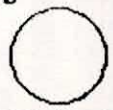
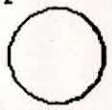
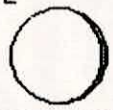
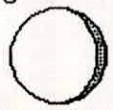
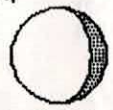
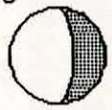
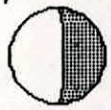
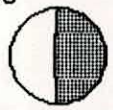
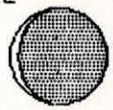
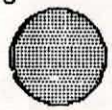
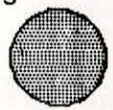
	1 MR 7:15 TR 11:55 MS 16:29 335 	2 MR 8:34 TR 13:01 MS 17:27 336 	3 MR 9:44 TR 14:09 MS 18:37 337 	4 MR 10:48 TR 15:14 MS 19:54 338 	5 MR 11:24 TR 16:14 MS 21:11 339 	6 MR 11:59 TR 17:08 MS 22:26 340 
7 MR 12:27 TR 17:57 MS 23:36 341 	8 MR 12:51 TR 18:42 342 	9 MR 13:12 TR 19:24 MS 0:43 343 	10 MR 13:34 TR 20:06 MS 1:47 344 	11 MR 13:56 TR 20:49 MS 2:50 345 	12 MR 14:20 TR 21:33 MS 3:53 346 	13 MR 14:48 TR 22:19 MS 4:57 347 
14 MR 15:21 TR 23:08 MS 6:00 348 	15 MR 16:01 TR 23:58 MS 7:01 349 	16 MR 16:48 MS 7:59 350 	17 MR 17:42 TR 0:50 MS 8:50 351 	18 MR 18:41 TR 1:41 MS 9:34 352 	19 MR 19:43 TR 2:30 MS 10:11 353 	20 MR 20:46 TR 3:18 MS 10:42 354 
21 MR 21:49 TR 4:03 MS 11:09 355 	22 MR 22:52 TR 4:46 MS 11:32 356 	23 MR 23:56 TR 5:29 MS 11:54 357 	24 TR 6:11 MS 12:16 358 	25 MR 1:02 TR 6:55 MS 12:38 359 	26 MR 2:11 TR 7:43 MS 13:04 360 	27 MR 3:25 TR 8:34 MS 13:35 361 
28 MR 4:43 TR 9:32 MS 14:14 362 	29 MR 6:03 TR 10:36 MS 15:05 363 	30 MR 7:18 TR 11:44 MS 16:09 364 	31 MR 8:23 TR 12:52 MS 17:25 365 			

NOTES

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7 341 MA 5:39 MN 6:11 MC 6:45 SR 7:15 TR 11:59 SS 16:44 EC 17:14 EN 17:47 EA 18:20	**8** 342 MA 5:39 MN 6:12 MC 6:46 SR 7:16 TR 12:00 SS 16:44 EC 17:14 EN 17:48 EA 18:20	**9** 343 MA 5:40 MN 6:13 MC 6:47 SR 7:17 TR 12:00 SS 16:44 EC 17:14 EN 17:48 EA 18:20	**10** 344 MA 5:41 MN 6:14 MC 6:47 SR 7:17 TR 12:01 SS 16:44 EC 17:14 EN 17:48 EA 18:20	**11** 345 MA 5:42 MN 6:14 MC 6:48 SR 7:18 TR 12:01 SS 16:44 EC 17:14 EN 17:48 EA 18:21	**12** 346 MA 5:42 MN 6:15 MC 6:49 SR 7:19 TR 12:02 SS 16:44 EC 17:14 EN 17:48 EA 18:21	**13** 347 MA 5:43 MN 6:16 MC 6:50 SR 7:20 TR 12:02 SS 16:44 EC 17:15 EN 17:48 EA 18:21
14 348 MA 5:44 MN 6:17 MC 6:50 SR 7:21 TR 12:03 SS 16:45 EC 17:15 EN 17:49 EA 18:21	**15** 349 MA 5:44 MN 6:17 MC 6:51 SR 7:21 TR 12:03 SS 16:45 EC 17:15 EN 17:49 EA 18:22	**16** 350 MA 5:45 MN 6:18 MC 6:52 SR 7:22 TR 12:04 SS 16:45 EC 17:15 EN 17:49 EA 18:22	**17** 351 MA 5:46 MN 6:18 MC 6:52 SR 7:23 TR 12:04 SS 16:46 EC 17:16 EN 17:50 EA 18:22	**18** 352 MA 5:46 MN 6:19 MC 6:53 SR 7:23 TR 12:05 SS 16:46 EC 17:16 EN 17:50 EA 18:23	**19** 353 MA 5:47 MN 6:20 MC 6:54 SR 7:24 TR 12:05 SS 16:46 EC 17:17 EN 17:50 EA 18:23	**20** 354 MA 5:47 MN 6:20 MC 6:54 SR 7:24 TR 12:06 SS 16:47 EC 17:17 EN 17:51 EA 18:24
21 355 MA 5:48 MN 6:21 MC 6:55 SR 7:25 TR 12:06 SS 16:47 EC 17:18 EN 17:51 EA 18:24	**22** 356 MA 5:48 MN 6:21 MC 6:55 SR 7:25 TR 12:07 SS 16:48 EC 17:18 EN 17:52 EA 18:25	**23** 357 MA 5:49 MN 6:22 MC 6:56 SR 7:26 TR 12:07 SS 16:48 EC 17:19 EN 17:52 EA 18:25	**24** 358 MA 5:49 MN 6:22 MC 6:56 SR 7:26 TR 12:08 SS 16:49 EC 17:19 EN 17:53 EA 18:26	**25** 359 MA 5:50 MN 6:23 MC 6:56 SR 7:27 TR 12:08 SS 16:49 EC 17:20 EN 17:54 EA 18:26	**26** 360 MA 5:50 MN 6:23 MC 6:57 SR 7:27 TR 12:09 SS 16:50 EC 17:20 EN 17:54 EA 18:27	**27** 361 MA 5:51 MN 6:23 MC 6:57 SR 7:27 TR 12:09 SS 16:51 EC 17:21 EN 17:55 EA 18:28
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NOTES

MA = Morning astronomical twilight, sun is at -18 degrees altitude.
MN = Morning nautical twilight, sun is at -12 degrees altitude.
MC = Morning civil twilight, sun is at -6 degrees altitude.
SR = Sunrise, upper limb on horizon.
TR = Transit, sun is due south and also highest in the sky.
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4 MR 10:52 TR 16:36 MS 22:30	5 MR 11:16 TR 17:21 MS 23:37	6 MR 11:38 TR 18:04	7 MR 12:00 TR 18:47 MS 0:42	8 MR 12:24 TR 19:31 MS 1:46	9 MR 12:50 TR 20:16 MS 2:49	10 MR 13:22 TR 21:04 MS 3:52
11 MR 13:59 TR 21:54 MS 4:54	12 MR 14:44 TR 22:45 MS 5:53	13 MR 15:36 TR 23:36 MS 6:47	14 MR 16:34 MS 7:33	15 MR 17:36 TR 0:27 MS 8:12	16 MR 18:39 TR 1:15 MS 8:45	17 MR 19:43 TR 2:01 MS 9:12
18 MR 20:45 TR 2:45 MS 9:37	19 MR 21:48 TR 3:28 MS 9:59	20 MR 22:52 TR 4:09 MS 10:20	21 MR 23:58 TR 4:52 MS 10:41	22 TR 5:36 MS 11:05	23 MR 1:08 TR 6:25 MS 11:33	24 MR 2:21 TR 7:18 MS 12:06
25 MR 3:37 TR 8:16 MS 12:50	26 MR 4:53 TR 9:20 MS 13:45	27 MR 6:02 TR 10:27 MS 14:54	28 MR 7:00 TR 11:33 MS 16:13	29 MR 7:45 TR 12:35 MS 17:34	30 MR 8:21 TR 13:32 MS 18:53	31 MR 8:50 TR 14:24 MS 20:08

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				1 1 MA 5:52 MN 6:25 MC 6:58 SR 7:29 TR 12:11 SS 16:55 EC 17:25 EN 17:58 EA 18:31	**2** 2 MA 5:52 MN 6:25 MC 6:59 SR 7:29 TR 12:12 SS 16:55 EC 17:25 EN 17:59 EA 18:32	**3** 3 MA 5:52 MN 6:25 MC 6:59 SR 7:29 TR 12:12 SS 16:56 EC 17:26 EN 18:00 EA 18:33
4 4 MA 5:53 MN 6:25 MC 6:59 SR 7:29 TR 12:13 SS 16:57 EC 17:27 EN 18:01 EA 18:33	**5** 5 MA 5:53 MN 6:25 MC 6:59 SR 7:29 TR 12:13 SS 16:58 EC 17:28 EN 18:02 EA 18:34	**6** 6 MA 5:53 MN 6:25 MC 6:59 SR 7:29 TR 12:14 SS 16:59 EC 17:29 EN 18:02 EA 18:35	**7** 7 MA 5:53 MN 6:25 MC 6:59 SR 7:29 TR 12:14 SS 17:00 EC 17:30 EN 18:03 EA 18:36	**8** 8 MA 5:53 MN 6:25 MC 6:59 SR 7:29 TR 12:15 SS 17:01 EC 17:31 EN 18:04 EA 18:37	**9** 9 MA 5:53 MN 6:25 MC 6:59 SR 7:29 TR 12:15 SS 17:02 EC 17:32 EN 18:05 EA 18:38	**10** 10 MA 5:53 MN 6:25 MC 6:59 SR 7:28 TR 12:15 SS 17:03 EC 17:33 EN 18:06 EA 18:38
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18 18 MA 5:51 MN 6:23 MC 6:56 SR 7:26 TR 12:18 SS 17:11 EC 17:41 EN 18:14 EA 18:46	**19** 19 MA 5:51 MN 6:23 MC 6:56 SR 7:25 TR 12:19 SS 17:12 EC 17:42 EN 18:15 EA 18:47	**20** 20 MA 5:51 MN 6:23 MC 6:56 SR 7:25 TR 12:19 SS 17:14 EC 17:43 EN 18:16 EA 18:48	**21** 21 MA 5:50 MN 6:22 MC 6:55 SR 7:24 TR 12:19 SS 17:15 EC 17:44 EN 18:17 EA 18:49	**22** 22 MA 5:50 MN 6:22 MC 6:55 SR 7:24 TR 12:20 SS 17:16 EC 17:45 EN 18:18 EA 18:50	**23** 23 MA 5:49 MN 6:21 MC 6:54 SR 7:23 TR 12:20 SS 17:17 EC 17:46 EN 18:19 EA 18:51	**24** 24 MA 5:49 MN 6:21 MC 6:53 SR 7:22 TR 12:20 SS 17:18 EC 17:47 EN 18:20 EA 18:52
25 25 MA 5:48 MN 6:20 MC 6:53 SR 7:22 TR 12:20 SS 17:19 EC 17:48 EN 18:21 EA 18:53	**26** 26 MA 5:48 MN 6:20 MC 6:52 SR 7:21 TR 12:21 SS 17:20 EC 17:49 EN 18:22 EA 18:54	**27** 27 MH 5:47 MN 6:19 MC 6:51 SR 7:20 TR 12:21 SS 17:22 EC 17:50 EN 18:23 EA 18:55	**28** 28 MA 5:47 MN 6:18 MC 6:51 SR 7:19 TR 12:21 SS 17:23 EC 17:52 EN 18:24 EA 18:56	**29** 29 MA 5:46 MN 6:18 MC 6:50 SR 7:19 TR 12:21 SS 17:24 EC 17:53 EN 18:25 EA 18:57	**30** 30 MA 5:45 MN 6:17 MC 6:49 SR 7:18 TR 12:21 SS 17:25 EC 17:54 EN 18:26 EA 18:58	**31** 31 MA 5:45 MN 6:16 MC 6:48 SR 7:17 TR 12:21 SS 17:26 EC 17:55 EN 18:27 EA 18:59

NOTES

MA = Morning astronomical twilight, sun is at -18 degrees altitude.
MN = Morning nautical twilight, sun is at -12 degrees altitude.
MC = Morning civil twilight, sun is at -6 degrees altitude.
SR = Sunrise, upper limb on horizon.
TR = Transit, sun is due south and also highest in the sky.
SS = Sunset, upper limb on horizon.
EC = Evening civil twilight, sun is at -6 degrees altitude.
EN = Evening nautical twilight, sun is at -12 degrees altitude.
EA = Evening astronomical twilight, sun is at -18 degrees altitude.

Origin of Comets, Summary of November Lecture

Dr. Michael A'Hearn, Director of the Astronomy Program at the University of Maryland, and Discipline Specialist for the International Halley Watch, presented a talk entitled "The Origin and Chemical Abundances of Comets", at the November 19 meeting.

Dr. A'Hearn began his lecture by showing slides of some of the more dramatic comets of recent years, including West (1976 VI), Kahoutek (1973 XII), Bennet (1970 II), and Ikeya-Seki (1965 VIII), which was photographed in broad daylight. On the average we see one spectacular comet every 10 years. This year, 1986, the year of Halley's Comet, ten years after Comet West, we would have expected to see another bright comet. It was hoped in vain that 1910 would repeat itself when Halley's Comet was upstaged by a magnificent comet in January of that year. Typically however, most comets are not naked eye objects, like Comet Giacobini-Zinner in 1985, and tailless comets with obscure names, included in Dr. A'Hearn's slides.

Next, Dr. A'Hearn turned to cometary orbits. Comets that return periodically are simply called "periodic". Comets with orbital periods under 200 years are the "short period" comets. Typical short period comets such as Enke tend to have their aphelia, or farthest point in their orbit, at a distance roughly that of the planet Jupiter. There are over 100 known short period comets, of which Halley is one, having a period of 76 years. Every year about two dozen comets are observed, about half of which, having been previously observed and known to be periodic, are returning as predicted. The other half are new discoveries which may be short or long period comets. Also while all planets orbit the sun in roughly the same plane and in the same direction, comet orbits may be of any shape, direction, or inclination. The short period comets do tend to deviate less from the ecliptic plane than do the long period comets, however.

So where do comets come from? Scientists postulate that they come from a vast cloud of comets at the outskirts of the solar system. This "Oort cloud", once thought to contain over a trillion comets, may actually contain ten times this many (10,000,000,000,000) or more, with a radius extending half the distance to Alpha Centauri, the nearest star system. Dr. A'Hearn demonstrated how Oort deduced the existence of the cloud with a bar graph that plotted numbers of comets by the reciprocal of the eccentricities (shape) of their orbits, which is in turn proportional to the orbital energy. The orbital energy for a few comets indicate they are not bound gravitationally to the sun. These comets appear once, then leave the solar system, never to return again. Long and short period comets are bound to the sun, usually as a result of encounters with a planet such as Jupiter. A large spike on the graph at zero energy indicates that a significant percentage of known comets were observed on their first pass through the inner solar system, their orbital energies having never been altered previously by mighty Jupiter.

The Oort cloud was formed along with the solar system roughly five billion years ago. The comets in the cloud lazily orbit the sun at great distances. What could alter the orbit of comets, plunging them deep into the solar system? Over the course of time, passing stars perturb comets in the Oort cloud, causing them to fall toward the sun. Gravitational influences of the planets further perturb these comets, thus capturing them in

smaller orbits. Further encounters during subsequent orbits continue to change the orbital elements of the comet. These gravitational effects, from passing stars and planets, can also work in reverse to kick the comet completely out of the solar system never to again return. Thus, Dr. A'Hearn explained where comets come from. But where were the comets formed?

One theory says that comets were formed in the vicinity of Jupiter and Saturn and were later ejected by these planets to form the Oort cloud. Similarly, they may have formed around the orbits of Uranus and Neptune before being ejected by them. Another theory is that the comets developed already inside the Oort cloud from material remaining from the protostellar cloud in which the sun and planets formed. Regardless of which theory is correct, comets in the cloud have been frozen at about 20 degrees Kelvin since their formation. Locked inside, comets may contain information about the chemicals that were abundant during their formation. From these molecules can be inferred the conditions when the solar system formed.

What kind of molecules do comets contain? Nearly all of the 36 molecules presented on a view graph are unstable fragments of other compounds. Other stable molecules may exist, but are difficult to view from earth. The fragments in turn are used to deduce the presence of other molecules. Sunlight for instance breaks the water molecule into fragments including the hydroxyl radical, molecular hydrogen, atomic oxygen, ionized water and free electrons. But for most molecules it is difficult to work backwards to determine the parent molecule. On the positive side the lack of chemical variation between comets tells us that nearly all comets share a common history.

Dr. A'Hearn showed several comet spectra and gave an overview of comet spectroscopy. He also explained how false color photography can be used to accentuate spectral features. The naked eye comet IRAS in 1983 passed only three million miles from earth and gave scientists an opportunity to make close spectral studies of this otherwise average comet. Molecules were discovered that are normally not observed in comets since they rarely get this close to earth. IRAS proved that comets formed by the accumulation of icy dust grains, at temperatures no greater than 100-150 degrees Kelvin, thus they could not have formed in the warm inner solar system.

Spacecraft have been useful in studying comets, such as the International Ultraviolet Explorer (IUE). Another advantage of remote sensing pointed out by Dr. A'Hearn is the comfort of a warm observing room, close to home at NASA's Goddard Spaceflight Center in Greenbelt, rather than a distant snowy mountain top, and there is never a cloudy night!

Early this year Comet Halley was visited by several spacecraft. Dr. A'Hearn admits that while Halley provided many beautiful photographs of its tail, he has "zero interest" in them. He is concerned with the nucleus of the comet, where both tail and coma originate. Inhanced images from the two Russian Vega spacecraft begin to show the shape of the nucleus of Comet Halley. The Vega images showed the comet in direct sunlight whereas Giotto observed the nucleus when it was backlit. Dr. A'Hearn showed several enhanced photographs that were taken with Giotto's multicolour camera, released in Heidelberg, West Germany, during October, by the Max Planck Institute. The photographs show that the dimensions of the irregularly shaped

nucleus are about 5 x 10 km, with an albedo of less than 4%. In other words the comet is blacker than soot, whose albedo is 6%.

Determining the rotation rate of a comet's nucleus is very difficult. While in Australia early this year, Dr. A'Hearn took near nuclear photographs of comet Halley in which faint spiral jets could be seen by the audience. Together with a colleague at Goddard, the images were processed in false color and the spiral features were dramatically revealed. Rotation of the jets, and therefore the nucleus, was obvious on slides where enhanced images taken over several days a few hours apart are shown side by side.

Dr. A'Hearn has made photometric measurements of comets in an effort to determine rotation period. If an irregularly shaped comet has a small coma, then as it rotates the shape of the nucleus will cause reflected light to vary in brightness, as it presents different sides to the observer. The photometric light curve made during March and April with a 24 inch telescope in Chile indicates a rotation period of 7.3 days for Halley's Comet. This contradicts the previously accepted value of 2.2 days, which Dr. A'Hearn stressed, was determined from indirect measurements and spacecraft data. Indirect measurements include recurrence rates of halos produced by jet activity. He notes that irregular jet activity makes this method ambiguous. Halley's rotation rate and the validity of methods used to measure it is a source of ongoing controversy among the professionals at the present time.

According to Dr. A'Hearn, amateurs can help settle the rotation controversy. Acknowledging the WAS members who do photometry with the 17.5" telescope at Key Observatory, he notes that in March Comet Wilson will be well placed along the equator, and bright enough at 6th magnitude to be easily observed with amateur photoelectric equipment. Dr. A'Hearn is presently planning his own research program for Wilson, including photographing the gas jets near the nucleus, and a search for deuterium, a molecule he hopes to use in determining the temperature at which the comet formed.

In summary we do know that comets formed in a cold region from stellar grains. It is not definitely known where they formed, although Dr. A'Hearn is inclined to believe it was at about the distance of Pluto. Astronomers will continue the search because, according to Dr. A'Hearn, "finding out where things came from and where they are going is the whole point of astronomy." (Curt Roelle -- MDA Editor)

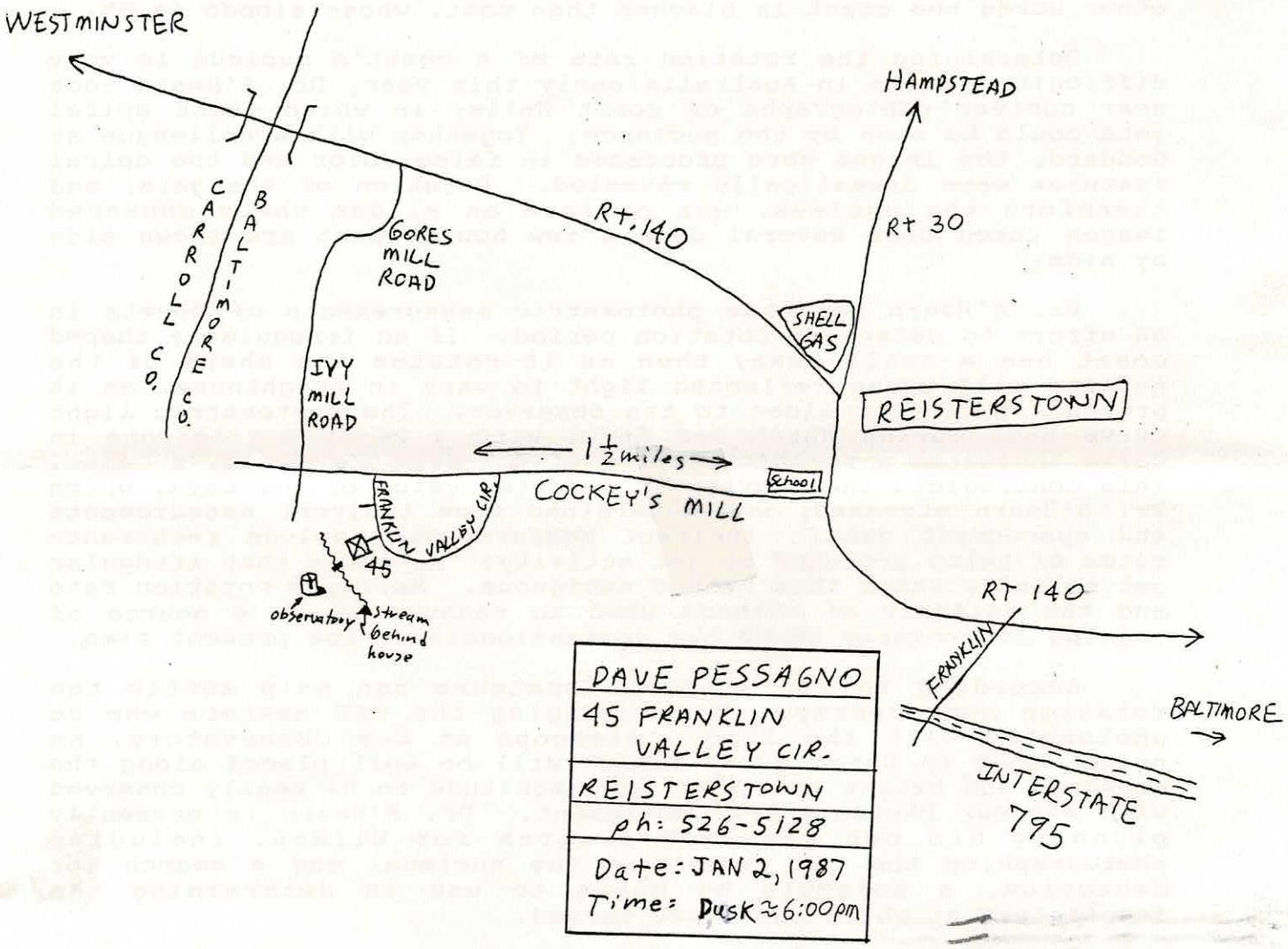
"Chemical Abundances and the Origin of Comets" is available for loan to WAS members on VHS format videotape. Contact Curt at 848-6384 to make arrangements.

WAS CALENDAR

December 17 7:30 p.m. WAS meeting -- Dixon Room, Library

January 02 6:00 p.m. Star Party -- D.Pessagno's, Reisterstown

STAR PARTY



DAVE PESSAGNO
45 FRANKLIN VALLEY CIR.
REISTERSTOWN
ph: 526-5128
Date: JAN 2, 1987
Time: Dusk ≈ 6:00pm

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