Star Dust

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December Speaker - Dr. Peter Teuben: "The Virtual Observatory"

Submitted by Jeff Guerber

Abstract

With the advent of modern fast computers and larger and larger datasets, a consortium of astronomers around the world is working on the concept of the Virtual Observatory, meaning the federation of all existing databases of data observed and relating data from different observatories at scales never being possible before. If theoretical data could be added to this "VO", a whole new set of questions could be asked about the data. The talk will deal with this concept of theoretical data in a virtual observatory, and will be spiked with (possibly live) examples from the speaker's own experience.

Bio

Peter Teuben got his Ph.D. in Groningen (1986) on the topic of "Dynamics of Barred Galaxies". His first post-doc was in Princeton, at the Institute for Advanced Study, where he worked with Piet Hut and Josh Barnes on a novel idea to (as we would now call it) "open source" the software of stellar dynamics and n-body calculations. This package is called NEMO and is still under active development. His next postdoc brought him closer to observational data again, via a short BIMA post-doc in Urbana-Champaign. He arrived in 1989 in College Park, to continue to work on the BIMA (a mm wave radio synthesis array). He continues to develop software for this array, as well as the NEMO package, and combines theory with data from this and many other observatories.

"Exploring the Cosmos by Trying Something Different": A talk by Dr. David Dunham

Reviewed by Jay H. Miller

The November 6 NCA meeting featured a talk, "Exploring the Cosmos by Trying Something Different", by one of our members, Dr. David Dunham. His talk to us was based on the presentation he gave when he received the 2003 Dirk Brouwer Award for Space Flight Mechanics at the February 2004 meeting of the American Astronautical Society.

David told us that he got interested in astronomy during his father's work in Pakistan in the 1950's. He was looking through a dictionary and became interested in a list of stars. He decided to go on a quest to find them in the sky, so he obtained some star-charts and began his search. When they returned to California, his parents got him a subscription to *Sky and Telescope* (S&T) magazine and a 2.4" refractor when he was 15. In S&T, he noticed a prediction for a lunar occultation in October 1957 of beta Capricorni at a location 200 miles north of his house. This is a wide double star. He saw the first component disappear, but he was amazed as the second star could be seen moving past the mountains on the southern edge. He realized that he was not at the proper location to see the second star become occulted and said to himself that it would be neat if someone was able to calculate exactly where that second star would have been grazed by the mountains of the moon. He figured that that was so complicated he'd never be able to calculate it. After taking a course in solid geometry in college, he realized that this knowledge coupled with an astronomical almanac might enable him to calculate a graze path. So, armed with his log tables and a Marchant calculator (we didn't have PCs, or even electronic calculators back then), he was able to predict the path of the March 1962 graze of Aldebaran south of San Jose, just an hour and a half drive south. He convinced a fellow graduate student to drive him down, but saw on the way that the star had disappeared. They pulled off to the side of the road and David saw through his trusty 2.4" telescope that Aldebaran's reappearance was not instantaneous. He realized that while he was not exactly on the graze path, he was close enough that he was seeing the reappearance of a star with a large angular diameter. Later that year, he took a course in FORTRAN. His next six occultations were clouded out. His first success was a March 1963 Graze near

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The second star could be seen moving past the mountains on the southern edge.

NCA Events This Month

The Public is Welcome!

NCA Home Page: http://capitalastronomers.orgt

Fridays, December 3, 10, 17, 24, and 31, 6:30 to 9:30 P.M. NCA mirror- and telescope-making classes at the Chevy Chase Community Center, at the northeast corner of the intersection of McKinley Street and Connecticut Avenue, N.W. Contact instructor Guy Brandenburg at 202-635-1860 or email him at gfbrandenburg @yahoo.com.

Saturdays in December, except December 4. Observing with NCA's 14-inch telescope in Chevy Chase, MD. In Mike McNeal's backyard, 5410 Grove St, Chevy Chase, MD, (Friendship Heights Metro). Please make reservations by 10 p.m. the Friday before. Call Mike at 301-907-9449 or email him at mcnealmi@verizon.net to let him know you are coming.

Saturday, December 4 at 7:30 P.M. NCA meeting at the University of Maryland Astronomy Observatory on Metzerott Road in College Park, MD. Speaker: Dr. Peter Teuben: "The Virtual Ovservatory" See map and directions on Page 6.

Saturday, December 4 at 5:30 P.M., preceding the meeting, dinner with the speaker and NCA members at the Garden Restaurant in the UMD University College Inn and Conference Center. See map and directions on Page 6.

University of Maryland Observatory, in College Park on the 5th and 20th of every month at 9 P.M. The talks are non-technical.

Upcoming NCA Meetings
2005: January 8, February 12, March 12, April 2, May 7, and June 4

The deadline for the December Star Dust is November 15. Please send your material to Elliott Fein by that date to ensure inclusion.

Send submissions to Elliott Fein at elliott.fein@erols.com.

Text must be in ASCII, MS Word (97 or earlier), or WordPerfect.

All articles submitted may be edited to fit the space available.

"Exploring the Cosmos by Trying Something Different"

(Continued from page 1)
Roseville, CA. He continued to observe grazes and to write articles for S&T. In 1975, the International Occultation Timing Association was formed. He got his revenge on beta Cap in June 1977 soon after moving to the Washington area ,with a graze near Ashland, VA with 12 other observers.

David showed the results of data reductions and told us that Alan Fiala did the first video observation in May 1981 during a graze of delta Cancri. Previously, data had been obtained using visual observations with a time signal recording onto a tape recorder. He now sets up at remote sites with low light level video cameras and recorders so that he can get more data points. While the emphasis in the early days was on lunar grazes of stars, presently he is more interested in asteroidal occultations.

He then talked about some of the missions he has worked on, including the International Sun-Earth Explorer 3/International Cometary Explorer (ISEE 3/ICE). This was the first mission to go to a libration point. This is a point where the Sun's and the Earth's gravities are equal so a satellite will stay at this location. Its first job was to study the Sun and the solar wind. He talked about the difficulties in planning for various orbits. In 1985, the probe was redirected to fly into the tail of comet Giccobini-Zinner. The satellite is still in orbit and the plan is to program it so that the Earth can recapture it in 2014. David has also worked on the SOHO and Clementine missions.

David then told us about the Near Earth Asteroid Rendezvous (NEAR) spacecraft mission. NEAR swung by the asteroid Mathilde and then went on to its primary purpose, going into orbit about the asteroid

The rockets fired to push it into the ground

Eros in 2000. The maneuvers were quite complex with multiple flybys of the Earth and Moon. They got about 100,000 pictures. Eros is not a rubble pile as Mathilde is. To end the mission, NEAR landed on the asteroid. What's funny is that the way the spacecraft was programmed, as it got very close to the surface, inadvertently the rockets fired to push it into the ground and they kept firing until the fuel was gone. While NEAR was unable to take any pictures because of its orientation on the asteroid's surface, the solar panels continued to function and the gamma ray spectrometer, which was dug into the surface, yielded better data than when it was in orbit around Eros.

While this was going on, David continued with the IOTA (International Occultation Timing Association) work. In 1999, Leonid impacts were observed on the dark side of the moon. (Unfortunately, at this point, my camcorder ran out of tape. Thus there is little detail in the rest of this review.) David talked about the importance of capturing the Leonid impacts and about his present focus on asteroidal occultations. Observations of an occultation taken by several observers in different locations, have not only been able to give us the shape of several asteroids, but they have also detected moons of at least one asteroid. At first this was not believed. However, one of the space probes managed to photograph a satellite of one of the asteroids.

We appreciate that David was able to step in and give this delightful and interesting presentation at the last minute, when the scheduled speaker had to cancel because of illness. We are proud that one of our members, David Dunham, got the Brouwer award.

Girl Scout Event -- A Blast!

Guy Brandenburg

(*continued from last month)*

It was fairly hazy and nearly a full Moon, just about the only sky object we could see was the Moon, but towards the very end I was able to find Albireo and the Double Cluster, even though the dew was literally dripping off the scope and all of the finders were fogged up. So my plan wasn't to spend too much time looking through the scope anyway.

What we spent the most time on was walking an accurate scale-model tour of the Solar System based on some calculations I had made and a smallish yellow kickball the Girl Scouts had, that was the model of the Sun. I had about 60 little girl scouts following me and the girls who had volunteered to be the Planets around a huge field, with individual girls taking the lead as they counted out the number of giant steps (which are close enough to a meter each) to the various planets. I had drawn accurate (as well as I could - it's hard to draw dots that are small enough) diagrams of the planets, to scale, on 5 x 8 cards, with a note as to how many steps from the last planet needed to be taken. It was something like 9 meters/giant steps to Mercury, 7 more to Venus, 7 more to Earth, 11 more to Mars, then 83 (yes, eighty-three) more to Jupiter (which was the first one that was easily visible - the other previous inner planets were all small dots that were less than 2 mm in diameter), then 102 (that's right, one hundred and two) more to Saturn.

Then, when we discovered it was going to be 211 more steps to Uranus, everybody's reaction was -- OH, NO! We realized that we had run completely out of room and would have to start climbing the mountain to get there! And the next planet after that, Neptune, would have been 257 steps beyond that! OH, NO, again!

And then Pluto would have been (on average) about 194 steps beyond that! Then the question was, how far to the next star? Would it be in West Virginia? Ohio? California? Nooo - try Japan or Korea or maybe even Afghanistan or India!

From the group of eager hands waving at the beginning, I had selected someone to be Mercury; to be Venus; to be Mars, and so on. Each one of the 'planets' had a pointed stick to carry. One of the mothers brought along a sledgehammer, and pounded the stick into the ground when we reached the appropriate spot. Another girl held the staple gun and stapled the card onto the stake, after we had held up the card for all to see and the girls had shined their flashlights on it so they could read it easily and try to make out the size of the planet. A bunch of the girls knew quite a bit about the mythology of each of the gods/goddesses that each planet represented, and corrected me when I confused the Greek god Apollo with Hermes/ Mercury.

I also told them what I remembered about the mythology behind the constellations Andromeda, Cassiopeia, Perseus, Cepheus and Cetus - that one they hadn't heard, and part of Cassiopeia was about the only constellation visible outside of the Summer Triangle. I have never quite figured out how Cetus the sea monster was ravaging the coasts of Ethiopia when normally Ethiopia doesn't have much of a coastline. Maybe it did back then...

The girls corrected me when I confused Apollo with Hermes/Mercury.

After each talk or tour, they got a chance to look through my scope and any of the others that they cared to try. The other scopes (about three of them were set up) were all inexpensive, rickety little refractors with so-so optics [ones that Galileo would have consorted with the Devil himself to own, if only he could have, but by today's standards weren't much] that were extremely difficult to aim or find anything with. In a couple of cases, the owners had NEVER been able to find anything with them before.

When I told the groups of girls that I had made my large-ish 8" blue-green Dob, the reaction was uniform: "You MADE that?" And of course the images were much clearer than in any of the others, and there was no dew on the mirror, since it was protected down at the bottom of the tube, and as long as none of the girls actually leaned on the tube or pushed it out of the way, then it stayed on the target. Of course, my finders became dripping wet by the end of the night, and the eyepieces, too, so I alternated the two eyepieces (one stayed in my pocket warming up) and the finder, using a Telrad only at the end.

The parents were quite appreciative as well, and told me that they thought it went well. They even gave me $25 for gas money! The girls were great and extremely enthusiastic.

Some preparation on my part was definitely necessary, as well as flexibility, and some acting, and enthusiasm on my part, and a willingness to let them participate and tell the others what they had learned previously (from whatever source). I had originally intended to have all of the girls put red surveyor's tape over their flashlights, so I had cut out hundreds of little 3" sections of tape, but after I got there and saw how bright the moon was, it was obvious that that would be a waste of time. You could see everybody's face quite well by moonlight, and we were casting moon shadows quite clearly.

If anybody is interested, I could email them a copy of the spreadsheet I used, which has a scale of 1 cm : 41,143 miles (because that's the size of a #5 soccer ball or medium kickball with a circumference of 26 inches, standing in for the Sun). As it turned out, I forgot to bring my soccer ball, but their kickball was just the right size, and even a better color - yellow!

At the very end, I gave the adults a bunch of photocopies I had made of several things: My scale model solar system spreadsheet; the pages from Menzel and Pasachoff's *Field Guide to the Planets* for September 15/October 1; and the silly Richard Thompson cartoon on the fall wasteland of mediocre constellations like Sciatica, The Rake. They might be handing them out the next day...

The whole thing was really a blast. By the way, it was my first experience dealing with a group of girl scouts, and I had no idea really what to expect. I thought the organizers did a great job, too.

Oh, the idea for this scale model was not original with me. I forget who I got the idea from in the first place. I used to wonder about this when I was a kid back in the 1950's, looking at diagrams of the Solar System.

Mid-Atlantic Occultations and Expeditions

by David Dunham

Asteroidal Occultations

Date	Day	EST	Star	Mag	Asteroid	dmag	s	in.	Location
Dec 3	Fri	4:32	2UC38382705	12.0	Adorea	1.3	10	8	MD,DC,nVA,sPA
Dec 3	Fri	19:40	SAO 212333	5.5	Candy	11.4	1	2	Carolinas-low
Dec 17	Fri	6:40	2UC32201883	11.4	Hesperia	0.9	16	8	sWV,sVA,eNC
Jan 3	Mon	18:45	TYC12150509	11.3	Pales	1.2	21	7	sOH,PA,nNJ,NYC
Jan 4	Tue	1:34	TYC24360724	11.1	Ausonia	0.8	8	7	sNY-LI,nePA
Jan 7	Fri	3:06	SAO 58721	9.4	Lumen	2.3	13	4	sMD,DC,nVA,WV

Grazing Occultations

DATE	Day	EST	Star	Mag	%	alt	CA	Location
Dec 15	Wed	20:14	38 Cap	6.7	21+	8	15S	Pittsburgh, PA area; ZC 3160
Dec 16	Thu	20:42	SAO 165136	7.8	31+	16	14S	Chester &W.Pt.,VA; OceanC.,MD
Dec 17	Fri	20:04	ZC 3434	7.5	42+	33	16S	Richmond,VA; St.Marys City,MD
Dec 18	Sat	21:13	SAO 128626	7.9	53+	35	14S	Sligo, NC (s. of Moyock)
Dec 19	Sun	21:54	SAO 109568	7.6	64+	40	13S	Pittsburgh, PA area
Jan 6	Thu	4:50	SAO 183194	8.5	23-	15	17S	Ladysmith & Townsend, VA
Jan 7	Fri	6:58	SAO 184198	8.1	13-	19	20S	n. Lexington, VA; Sun -7 deg.
Jan 8	Sat	6:37	SAO 185197	8.5	6-	7	22S	Millville, NJ; Sun -8 deg.

Total Lunar Occultations

DATE	Day	EST	Ph	Star	Mag	%	alt	CA	Sp.	Notes
Dec 7	Tue	3:54	D	Jupiter	-1.8	26-	20	-74S		disk duration 68 sec.
Dec 7	Tue	4:28	R	ZC 1850	6.5	26-	26	49N	K0	
Dec 7	Tue	4:49	R	Callisto	6.5	26-	29	84N		disk duration 2.5 sec.
Dec 7	Tue	4:59	R	Ganymede	5.4	26-	31	82N		disk duration 2.8 sec.
Dec 7	Tue	5:03	R	Jupiter	-1.8	26-	31	80N		disk duration 74 sec.
Dec 7	Tue	5:05	R	Europa	6.1	26-	31	79N		disk duration 1.6 sec.
Dec 7	Tue	5:33	R	SAO 139039	7.3	26-	35	39N	G5	
Dec 7	Tue	6:37	R	ZC 1855	7.2	25-	42	70N	A0	Sun -7;mg2 8.9 6",PA148
Dec 10	Fri	6:40	R	ZC 2226	7.0	3-	9	47N	A1	Az. 128 deg.
Dec 15	Wed	19:58	D	37 Cap	5.7	21+	9	69S	F5	ZC 3158; Az. 235 deg.
Dec 16	Thu	19:59	D	ZC 3304	6.4	32+	21	66S	B8	
Dec 16	Thu	20:30	D	SAO 165136	7.8	32+	17	37S	K0	graze, s VA & se MD
Dec 17	Fri	16:52	D	psi1 Aqr	4.2	41+	41	-3N	K0	ZC 3419; Sun alt. -2
Dec 17	Fri	17:14	D	psi2 Aqr	4.4	42+	42	79S	B5	ZC3425; Sun-5; double?
Dec 17	Fri	19:53	D	ZC 3434	7.5	42+	33	34S	A2	graze, s VA & s MD
Dec 18	Sat	18:19	D	ZC 0012	6.4	53+	49	88N	B8	
Dec 18	Sat	18:42	D	AP Piscium	6.2	53+	48	88N	K2	ZC 0013; spec.binary
Dec 18	Sat	19:18	D	ZC 0015	7.1	53+	47	70N	G5	maybe close double
Dec 18	Sat	22:46	D	ZC 0022	7.2	54+	19	21N	K0	
Dec 20	Mon	20:39	D	ZC 0252	7.3	73+	59	15N	A2	
Dec 20	Mon	23:37	D	ZC 0264	7.1	74+	33	53N	B9	
Dec 21	Tue	1:33	D	54 (Ceti)	5.9	75+	12	78S	F2	ZC 272; dbl?; az. 275
Dec 23	Thu	0:58	D	65 Arietis	6.1	90+	41	19N	A1	ZC 492
Dec 29	Wed	22:02	R	ZC 1393	6.5	89-	25	41S	G7	WA 289
Jan 3	Mon	1:42	R	SAO 138836	7.3	54-	21	87N	G0	
Jan 6	Thu	6:40	R	SAO 183232	7.2	22-	27	64S	F6	Sun alt. -9 deg.
Jan 7	Fri	5:40	R	ZC 2311	6.3	13-	10	64N	B8	Az. 133 WA 294
Jan 7	Fri	6:38	R	ZC 2317	6.6	13-	17	37N	A0	Sun alt. -9; WA 321
Jan 7	Fri	11:46	D	sigma Sco	2.9	12-	29	-85N	B1	Sun +29 deg.

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Those Nice Old Lenses

Jim Roy

In October, I collected a number of lenses (most of them since given away) from Harry Chow and John Smith (who kindly stored them) for distribution to NCA. The lenses were originally used for copying at the Department of Commerce. Harry works for Commerce in its Aquarium and collected these essentially from a Dumpster. Like me, Harry is also a stereo photographer, and he thought I might, with help from our NCA members, find an astronomical use for these fine, old lenses.

Some of the lenses are cosmetically beautiful, others just functional – most of the later ones (Goertz and Nikon) are 1950s-1980s vintage with excellent flat fields and conventional iris diaphragms typically f/11-f/64, made to copy and enlarge book pages, maps, sea charts, developers' plats, and construction blueprints with long, slow exposures at small apertures. The Goertz and Nikon lenses average over 5 pounds, even without their mounts and lensboards.

The older copy lenses take Waterhouse stops (thin washers with holes of various sizes), and would make superb "Alvan Clark" style 19th Century refractor telescopes.

All the lenses are bulky and heavy, at least 2 pounds each, requiring several feet of 3″, 4″, or even 5″ heavy duty tubing and a suitable rack and pinion or other refractor focus arrangement. Field coverage is enormous for all lenses – 2″ eyepieces or 4″ x 5″ sheet film holders are no problem for a lens intended to cover a flat copy field of 14″ x 17″. Also present are lovely but mostly worn vintage wooden boxes for some of the older and less bulky lenses.

The apochromatic (APO) Goertz and Nikon lenses are black painted brass, multicoated, and originally cost thousands of dollars each. Even the oldest brass mounted ones cost hundreds (in pre-1910 gold dollars). All were top quality professional equipment in their day, carefully ground, hand assembled and collimated, and well finished, often in lacquered brass.

Many older copy and view camera lenses, from the 1860s to about 1910, were engraved solely with what field they would cover in inches, and no mention of aperture or focal length. Since these are copy lenses, all are "slow" apertures, f/11-f/22 wide open, and the focal length is normally a bit more than the diagonal of the coverage. For instance, on the 16″ x 18″ Cooke Triplet, someone marked "focal length 25.3", and the speed is about f/16 or a bit slower. Waterhouse stops would bring it to f/64 or f/90.

Each lens was then mounted on a thick lensboard, wood, or heavy metal, attached to a solidly built copy camera that looks like an office desk with an enormous enlarger on top, weighing hundreds of pounds, and up to 12 feet tall. The desk top was a bed on which the copy subject was forced flat by metal clips or (later) by vacuum suction. Focusing was done on a ground glass with a magnifier, and the exposure was made with high quality orthochromatic copy film. This had a bit less than the exposure sensitivity of modern enlarging paper – from 15 seconds up to several minutes, making a shutter unnecessary. First you would pull the darkslide. The normal means of timing the exposure was to whistle a suitable number of bars of a Sousa march or an entire Caruso aria, for which you would use a derby hat or black leather lens cap to uncover and then recover the lens. Finally you would put the darkslide back. We have a couple of those lens caps with the older lenses, which have seen much use.

The older lenses are uncoated, so contrast is well below the standard of the today's lenses. Single coating came in during the 1930s, and multicoating in the late 1950s. The oldest lenses have 3 (Cooke Triplet) or 4 (Tessar and imitations) elements, the newest apochromats 4 to 6 elements and full multicoating. Some old ones have severe element separation and a bit of dirt between elements due to age and use, but others are in very good or excellent condition. A few are both good-looking and fully functional. All should be carefully and gently cleaned to prevent damaging the coating or scratching the glass.

It will be an effort of several tens of hours to install these lenses as objectives of good refractor telescopes, but the quality should be excellent and the results rewarding. Do use the stiffest tube, least jiggly focuser, and most solid tripod you can manage. As for eyepieces, the leftover ones from junked binoculars would be satisfactory, but proper telescope eyepieces in the $50-150 range would be better. The best of these old lenses are rivals in quality of Takahashi or Tele View 70-100mm diameter apochromatic objectives, but are not as compact or light. Two of the tubes will be 4 and 6 feet long, the others 1.5 to 3 feet.

The items are:

- Goertz Artar (APO) 70″ (1.78m) f/16, huge, bulky mount, over 40 pounds, basic lens still about 20 pounds, should have 5″ tube
- Zeiss Anastigmat (Brass) 16″ x 20″ format, at least 600 mm f.l., about f/16, made c. 1890-1910[1]
- Goertz Artar (APO) 35″ (890mm) f/12.5 #760128, with wooden box, c. 1970[1]
- Brass 750mm (29.5″) Doppel Anastigmat with "hat" box and cover, cap,c. 1890s – uses Waterhouse Stops. Marked "D.R.P"., which means "Deutsche Reichs Patent" – likely in the days of Kaiser Wilhelm II, who reigned 1888-1918.[2]
- Goertz Artar (APO) 35″ (890mm) f/12.5[1]
- Goertz Artar (APO) 48″ (1220mm) f/15 with wooden box, looks ugly, at least 6 pounds without lensboard and should have 4″ tube[1]
- Bausch & Lomb 500mm (19.7″) f/10-f/45, c. 1920[2]
- Bausch & Lomb Tessar 14″ x 17″, patent 1903 with wooden box, c. 1904-1910, at least 900mm f.l.[2]
- APO-Nikkor 760mm (30″) f/11-f/90 with flap lenscap, unscrews from ½″ plate lensmount. Maybe newest lens, c. 1980.[1]
- Metra-Scienar 19″ (480mm) f/11, old but with nice wooden box (box needs work)[1]
- Taylor, Taylor & Hobson (English) Cooke Triplet 16″ x 18″, 25.3″ f.l., (642mm) Brass, c. 1885-1900[2]
- 4 huge, extra thick square 3″ plus Wratten filters[1]
- 9 Waterhouse filters for narrow slit spectroscopy, etc. (not aperture variation)
- Box of Double Waterhouse Stops (big, but thin washers with rounded ends - slides into slit between ele-

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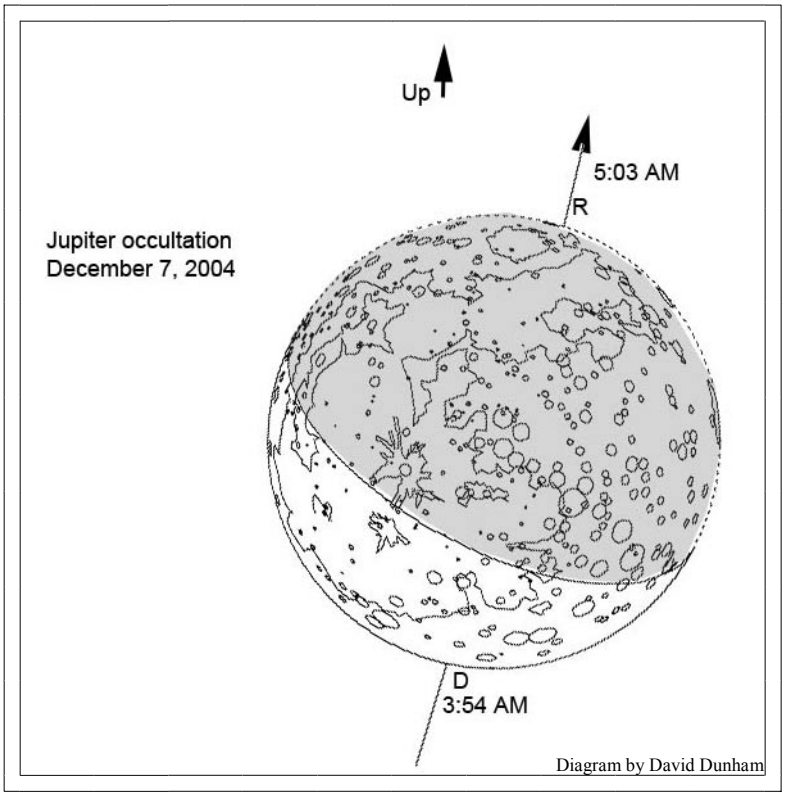
Occultation of Jupiter by the Moon in the Early Morning of December 7

Joan Dunham

The best occultation this year for most of North America will be the one of Jupiter by a crescent Moon early in the morning of December 7th, a Tuesday. Binoculars will probably be needed for the bright-side disappearance, but the reappearance at the Moon's dark limb, lasting about a minute, will be a spectacular naked-eye event. Jupiter's faint ring might be glimpsed with large telescopes just before the planet's globe starts to emerge. The diagram shows where Jupiter will disappear (D) and reappear (R) as it is occulted by the crescent Moon.



This is a view of the Moon as it will appear during the occultation for the Washington, D.C. area. It shows where to look for the occultation events - not so important for the disappearance, where you can see Jupiter beforehand, but can be critical for the reappearance, to point your telescope to the right location (if you can see the whole dark side of the Moon, as with a low-power eyepiece or binoculars, then that's not so difficult, either). The upper part of the crescent Moon is shown shaded, as if faintly illuminated by Earthshine). The line, with arrowhead at top, is the path that Jupiter will follow relative to the Moon. The "D" at the bottom shows the location of the disappearance on the sunlit side of the Moon, at 3:54 a.m. E.S.T., and "R' near the top shows the location where Jupiter will reappear at 5:03 a.m.

David Dunham

Elementary Astronomy – Magnitude Systems

Nancy Grace Roman

Humans have observed the stars since before history. Thus, it is not surprising that many astronomical concepts are quite old. Constellation names are derived from Greek and Roman gods; star names are primarily Arabic. The magnitude system is no exception. It dates at least to before the Christian era. The Greeks decided that they could divide the stellar brightnesses into five steps, with the brightest stars classified as 1 and the faintest they could see as 6.

When it became possible to measure stellar brightnesses more accurately, a finer division was needed. Measurements showed that the scale was a logarithmic function of brightness with the difference between 1 and 6 about a factor of 100. Most sensory impressions are logarithmic functions of the underlying stimulus. This provides a much wider range of sensitivities than would a linear scale. Because the brightest stars have the greatest luminosity, the magnitude is inversely proportional to the logarithm of the luminosity, a fact which many beginners find confusing. However, this has proved advantageous as we observe fainter and fainter sources, permitting an easy extension of the system without using negative numbers, except for a few of the brightest objects, such as the Sun. These considerations lead to the formula for the difference in magnitude between two sources as follows:

$$m_1 - m_2 = 2.5 \log(l_2/l_1)$$

where m_1 and m_2 are the apparent magnitudes of the first and second star, respectively and l_1 and l_2 are their respective luminosities.

This formula only defines the magnitude difference between two objects. To set the zero point, all magnitudes are referred to Vega which is defined to have magnitude = 0. The early magnitude system was a visual system, defining brightness differences as they appear to the human eye. When photographic photometry became common, it was realized that because the photographic emulsions had little sensitivity to the red, photographic and visual magnitudes differed for most stars. This entailed the development of a photographic magnitude system, with the two magnitudes designated as m_v and m_p, respectively. About 50 years ago, Harold Johnson used the newly developed photomultipliers together with well defined filters to set up a three color system: U (ultraviolet), B (blue), and V (visible), where B and V were approximately the same as the photographic and visual magnitudes and U was concentrated between the peak of B and the ultraviolet atmospheric cutoff. In parallel to the other systems, these are designated as m_U, m_B, and m_V. This is still the most used system, but others are in common use, particularly for specialized investigations. The development of infrared sensitive detectors resulted in the system being extended into the near infrared using the letters H, K and L (for the different energy bands). Systems have also been developed for wavelengths that do not reach the ground. They all follow the above formula with Vega having magnitude = 0.

One other extension of the magnitude is important. The system defined above refers to the brightness of an object as it appears from Earth. The magnitudes are called **apparent magnitudes**. For many purposes, it is important to describe the brightness of an object that allows a comparison of objects at different distances. This leads to the **absolute magnitude** system for the Sun and objects outside the solar system; this is the apparent brightness the object would have if it were at a distance of 10 parsecs. For asteroids, a special definition of absolute magnitude is used. It takes into account an asteroid's varying distance from the earth. Absolute magnitudes are designated in the same way as apparent magnitudes except that M is used instead of m.

Another important magnitude system is bolometric magnitudes. Unlike the others, which depend on the particular detector and instruments used, a bolometric magnitude measures the total brightness (luminosity) of a source in all wavelengths. It is never measured directly, but must be extrapolated from measurements.

Those Nice Old Lenses, continued

(Continued from page 5)

ments in lens, large hole on one side, smaller hole on other to give about f/16 and f/32 on f/11 basic lens)

As of Nov. 7, the only lens left to distribute was the 20 pound beast of a 70″ Goertz Apo-Artar, which requires a 6 foot tube of the strongest sort. Its glass has a clear diameter of 4 3/8″, and as now mounted covers 13″ x 12″ square in its mount and is nearly 20″ high. It would make a wonderful planetary objective for someone willing to handle its size. There is a diaphragm that stops from f/16 to f/90, and coverage is enough for flat field copying of full size blueprints, at least 30″ x 40″.

We may get a few more lenses, because Harry Chow is in negotiation with the Commerce Dept. people who dumped these vintage beauties for digital electronic scanner/copiers.

I plan to take the 70″ Goertz APO-Artar to our December meeting, but may need help moving it. Surely our members can find it a good home.

[1]given to members at the NCA meeting, Saturday, Nov. 6

[2]given to Guy Brandenburg for use by members at the NCA Telescope/Mirror Class, Friday, Nov. 5

Do You Want to Get *Star Dust* Electronically?

Any member wishing to receive *Star Dust,* the newsletter of the National Capital Astronomers, via e-mail as a PDF file attachment, instead of hardcopy via U.S. Mail, should contact Nancy Grace Roman, the NCA Secretary, at nancy.roman6@verizon.net or 301-656-6092 (home).

Getting to the NCA Monthly Meeting and the Dinner Before the Meeting

Jeff Guerber

NCA meetings are now held at 7:30 p.m. at the University of Maryland Observatory, in College Park on Metzerott Rd. between University Blvd. (MD-193) and Adelphi Rd. To get there from the Capital Beltway (I-495), either take US Rt. 1 south about a mile, turning right onto MD-193 West, then at the first light turn right onto Metzerott; or, take New Hampshire Ave. (MD-650) south, turn left at the second light onto Adelphi Rd., two more lights, turn left onto Metzerott, and proceed about a mile to the observatory. The observatory is on the south side of Metzerott Rd., directly opposite the UM System Administration building; you can park there if the observatory lot is full, but be careful crossing Metzerott Rd.

At 5:30 p.m. before the meeting, please join us for dinner at the Garden Restaurant in the UMD University College Inn and Conference Center, 3501 University Blvd. East at Adelphi Rd. From the Beltway, either take New Hampshire Ave. south, turn left onto Adelphi, and at the third light (passing Metzerott) turn left onto University then immediately right into the garage; or, take US-1 south, turn right onto University Blvd. west, and take it to the intersection with Adelphi Rd. Park either in the garage (costs), or in Lot 1 nearby (free). To get to the Observatory, exit to the right onto University Blvd. (MD-193) east, and at the second light turn left onto Metzerott Rd.

Are You Coming to Dinner?

If you are planning to come to the dinner before the meeting, please tell Benson J. Simon, telephone: 301-776-6721, e-mail st88@ioip.com, so that we can make reservations for the right number of people.

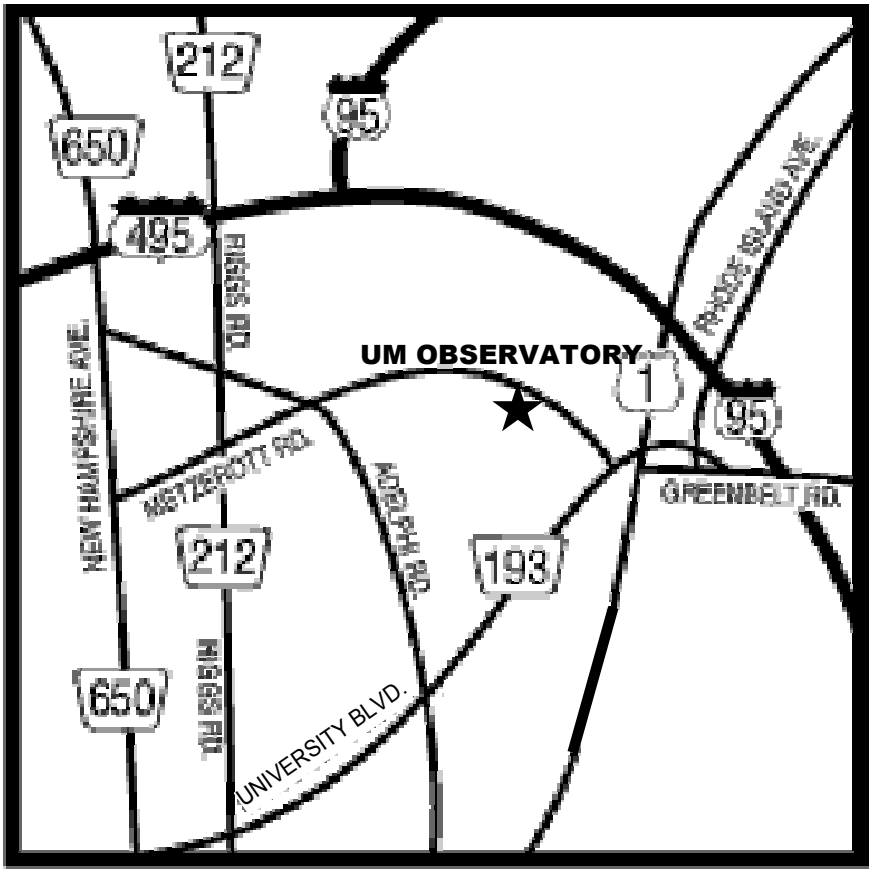
Do You Need a Ride?

Please contact Jay Miller, 301-530-7942, if you need a ride from the metro to dinner or to the meeting at the observatory. (Please try to let him know in advance by email at jhmiller@os2bbs.com.)

Observing after the Meeting

Elizabeth Warner

Following the meeting, members and guests are welcome to tour through the Observatory. Weather permitting, several of the telescopes will also be set up for viewing.



Getting to the NCA Meeting

Meteor Showers

December Radiants

Full Moon: December 26

Radiant	Major Activity Duration	Maximum
Geminids (GEM)	Dec. 6 - 19	Dec. 13 at 20:45 UT
Radiant	**Moderate Activity Duration**	**Maximum**
Ursids (URS)	Dec. 17 - 25	Dec. 22 @ 05:05 UT
Radiant	**Minor Activity Duration**	**Maximum**
Delta Arietids	Dec. 8 - Jan. 2	Dec. 8/9
11 Canis Minorids	Dec. 4 - 15	Dec. 10/11
Coma Berenicids (COM)	Dec. 8 - Jan. 23	Dec. 18-Jan. 6
Sigma Hydrids (HYD)	Dec. 4 - 15	Dec. 11/12
December Monocerotids (MON)	Nov. 9 - Dec. 18	Dec. 11/12
Northern Chi Orionids (XOR)	Nov. 16 - Dec. 16	Dec. 10/11
Southern Chi Orionids (XOR)	Dec. 2 - 18	Dec. 10/11
Phoenicids (PHO)	Nov. 29 - Dec. 9	Dec. 5/6
Alpha Puppids (PUP)	Nov. 17 - Dec. 9	Dec. 2-5

Source:http://comets.amsmeteors.org/meteors

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http://capitalastronomers.org

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SERVING SCIENCE & SOCIETY SINCE 1937

NCA is a nonprofit, membership-supported, volunteer-run, public-service corporation dedicated to advancing astronomy, space technology, and related sciences through information, participation, and inspiration, via research, lectures, presentations, publications, expeditions, tours, public interpretation, and education. NCA is the astronomy affiliate of the Washington Academy of Sciences. All are welcome to join NCA.

SERVICES & ACTIVITIES:

Monthly Meetings feature presentations of current work by researchers at the horizons of their fields. All are welcome; there is no charge. *See* monthly *Star Dust* for time and location.

NCA Volunteers serve in a number of capacities. Many members serve as teachers, clinicians, and science fair judges. Some members observe total or graze occultations of stars occulted by the Moon or asteroids. Most of these NCA members are also members of the International Occultation Timing Association (IOTA).

Publications received by members include the monthly newsletter of NCA, *Star Dust*, and an optional discount subscription to *Sky & Telescope* magazine.

Consumer Clinics: Some members serve as clinicians and provide advice for the selection, use, and care of binoculars and telescopes and their accessories. One such clinic is the semiannual event held at the Smithsonian Institution National Air and Space Museum.

Fighting Light Pollution: NCA is concerned about light pollution and is interested in the technology for reducing or eliminating it. To that purpose, NCA is an Organization Member of the International Dark Sky Association (IDA). Some NCA members are also individual members of IDA.

Classes: Some NCA members are available for educational programs for schools and other organizations. The instruction settings include star parties, classroom instruction, and schoolteacher training programs that provide techniques for teaching astronomy. NCA sponsors a telescope-making class, which is described in the *Star Dust* "Calendar of Monthly Events."

Tours: On several occasions, NCA has sponsored tours of astronomical interest, mainly to observatories (such as the National Radio Astronomy Observatory) and to the solar eclipses of 1998 and 1999.

Discounts are available to members on many publications, products, and services, including *Sky & Telescope* magazine.

Public Sky Viewing Programs are offered jointly with the National Park Service, and others. Contact: Joe Morris, joemorris@erols.com or (703) 620-0996.

Members-Only Viewing Programs periodically, at a dark-sky site.

NCA Juniors Program fosters children's and young adults' interest in astronomy, space technology, and related sciences through discounted memberships, mentoring from dedicated members, and NCA's annual Science Fair Awards.

Fine Quality Telescope, 14-inch aperture, see "Calendar of Monthly Events."

✂

Yes! I'd like to join the NATIONAL CAPITAL ASTRONOMERS **Date:**

Name(s): _____
Address: _____
_____
Telephone: _____ E-mail: _____
Other family members who should receive a membership card: _____
_____ I prefer to receive *Star Dust* by e-mail

Dues:
___ $27 With *Star Dust*.
___ $60 With *Star Dust* and a discount subscription to *Sky & Telescope*.
___ $15 Junior membership with *Star Dust*.
___ $45 Junior membership with *Star Dust* and a discount subscription to *Sky & Telescope*.
___ $100 Contributing member (with *Sky & Telescope*) ($40 tax-deductible).
___ $150 Sustaining member (with *Sky & Telescope*) ($90 tax-deductible).

Junior members only: Date of Birth: _____ Only members under the age of 18 may join as juniors.

Tax deductible contribution: ____ Thank You.

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