



REFLECTIONS

of the University Lowbrow Astronomers

July 2002



The University Lowbrow Astronomers is a club of Astronomy enthusiasts which meets on the third Friday of each month in the University of Michigan's Physics and Astronomy building (Dennison Hall, Room 130 or 807). Meetings begin at 7:30 PM and are open to the public. Public star parties are held twice a month at the University's Peach Mountain Observatory on North Territorial Road (1.1 miles west of Dexter-Pinkney Road; further directions at the end of the newsletter) on Saturdays before and after the new Moon. The party may be canceled if it's cloudy or very cold at sunset. For further information call (313) 480-4514.

This Month:

July 6th Public Open House and Star Party at the Peach Mt. Observatory
July 13th Public Open House and Star Party at the Peach Mt. Observatory
July 14th the 24" mirror from the McMath will be removed for recoating.

July 19th Lowbrow Meeting at 7:30pm at Peach Mt. Observatory

Also note that our web site has a new URL: www.umich.edu/~lowbrows/ Thanx Dave!!

Next Month:

August 3rd Public Open House and Star Party at Peach Mt. come and feed the mosquitoes!
August 10th Public Open House and Star Party at Peach Mt.
August 16th Lowbrow Meeting at 7:30pm at Dennison Hall. Speaker TBA
Also note that our web site has a new URL: www.umich.edu/~lowbrows/ Thanx Dave!!

Tom Ryan is Back!

This Time He Gets A Little Abrasive!

Bob Gruszczynski Goes to Big Sky Country

Planetarium: Astronomy in the Palm of Your Hand!

Harry Juday ... WRITES AGAIN!

Pictures and Letters to the Editor.

On July 14th the Lowbrows will be taking the mirrors out of the 24" McMath for re-coating at Clausing in Skokie, IL. The cartoon on the right shows two post-doctorates expertly adding to the world's supply of non-usable optical equipment, and at least seven years of bad luck for the both of them!





A Review: Planetarium for Palm OS
 By Mark Deprest

A couple of months ago, I wrote an article, that sung the praises of technology and how wonderfully it merged with astronomy. Well, here is a powerful little program that gives you great excuse to buy one of those PDA's. Planetarium by Andreas Hofer Software has an impressive database of stars, deep-sky objects and comets. All of which can be expanded and / or updated fairly easily.

"Planetarium" is just that, a planetarium style program that offers the user a number of features and provides a "user friendly" platform for both the novice and the seasoned astronomer. When you have downloaded all of the databases currently available through the Planetarium support website, the program provides a rather impressive amount of standard information on a given object, and some info that is unique to a specific object. For instance when you tap your stylus on the Moon and then tap the info icon you are provided with:

1. Positional data such as: Location and UT offset of your location, Local Time, the constellation the Moon currently is in, Its current RA and Dec., its Hour Angle, its Ecliptic Longitude and Latitude, its Azimuth and Altitude, Magnitude, and its Distance in kilometers and "Light time".
2. Statistical data such as: Elongation from the Sun,

its current Phase, the percent of Illumination visible to us, its current phase Age in days and hours and minutes, and its angular size.

3. Rise and Set data which includes the local rising, transit and setting times for the next few days. Plus the azimuth for rising and setting positions and the altitude at transit. Additionally you can pull up "Twilight" information for that particular day. The "Twilight" info includes: Both the Sun and Moon's rise, transit and set times; the length of both Day and Night in hours and minutes; the Difference from the previous day; the Morning and Evening times of Civil, Nautical and Astronomical twilight.

4. Time data for the current time such as: Local time, Universal time, the Julian Date, and Local Mean Sidereal Time.

5. Phase data for the major phases of the next few months.

Planetarium

0.0°S, 0.0°E, +0h Jan 17, 2002

| | Rise | Trans | Set |
|------|-------|--------|-------|
| Sun | 6:06a | 12:10p | 6:14p |
| Moon | 9:06a | 3:16p | 9:26p |

*following day

| | | |
|--------------------|--------|--------|
| Day/Night Length | 12h07m | 11h53m |
| Diff. to prev. day | -2s | |

| Twilight | Morning | Evening |
|--------------|---------|---------|
| Civil | 5:44a | 6:36p |
| Nautical | 5:19a | 7:02p |
| Astronomical | 4:53a | 7:27p |

Compass view

Sky view

Planetarium provides similar info for all of the planets with a few bonus features added in, such as: a graphic display of the current phase on the inferior planets, and a graphic display of the current position of the Galilean moons for Jupiter.

Planetarium's databases contain easily retrievable information of a similar nature on over 9000 stars, hundreds of comets, all of the named asteroids, the Messier catalog, the Herschel 400 catalog, the Caldwell catalog, and some sub-database catalogs such as: the Astronomical League's double

star list and a list of 85 Colorful stars. Addition databases can be downloaded once they are created using the correct layout and producing them as comma delineated text files. The user can also edit any of the data or add new data very easily through the pull down menus for an object's database. Notes for an observed object can be added in the same fashion as well as new comet or asteroid's elements. Planetarium has a unique feature that I find to be very helpful for field operations. The Compass View is just that; an electronic version of a compass that gives you a very accurate compass position of any object in its databases, plus its relative position to the horizon. This is a wonderful tool in the field for owners of Dobsonian scopes and other telescopes on Alt/Az mounts, and for binocular users.

The Compass View provides a graphic display of the positional info the way Alt/Az scopes and binocular users work.

In version 2.2 Planetarium has added two new features to an already featured packed program. The first is called Meteor Showers and provides an interactive database and graphic displays of the major meteor showers. The second new feature is called Observational Log; this is a feature that will come in handy for anyone doing an observing project of any kind. Observational log interfaces with all of the databases contained in Planetarium, so that once you've used the program to locate an object merely tap the Observational Log icon and that object along with the date and time are listed at the top of the form with plenty of room below for comments.



| Meteor Showers | Aug 8, 2002 | |
|----------------------------|---------------|------------|
| Pegasisds | Jul 10 | 3 |
| July Phoenicids | Jul 14 | var. |
| Pisces Austrinids | Jul 28 | 5 |
| Southern delta-... | Jul 28 | 20 |
| Alpha-Capricorni... | Jul 30 | 4 |
| Southern iota-A... | Aug 5 | 2 |
| Northern delta-... | Aug 9 | 4 |
| Perseids | Aug 13 | 110 |
| Kappa-Cygnids | Aug 18 | 3 |
| Northern iota-Aquari... | Aug 20 | 3 |
| Alpha-Aurigids | Sep 1 | 10 |

Planetarium ▼ Jupiter

63.2° Alt. 29.0° Az.

16.3%

r.a./dec. 6h37m 23.2°

Gem m-2.7 4.24 AU

0.0°S, 0.0°E, +0h LMST 5h42m

Jan 17, 2002 9:54 pm 2452 292.4123

Planetarium 2h, 20°/div ▼ 90°

RA AZ

LMa, LMi, CMi, Crs, Leds, Sex, Coma, Hya, SE, Hnt

Zurich, +1h Nov 18, 2002 3:08 am

Planetarium also can be connected to some of the new "Goto Scopes" out there as well as a GPS unit. Admittedly I have not used either of these functions; however, if they work half as well as the other functions this program performs they would be superbly useful.

As you probably already figured out, I like this program, its user friendly, provides accurate data, enough information to soothe even the most hard-core info-junkie, easily expandable, field operationally sound and inexpensive. The support website is well constructed and provides answers to most of questions commonly asked. A downloadable Users Manual is available through this site and is very comprehensive and complete. If you are looking for a program that puts use-ability, information, and features not found in programs costing three times as much then Planetarium 2.2 by Andreas Hofer Software is for you. For more info and the latest release go to: <http://www.aho.ch/pilotplanets> or email: planets@aho.ch

SOME MUSING ON THINGS **ASTRONOMICAL**

Harry L. Juday

When reading about the Universe, and our knowledge of it, one thing seems very apparent, that all things have a cyclic life. They are born, develop, exist and die, to be born again.

This got me to wondering about Black Holes. Do they also have a life cycle (that we are just not aware of as yet)?

Do Black Holes have a Critical Mass? Can they only get so large before they explode? (and what an explosion that would have to be.) Could this be the source of at least some of the massive energy releases we have detected?

I did e-mail NASA's "Ask a Scientist" with this query. No answer.

Maybe one of our Club experts could shed more light on this for me.

I don't know if any of the rest of you think about these types of things, and I am certain others have had the same questions, but as yet, I have not read or heard of this possibility.

I recently sent these questions to Astronomy Mags' "Ask Astro". I wonder if I will get any reply?



A COUPLE OF INTERESTING **OBJECTS**

Harry L. Juday

Now that Scorpius is high in the night sky, I would suggest viewing a couple of objects that I find kind of interesting, G Scorpii (RA 17 49 51 Dec -37 02) and just to the East, Globular cluster NGC 6441(RA 17 50 02, Dec -37 03).

G Scorpii is a 3.2 v. mag. spectral class K0/K1 III orange/orangish red star located approx. 16 min. East and slightly South of Lambda Scorpii (the Eastern star of the stinger) and a little more than 2d South and a bit West of M7.

NGC 6441 is a 7.2 v. mag Globular Cluster 7.8' dia. It is made seemingly fainter by absorption and its relatively low position in our skies.

I realize that this is one of the richest areas in the night sky with numerous viewing wonders, but what makes this pair interesting to me is that the first time I viewed them, it seemed I was seeing a low power mirror image of Antares and M4.

I find it quite interesting that both of these combinations of a bright orange/red star and near-by Globular Cluster appear in the same Constellation.

Telescope Topics: "Fine Grinding"

By Tom Ryan

My son, who is a teenager and is interested in everything that I am not, saw me rough grinding the back surface of a Zerodur secondary, and idly asked me how I would be able to see through it, since it looked pretty rough to him. I told him that the surface would be ground with finer and finer abrasives, until the scratches were smaller than the wavelength of light, at which point they would become invisible, and the surface would appear polished. He seemed satisfied with this explanation, then asked to borrow the tape measure (his real reason for talking to me), which hasn't been seen since.

His interest in this mundane process made me think that it would be worth sharing some of the things I have learned about fine grinding. Fine grinding, of course, is the step between rough shaping the optic and polishing it, and is necessary to get to the really interesting part, which is figuring. Its sole purpose is to reduce the scratches, pits, and subsurface fractures left on the surface from the roughing operation to a point where the surface can be polished out on a pitch lap in a reasonably short length of time. It's an intellectually undemanding process, and if you like jogging, you'll probably like fine grinding. Personally, I much prefer it to polishing.

A typical progression of abrasive grades, from rough to fine, might look like this:

SiC Carborundum Grade Particle Size, microns

46 356 (559-241)

80 165 (292-102)

120 102 (140-38)

220 63 (102-20)

Al2O3 MicroGrit Grade Particle Size, microns

25 25

9 9

3 3

Some people start with #80 for rough grinding, and if the mirror has been diamond generated, they may start finishing with #220 or 25 micron. Your mileage may vary.

When I made my first few telescope mirrors, I spent a lot of time checking the surface with an eyepiece for pits left over from the previous grade.

I

spent a lot of time finding them, too, and more time grinding them out. As you can tell from the numbers in parentheses in the chart above, some abrasive grades are not very well defined. I would religiously shake grit onto the wet mirror's surface, wet and evenly spread the abrasive, then lower the mirror gently onto the surface, being careful to move it in little circles before allowing its full weight to press against the abrasive. The reasoning was that if any large clumps of abrasive were lurking in the mix, this operation would break them down before they could do significant damage. Usually, it worked.

Between then and now, I worked as Manager of R&D at a machine tool company that made electrical discharge machines. These are machines that cut metal with a spark. This gives them all kinds of advantages over ordinary metal cutting machines, not the least of which is the ability to cut hardened mold steel as if it were butter, and leave a sand-blasted appearance on the mold. Take a close look at the surface texture of your computer keys, the bezel on your monitor, the plastic parts in your car; all came from molds made by EDM machines.

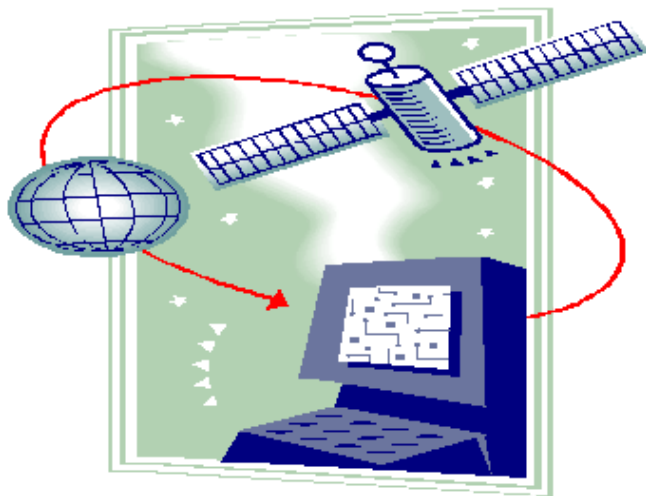
What does this have to do with grinding glass? Making a plastic injection mold is a lot like making a telescope mirror. A large part of the material is removed in a violent process that leaves a rough surface, and the remaining effort is devoted to refining the surface finish. When I arrived at the EDM company, the machine's electrical discharge control system was not tremendously sophisticated. Each individual spark could vary in duration, which left the surface with spark craters of different sizes, and an uncertain surface texture.

A rule of thumb was that for every hour of roughing, a mold would require an hour of finishing. This cost our customers a lot of very expensive machine and operator time, since the EDM process is relatively slow. One thing I changed in the spark generator was the way it timed out the individual sparks. Faster electronics permitted the machine to monitor each spark, and made sure that it produced the same size crater as all of the other sparks. Immediately the finishing time dropped to 20%-30% of its previous value. The customers were very happy. The technology still didn't save the company.

My first mirrors were made before Microgrit was

available, and the fine grinding stopped with #600 (about 35 to 9 micron particle size). Fine grinding then took a long, long time, and polishing was worse. There always seemed to be deep pits left over, and polishing them out took days. Microgrit is an aluminum oxide with uniformly shaped and sized particles. Fine grinding the back side of the previously mentioned secondary (so I could test through it) took a little over two hours, start to finish, and the surface was uniform and ready to polish in less time than I used to spend on one or two abrasive grades.

My only caution is associated with having the mirrors stick together when grinding with the 9 micron and 3 micron grades. Keep a spray bottle of distilled water handy to wet the surfaces if they seem to be drying out. Don't stop moving the mirror on the tool, even for an instant. I had to modify my stroke from a linear center-over-center to long ellipses, so the glass wouldn't be stationary at the end of a stroke. If they do stick together, wet them down thoroughly, get out your plastic hammer and hope that you've banked up some good will in the universe.



A Few E-mails to the Editor

Every month I get a number of interesting messages as e-mails. They don't always lend themselves to become an actual article, without a lot of additional work. I decided to share a few with the rest of the club for a change. The following are almost unedited:

Dear Mark,

I wonder whether you would publish the following note in the Newsletter:

I would like to take this opportunity to thank the Lowbrows for their assistance in moving a number of heavy, ungainly, and bulky cabinets from Dennison Hall to the Science Library in the Shapiro Undergraduate Library. These cabinets contained a fair proportion of the observational records of the Michigan astronomy program during the generations before and after World War II. Included were hundreds of slides that UM astronomers used in teaching and in presenting their research before a wider audience of professionals and amateurs, thousands of spectrograms that mark the entire career of the "great" 37.5" reflector, tens of thousands of cards providing information about peculiar stars, and numerous plates of astronomical objects ranging from individual stars to asterisms to clusters to nebulae to galaxies. This was a labor of love and, writing as a historian, I am especially grateful to the Lowbrows for their interest, enthusiasm, very hard work, and gracious response to the need for preservation of the labors of astronomers ranging from W. J. Hussey and Ralph Curtiss through Dean B. McLaughlin and Heber D. Curtis up to the late Freeman Miller and Leo Goldberg.

With best wishes,
Rudi Paul Lindner



Hi Mark,
Here's a bit about the Longmont Astronomical Society's trip to Mt. Evans on the 18th from their newsletter editor. I'm trying to piece together some panoramic images from the trip. I got sooooo many images (319 in one evening) that I need a new computer just to assemble the panoramics!

Cheers,
-Mark Vincent, Ph.D.

----- Original Message -----

Last Tuesday June 18th, Mark Vincent, Thomas Cooper and myself, Gary g, spent the night up on top of 14,258 foot mountain top, It's a 28 inch

scope. We got tour of building with good old friend Dr. Bob Stencel from Denver university. Dr Bob went way out of his way for us by doing this free night for us amateur guys in the big boys astronomy world to look at what ever we wanted to thru highest telescope in the world. I know it looked bad with all the smoke and stuff in the air but remember your above most of it at 14,000 plus feet in elevation. The over head sky was good along with west and north, but east and south were pretty smoke filled so we stayed in upper sky most of the time. Your not going to believe this but at 2:30am or so they spotted another fire at Echo Lake area, so we were told to get off the summit right away, because that is where the road to the summit begins, 14 mile road to the top. This is the year of fires ! for sure, pretty scary anymore.

The seeing at 14,258 feet is so much better than anything I have ever experienced, with views of moon craters at high powers were awesome. The Ring nebula you could easily see the 14.5 and 16 mag stars in the middle of ring. M 13 my eye got stuck on the eyepiece I think, trying to count all the stars. Even my 30 scope at lower elevations does not come close to how good the views were on the Summit. I did bring my 16 scope because I thought there would be a line at 28 inch scope, but I must have died and went to heaven, no lines at scope all night. We set up my 16 and several scopes in panorama viewing area on top by the parking lot. Some casual people who just happened to be there were treated to some awesome views thru my 16 scope and others. Dr Bob has done so much for us amateur people, he is a star himself. Thanks Bob, want to do it again maybe yet this Summer.



REFLECTIONS - July 2002

Mark,

Here are a couple shots, experimenting with a digital camera (Canon D30) through my 10" SCT. You can use them if you like, or pitch them. I am just learning how to use this set-up. With the D30, I can adjust the ISO speed, along with aperture and shutter speed. I can also preview on the fly, rather than waiting for film to come back a day or two later. I have the specifics recorded for these shots, but not with me right now. I am not real pleased with the Jupiter shot. I hope to figure out how to capture the bands, and get some color, but not quite there yet. Anyway, Stars Up, Lights Down!

Chris Scharrer



I don't know about the rest of the club, but I sure like your Jupiter shot!

Tycho and its rays is a beautiful shot.!



Journey to the Big Sky By Bob Gruszczynski

Well, it's time for the annual trek to the American Bowling Congress Championship Tournament. This year it was held at Billings, MT. As most of you know, I was pretty pumped about getting out to Big Sky, and Mark asked me to do a trip report for the newsletter. My doubles partner and I crammed the VW full of enough bowling equipment and clothes for an 11-day trip. Jeff had never seen this part of the country by land before, and I was ready for a road trip. I made sure to save room for the Skyquest. Big Sky or bust!

The trip to Billings took 3-1/2 days and encompassed stops at Badlands National Park, Mt. Rushmore National Memorial, Devil's Tower National Monument, and Yellowstone National Park. We managed to miss a tennis-ball-sized hail storm in Wisconsin by a few miles, almost got taken out by an errant SVT Ford Contour at snow covered Powder River Pass, and were snowed out at the entrance to Yellowstone. Are you seeing a pattern forming here? BAD ASTRONOMY WEATHER.

I personally think that the rugged western high desert plains country is beautiful, and even though the weather was bad for photon gathering, it was quite good for sightseeing and hiking. Cool (but not cold) cloudy days - it only rained at Mt. Rushmore as we were leaving. The exception was at the higher elevations, where we did get some snow while driving. On to Billings.

Three days in Billings. Big Sky Country. We arrived at noon under the bluest sky in the world. This is going to be great! We met up with the rest of the team and went off to do team bowling things together. Jeff told them that I had stuffed the 10-inch telescope in the back set of the car. They were amazed and most became instant astronomers. "What can we see?" "How much magnification?" etc... Open house in Billings, sharing the photons, now we're talking.

As darkness approached on the first day, I had an uneasy feeling watching some high cirrus escape over the western mountains. By dark it was completely overcast. Shut out again. No problem, we still have three nights left.

The next day, between bowling events, I checked out a few potential dark sky sites. The sky cleared and hopes were up. We went to dinner, and as we finished and

walked outside, the planets were in action. A little naked-eye astronomy from the restaurant parking lot and everyone was ready for some 'scope time. "Just wait 'til you see Jupiter and Saturn through this baby." I said. But then someone said "Hey, they're gone!" I looked up just in time to see the last planet get swallowed by those pesky high cirrus again. Grrrr...

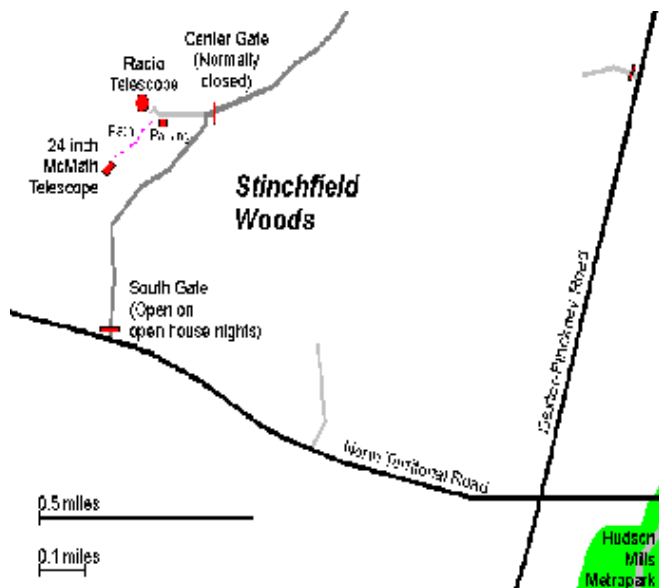
Day three and I'm starting to get anxious about gathering photons. The day clears to a beautiful blue sky yet again. This time two of us are going to start the evening at one of my viewing locations and catch some photons before the clouds come. The first place had an obnoxious light that I did not notice during my daytime trip. The second looks more promising except for the sign says "Park closes at 10 PM." It was after 10, but all of the gates were open. I found a spot not too far from the gate and set up the scope. Parked the car at the gate so that someone coming to shut the gate would know that we were there.

I set up on Jupiter at 138x. Looks kind of fuzzy. Here come the clouds. Grrr. Time to start looking at things where the clouds aren't. M35, 36, 37, and 38 are still in the clear. Just as I get a bead on 38, my friend says "There's a cop." "Cool." I say, hoping that he's into astronomy. He notices that we have a telescope and kills his headlamps. Yessss! "A telescope, eh?" "Yes sir, wanna see Jupiter?" "Sure, can you see anything in this haze?" "Kinda hard, but we drove here from Michigan to see some dark skies, so here we are." So we chatted for a while as the clouds continued to move in and obscure everything yet again. I start to tear down. "Sorry about the skies. If it clears again," he says, "you didn't hear this from me, but if you go back a few roads, turn right, and head to the end, it's really dark back there. It's usually where I catch the kids necking. Good luck!" "Thanks!" I said, not really believing that the sky will ever be clear here. Nice guy, though.

Unfortunately, I was right. Day 4 and night 4 in Billings was cold and rainy. The rest of the trip proved just as fruitless. I should have seen the writing on the wall on the drive out, but optimism among astronomers reigns supreme. Eleven days with a 10-inch telescope, and very few photons to show for it. Fortunately a trip to Big Sky Country always holds enough fascination to make it worthwhile, no matter what the weather. Next year - Knoxville - and we'll try it again.

Places and Times:

Dennison Hall, also known as The University of Michigan's Physics and Astronomy building, is the site of the monthly meeting of the University Lowbrow Astronomers. It is found in Ann Arbor on Church Street about one block north of South University Avenue. The meeting is held in room 130. Monthly meetings of the Lowbrows are held on the 3rd Friday of each month at 7:30 PM. During the summer months, and when weather permits, a club observing session at Peach Mountain will follow the meeting.



Peach Mountain Observatory is the home of The University of Michigan's 25 meter radio telescope as well as the University's McMATH 24 inch telescope which is maintained by the Lowbrows. The observatory is located northwest of Dexter. The entrance is on North Territorial Road, 1.1 miles west of Dexter-Pinckney Road. A small maize-and-blue sign marks the gate. Follow the gravel road one mile to a parking area near the radio telescopes. Walk along the path between the two fenced in areas (about 300 feet) to reach the McMATH telescope building.

Public Star Parties:

Public Open House/Star Parties are held on the Saturday before and after each new Moon at the Peach Mountain Observatory. Star Parties are canceled if the sky is cloudy at sunset or the temperature is below 10 degrees F. Call 480-4514 for a recorded message on the afternoon of a scheduled Star Party to check on the status. Many members bring their telescopes and visitors are welcome to do likewise. Peach Mountain is home to millions of hungry mosquitoes - bring insect repellent, and it does get cold at night so dress warmly!

Amateur Telescope Making Group meets monthly, with the location rotating among member's houses. See the calendar on the front cover page for the time and location of next meeting.

Membership:

Membership dues in the University Lowbrow Astronomers are \$20 per year for individuals or families, and \$12 per year for students and seniors (age 55/+). This entitles you to the monthly REFLECTIONS newsletter and the use of the 24" McMATH telescope (after some training). Dues can be paid to the club treasurer **Charlie Nielsen** at the monthly meeting or by mail at this address:

**6655 Jackson Road #415
Ann Arbor, MI 48103**

Magazines:

Members of the University Lowbrow Astronomers can get a discount on these magazine subscriptions:
Sky and Telescope: \$29.95 / year
Astronomy: \$29.00 / year

For more information contact the club Treasurer. Members renewing subscriptions are reminded to send your renewal notice along with your check when applying through the club Treasurer. Make the check payable to "University Lowbrow Astronomers".

Newsletter Contributions:

Members and (non-members) are encouraged to write about any astronomy related topic of interest. Call or E-mail to Newsletter Editors at:

Mark Deprest (734)223-0262 msdeprest@comcast.net

Bernard Friberg (743)761-1875 bfriberg@aol.com

to discuss length and format. Announcements and articles are due by the first Friday of each month.

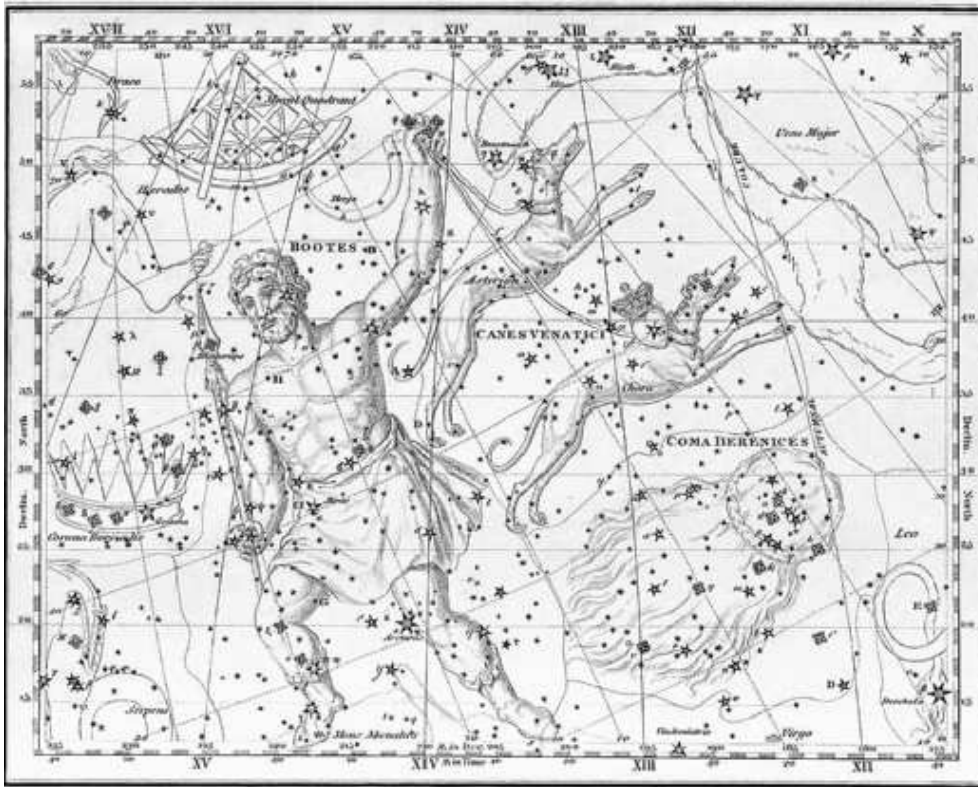
Telephone Numbers:

| | | |
|---------------------|-----------------|---------------|
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| Vice Presidents: | Dave Snyder | (734)747-6537 |
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| Treasurer: | Charlie Nielsen | (734)747-6585 |
| Observatory Dir.: | Bernard Friberg | (734)761-1875 |
| Newsletter Editors: | Mark Deprest | (734)662-5719 |
| | Bernard Friberg | (734)761-1875 |
| Parking Enforcement | Lorna Simmons | (734)525-5731 |
| Keyholders: | Fred Schebor | (734)426-2363 |
| | Mark Deprest | (734)662-5719 |

Lowbrow's Home Page:

<http://www.umich.edu/~lowbrows/>

Dave Snyder, webmaster



Some Antique Celestial Maps
 provided by:
 Visual Language Library
 569 S. Marengo Ave.
 Pasadena, CA 91101
 818-431-2778

Featured are:
 Bootes, Canes Venatici, Coma
 Berenices, Corona Borealis,
 and Mural Quadrant (no
 longer used)



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Lowbrow's WWW Home Page:
www.astro.lsa.umich.edu/lowbrows.html
 Check your membership expiration date on the mailing
 label!