REFLECTIONS / REFRACTIONS

University Lowbrow Astronomers

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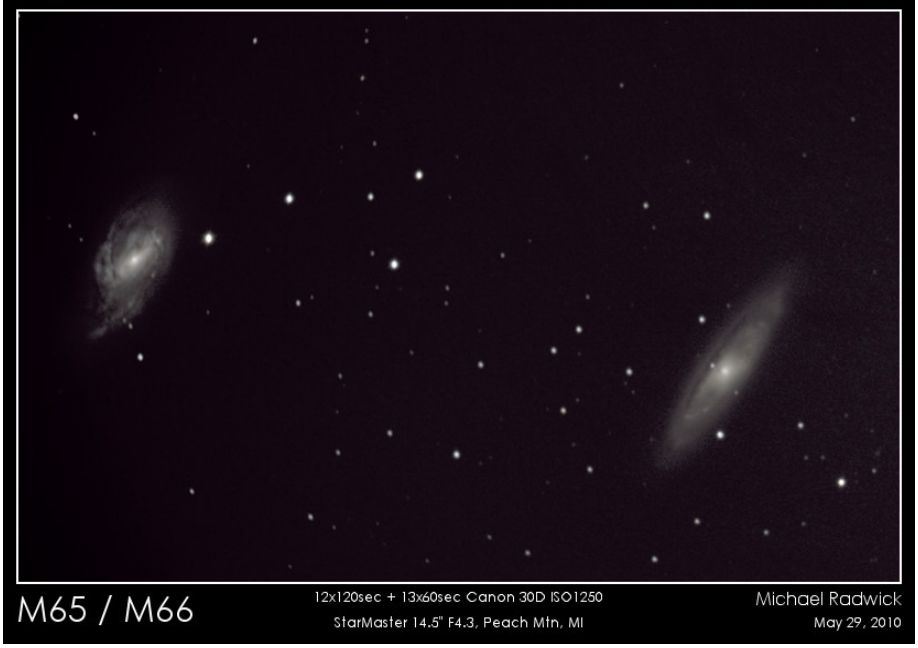


Memorial-Day Weekend

By Mike Radwick

For Americans, this is the unofficial start of summer; the celebration involves beaches, picnics, and so on. Amateur astronomers "celebrate" the end of long cold nights and the start of mosquito-swatting. I celebrated by convincing Mark Deprest, Arthur Suits, and Chris Sarnecki to accompany me to Peach Mountain only three days after full moon. Hence we had only an hour or so of dark skies. Everyone had their favorite objects to chase.

No one would be surprised to learn that Mark spent his time hunting three comets (yes, he found all three)!

For some time I have been writing software that will interface my StarMaster telescope with a laptop computer. The computer can then run additional software using my interface that will allow auto-guiding (a process that allows the computer to control the telescope so that it stays pointed at the same object with a high degree of precision). The goal is to obtain the ability to take deep-sky photos with relatively inexpensive equipment. I have been testing the software on almost every night out since last summer. But the testing requires only a couple of short images in the field, and a lot of debugging back at my home. So the images I've taken never really revealed the deep-sky.

I now feel my interface is working well, so I wanted to spend my time this weekend taking my first "long" exposure astro-photograph. Since the telescope is an Dobsonian design (axis rotates left/right and up/down with respect to the local horizon), the field of view in the telescope will rotate over time. So "long", that is the maximum time I can leave the camera shutter open without recording rotation, is dependent (partially) on the position of my target. Detail is acquired by taking many images and stacking them later on. Rotation is minimized for targets relatively low in the East or West; allowing for longer exposure times. But how long could I image before rotation was apparent? There is a arithmetic solution to that question, but I have yet to crunch the numbers; I prefer a experimental solution. I know from past experience that 1 minute exposures are no problem. I decided to try two sets; the first would be 15 one-minute exposures. My second set, following a rule set (mostly in jest) by some dear friends, is to "double it". That is, I took as many two-minute images as I could in the time left before the moon came up.

With that in mind, I chose M65/M66 to image. The galaxies position at 10:00pm EDT was 222 degrees Azimuth and 54 degrees Elevation. Moonrise was set for 11:03pm, giving me maybe an hour to image. By that time the galaxies moved to 240 deg. Az. and 46 deg. Alt.

These galaxies are moderately bright (AstroPlanner lists them as Mag 10.5 and Mag 10, respectively; SEDs lists them as 9.3 and 8.9), and not too spread out (M65 is 8x1.5 arcminutes and M66 is 8x2.5 arcminutes. They are close enough to observe in the same field of view with my scope, and are thought to be interacting with each other. The distance to these galaxies is about 35 Million Light-Years.

Good astro-photography requires good seeing. Poor seeing smears the image and prevents the capture of fine detail. The daytime temperature was in the upper-80s (F). After a hot day the atmosphere cools quickly which usually creates turbulence, so I did not have much hope for steady seeing; but as luck would have it, the seeing was very good. The resulting image was somewhat better than I expected.

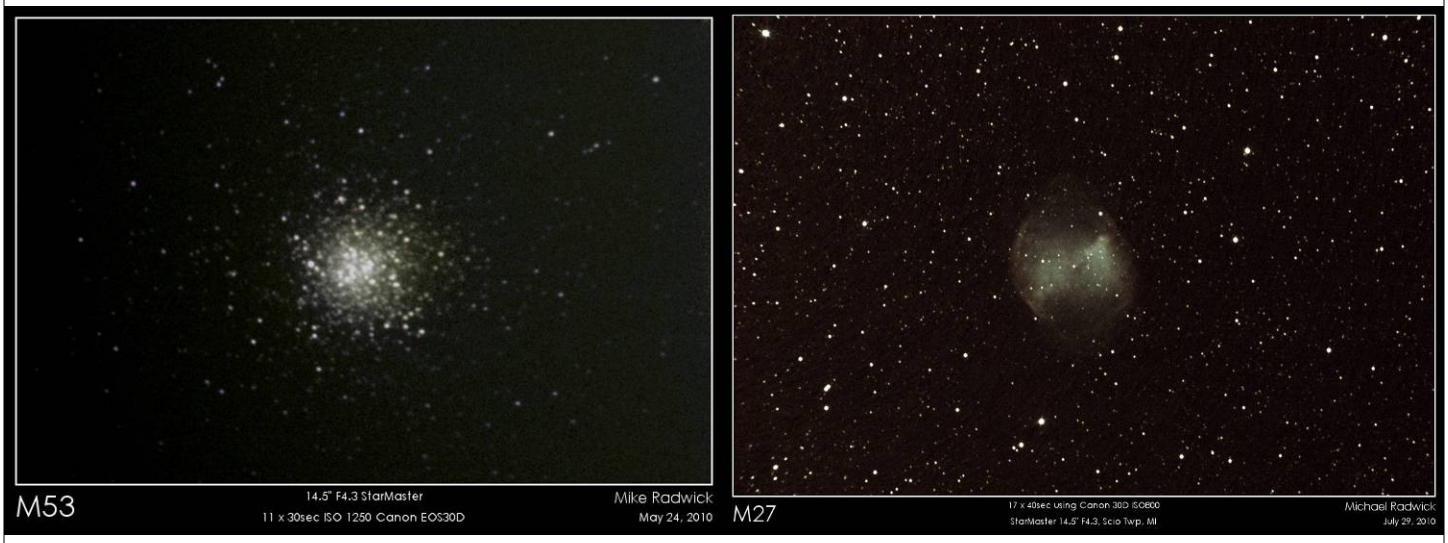
Here is what I ended up doing:

For guiding I used a Meade Deep-Sky-Imager (DSI) camera in a Williams Optics 66mm telescope piggybacked on the StarMaster. The telescope was guided using free software called PHD-Guiding and controlled with my own software. I used an unmodified Canon 30D DSLR camera set at ISO1250 with a correcting lens (called an OCS) from Denkmeier Optical at the prime-focus of my StarMaster 14.5 F/4.3.

I took 15 one-minute images, 20 two-minute images, and 5 two-minute dark-frames. The Canon was controlled by another free program called DSLR-Shutter, written by the same guy who wrote PHD-Guiding (Stark Labs). Once the set was started I had nothing to do but sponge off of Mark, Art, and Chris for views of the sky. I'm really glad they were good sports about it (and for putting up with the light-pollution from my computer).

The next day, I stacked the images using software called Deep-Sky-Stacker. Two of the one-minute images where thrown out; some satellites passed through them leaving a long streak (maybe someday I'll learn to erase such imperfections before stacking). Seven of the two-minute images were thrown out, these had out-of-round stars that were probably caused by a slight breeze shaking the scope and occasional overcorrection by the guiding system.

Final processing was done in Photoshop, but only minimal touch up has been done. Basically I cropped the image, then enhanced the contrast a bit to show the details. There are alot more things I could try with this image, but I am still unskilled in this. Image processing can take many hours (in this case however, I spent maybe 1/2 hour on it). Coverage of I what little I know would require a whole separate article, and there are others in the club who know much, much more that I do on this subject. I'll leave that for the future.



An Interesting Telescope

By Tom Ryan

Well, it's not as if there aren't enough interesting telescopes out there already, but I ran across one that I thought was particularly neat a few months ago. I was sorting through the solution space of a multi-element, 8” aperture, f/0.5, +/- 25 degree field of view telescope (I'll pause for a moment while you imagine that). I had the field flat, and the color error below the system resolution, and the aperture was OK and the focal ratio was what I needed, but the field of view was not what we were hoping for.

When that happens, it is time to let the optical design program, Zemax, off the short leash against which it normally strains. The “leash” is really a set of limits in the potential solution space over which the program wants to roam. If you don't set those constraints, you quickly find yourself with a solution to your customer's problem that involves Weird Physics and Impossible Things, which usually leads directly to “Your solution can't be built”, which eventually leads to unemployment. Hence, the leash.

However, sometimes a good solution lies just on the other side of those garbage cans, or through the Glass-wares Store, or into the hen house, and the only hope of finding it is to let the program off the leash. Not much. Just a little bit. There's a fine line between No Solutions and Crazy Solutions.

So, I reached into Zemax and made some changes. When a project, such as this one, has been in development for months, it acquires a history. A history that is not always perfectly documented. "This bit is set here to control the ray slopes between the 28th and 31st surfaces, in order to keep those apertures from growing and intruding into the cooling system, but why did I set the system magnification ratio to the product of that lens' focal length and this arbitrary number? Hmmmm. Maybe we don't need that any more. Let's delete that. Also, we probably don't need to find the vignetted limits of the normalized rectangular fields before we optimize. It's probably just slowing down the process, anyway."

This, of course, is exactly the kind of thinking that led to Chernobyl. "Hey, who needs those graphite rods, anyhow?" The best that can be said about this is that it all happens on a computer that is not connected in any way to the outside world (and I hope all of the young programmers who are reading this understand that it may be just such simple precautions as that which stand between us and the gray goo replicators), and the fact that taking off the constraints occasionally works.

In this particular case, it didn't work. It did, however, completely alter the system into something unrecognizable and unrecoverable. Fortunately, the program had been ordered to record some of the steps along its path to Insane Configuration Space, and one of those steps held a very interesting telescope.

One of the first things that an Optical engineer learns is that there are certain Standard Forms for optical systems. The Newtonian, the Cassegrain, the Double-Gauss and the Petzval lens are all standard solutions to certain problems. It is even possible to put together a chart with "f/ratio" as the X-axis and "field angles" as the Y-axis, and have it cover nearly every optical system yet devised, so that someone who needs to cover a certain field angle at a certain f/ratio can just look at the chart and say, "Oh, I need either a cheap three-mirror anastigmat, or an expensive microscope objective." They overlap at f/2.7 and 4 degrees coverage.

What is slightly less well known is that the standard forms which use refractive components (I mean lenses) are duplicated in reflective optics. For example, a simple, positive lens corresponds to a positive Newtonian mirror. A refractor made of a positive and negative lens corresponds to a Cassegrain, with its positive concave mirror and negative convex secondary. The simplest lens system that is capable of correcting all of the first order aberrations is a three-element Cooke triplet, where the lenses are arranged as Positive-Negative-Positive, and it's corresponding reflective system is the Baker-Paul telescope, where the mirrors are arranged Positive-Negative-Positive, and which gives phenomenal images over a wide field of view.

There are, as you might expect, equally good refractive systems using three elements which are not arranged as PNP. Wide angle lenses are typically NPN, and so was the reflecting telescope that Zemax found.

Now you say, "Wait a minute. NPN means that the first element is convex, right? What good is a telescope that starts out with a convex mirror?", and I could say, "I didn't say you should build it. I just said it was interesting", but I won't. In fact, some amateurs have built telescopes whose first elements were convex. They used chromed hubcaps for the first element, and a camera lens on a pole for the second and third elements, and got themselves an all-sky camera with terrific resolution. I should say, though, that these telescopes are the equivalent of a refractor made from the bottom of a (glass) Coke bottle. The design is capable of so much more.

The trick to developing one of these systems is to treat it like a classical Cassegrain. Give the mirrors appropriate conic sections and space them at distances so their foci overlap, and the system will cover more than a hemisphere with terrific resolution. Want to map the entire sky with one photograph? This is the telescope to do that. Want to capture the entire visible earth from low-earth orbit? Again, this is the scope. How about an uninterrupted, high resolution, 360 degree view of the horizon from a device the size of a beer can? Is the Ma-

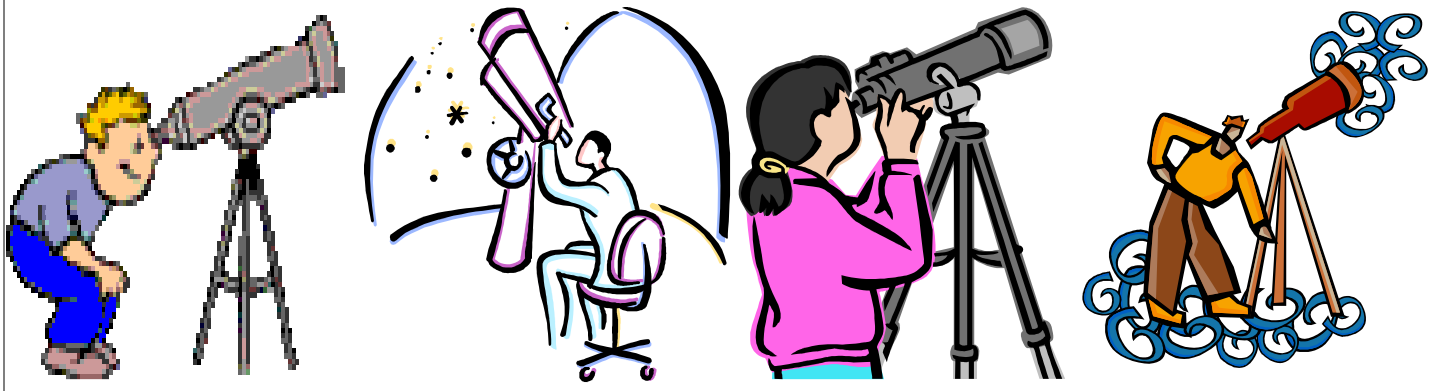
rine Procurement Office even *listening* to this article?

Making the system's steep conic sections is easier now than it was a few years ago, now that diamond turning lathes are becoming more common. Still, with the price of those lathes in the $100k range, it'll be a while before I have an all-sky diamond-turned telescope for myself.

I can't say that Zemax came up with the first example of this kind of telescope. An Engineer by the name of H. P. Brueggemann invented it in 1963. I even have his book, *Conic Mirrors*, in which he describes the device, which is how I recognized it when Zemax created it out of randomness and Chaos.

Randomness and Zemax's genetic optimization routines found the system. It is one of the Standard Forms of three-element systems. These three-element systems have actually been completely mapped now. However, higher-element systems are not yet complete.

Who knows what we might find out there?



Gracie's Bear

By Doug Scobel

By now most of you reading this know about the observating site that Yasu and Yumi discovered a few years ago up in the northeast "corner" of the Lower Peninsula. It's a campground by the name of Tomahawk Lake State Forest Campground, and it just happens to be located at Tomahawk Lake. What a coincidence! It's in Presque Isle County, just north of its border with Montmorency County, about fifteen miles north of Atlanta. It's about a three and a half hour drive from the Ann Arbor area. Yasu and Yumi and other Lowbrows have observed up there and reported it to be a truly dark site, comparable to if not better than Cherry Springs State Park, home of the Black Forest Star Party, in Pennsylvania.

For some time now I've wanted to check it out, but I've never been able to pull it off. Mark Deprest and I were talking about going this spring, and though I couldn't make it (again) he went up by himself on a moonless weekend in May. After he came back with his glowing reports (or maybe I should say "not glowing" reports as there is virtually no artificial skyglow up there) I just *had* to go.

The weather didn't cooperate in June, but it promised to be splendid the weekend of July 9-10, so we made our plans. Mark went ahead of me on Friday, but I couldn't pull away until Saturday. I arrived late that afternoon, and pulled into the camp site where Mark was set up complete with his tent and our Lowbrow banner hung prominently and proudly between two trees. I was surprised to see John Causland and Dave Snyder at his site as well. John and Dave were visiting a couple (Mike and Diane) from the area that several Lowbrows had befriended a couple years ago. Mike and Diane have a farm about seven or eight miles west of Atlanta, with the same awesome skies as the state campground, and John and Dave were doing some observing at their place. They came to Mark's campsite for a daytime visit. After I set up my tent, I waited for the sun to get a little lower before setting up my scope (My 13-inch Dob Papa Smurf) next to Blondie, Mark's 18-inch Dob, in a fairly large open area right next to our camp site.

Now big scopes attract attention, which leads me to the subject of this story. Saturday evening during twilight, after the scope covers came off, we started getting some curious visitors. We met one couple, John and Faye, from Wyandotte. They were touring the Traverse City area, but camped at Tomahawk because it's much less crowded and the surroundings much less built up. They asked what the price of admission was and Mark said nothing, but then I exclaimed "Hey,

Mark, not so fast". We got a good chuckle out of that, but that's not all we got. (More about that later.) We showed them Venus, Mars, and Saturn. Then another family stopped by, a mom and several small to middlin' kids. We showed them the planets too. One girl, I'd say she was maybe 10 or 11 years old, was duly impressed with Saturn. She told us confidently that Saturn has 63 moons. She was certain because she did a research assignment on it in school. Hmmm, we thought, here's a youngster with some astronomical potential!

We told everyone to come back after it got really dark, and we'd show them some more cool stuff. Near the end of twilight (which was nearly midnight) it was first John and Faye, bearing a nice batch of freshly picked and tasty Traverse City cherries. They made for a nice midnight snack. While John and Faye were both really impressed with what they saw in the eyepiece (perhaps the Captain Morgan they were sipping enhanced the already spectacular views), John, an engineer, was just as interested in looking at the construction of our scopes. We could see the wheels turning in his head; I think there could very well be a scope in his future. They left after munching on some eye candy while we munched on cherries. After it became truly dark, back comes the little girl who was so knowledgeable about Saturn, along with her dad and older brother. We found out her name is Gracie. Now Mark is always eager to show people the constellations, so he wasted no time giving them the tour. When he got to Corona Borealis I piped in that I thought it looks like a scoop of ice cream that fell off the cone (actually Bootes) right next to it. But Mark called it "Gracie's Smile". She got a kick out of that. After the constellations, we started showing them some big and chunky showpieces like we would at our open houses back home.

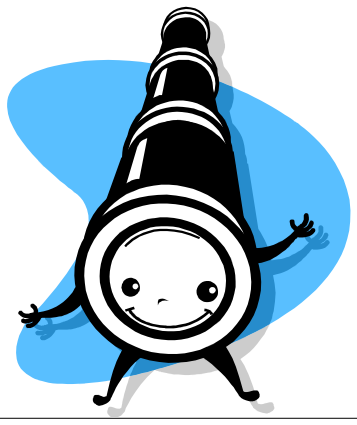
So what in the world is "Gracie's Bear"? You may be thinking it's either Ursa Major or Ursa Minor, but that would be too obvious. No, we discovered it that night. I was showing the family the double cluster, which is one of my favorite objects to show people. It is simply beautiful in virtually any telescope. Whenever I show it to folks I always point out the little ice cream cone in the middle of the western cluster (NGC 869). When Gracie got up to the eyepiece I asked her if she saw it (I must have had a hankering for ice cream that night, because I was seeing it everywhere.) She said yes she did see it. Then she said "I see a bear. Did you see the bear?" I had to admit to her that I had never seen a bear in the double cluster. But she said "Yes, I see a bear. I see his eyes, his nose, and his mouth. Are you sure you've never seen him?" Gracie turned the eyepiece back over to me. She tried to explain where and how to find the bear. "Is it big? Is it small? Is it in the same cluster as the one with the ice cream cone?" I inquired. "It's kind of big, and it's in the other cluster" she replied. "Sorry, I don't see a bear" I admitted again. By now Mark had heard all the commotion, so he started looking for it in his scope too. But alas he didn't see the bear either. Gracie went back to the eyepiece. "I see a bear. He has a freckle too! I can't believe you can't see him!" I tried. Mark tried. Her brother tried. No bear. A half hour went by with Gracie explaining what her bear looked like, and Mark using his scope, and Gracie's family members and I taking turns trying to see her bear in mine. Finally, I was starting to see the bear. Yeah, those two stars and that little triangle of stars look like a pair of eyes and a nose. And another little triangle of stars looks like they could be his mouth. Yeah, that does kind of look like a bear! The more I looked the more I saw a bear's face. After a little more scrutiny I could see a pattern of stars that formed the outline of his head, with two large ears. Mark must have been going through the same process as I, because almost at the same time both he and I said "I see it, Gracie, I see your bear!" Once we saw it the bear was unmistakable. It's the face of a little teddy bear. There is even an extra star on his face that Gracie saw as a freckle. Gracie was delighted that finally we were all able to see her bear. I'm sure that she was proud to be able to show us all something we had never seen before, and that she saw first.

Now I've been to a lot of open houses and shown a lot of folks a lot of objects through the telescope. Some folks you have to ask if they saw it and they just mumble "yeah", like it didn't make an impression at all. Others say "WOW!" and you don't even have to ask. But never have I had a complete novice look through my scope and see something in a completely new way, and show me something that I've overlooked after viewing it dozens of times. Gracie saw a bear, and with a little bit of work helped us to see her bear too. It was a special moment, because in that moment we opened up a whole new universe to some very nice people, in particular Gracie. And I was able to look at an old, familiar object with new eyes, the eyes of a child. Gracie's eyes.

It made me take pause. All too often while I'm observing I'm trying to analyze what I'm seeing in the eyepiece. It's this many light-years away, that many light years across. It looks like a single object but it's composed of hundreds of thousands or maybe billions of stars. That orange star is really a red giant, many times larger than our sun. But Gracie I hope has changed that in me a little. She wasn't analyzing what she was seeing, she was just seeing, and didn't see red giants or white dwarfs but instead saw a bear. And by doing so she reminded me that while it may be a good thing to know the distance to that galaxy, or the spectral class of that star, or how old the stars are in that globular cluster, that maybe it's a better thing just to take the time to appreciate the utter and almost indescribable beauty of what's in the eyepiece. That sometimes we should just turn off our brain, stop thinking, and simply look and admire and appreciate and soak it in. If

we do, chances are we'll see something we never noticed before.
And isn't that what attracted most of us to this hobby anyway - the sheer beauty of the night sky? So from now on, whenever I look at the double cluster, I'll still see that little ice cream cone, and notice those red giants scattered about. But the first thing I'll look for is Gracie's Bear, and remember a little girl who reminded me to not only look, but to actually see.
And what of Gracie? Did what she see through our scopes that night spark a life-long love of the stars like that first look through a telescope did for so many of us? For her sake I sure hope so. And if some day she ends up with her own scope, I hope that every time she looks at the Double Cluster, she remembers the time she showed a couple old-timers her bear in the sky. Gracie's Bear.

The Double Cluster. Do you see Gracie's bear? If you can't then you'll have to wait for next month's newsletter. Photo courtesy Clay Kessler.



Bring Your Own Scope...

John Manney *(brand new member)*

My first week in the Lowbrows concluded with a star party double-header: Friday night at Sherzer Observatory, and Saturday night at Peach Mountain. Although I have been interested in the skies for many decades, I was always working alone. This had its advantages and disadvantages. On one hand, I didn't need to learn the pronunciation for words like "Betelgeuse." On the other hand, I missed out on a lot of good help. I remember how difficult it was to find comet Halley during its 1986 appearance. We were able to come to Peach Mountain to view it with the Lowbrows.

My daughter Catherine joined me for the July 17 Open House. She thought that I should bring my Celestron 75-mm refractor. I explained that this modest scope would be out of place among so many bigger and finer instruments. She seemed unconvinced. Unlike all of our previous visits, we arrived during daylight, and were able to see the faces of the people we were meeting. I was impressed with the variety of telescopes, and the variety of methods of using them. Since the crescent Moon was visible, we started observing right away. We looked at the Moon and Saturn through a dozen different telescopes. We hiked down to the observatory to look through the Mc Math telescope, then returned to enjoy the astronomical smorgasbord. Catherine and I went in different directions to visit and view. After a while she found me and said, "Hey Dad, someone has brought a telescope that's exactly like yours!"

Editor—Now that's what I'm talking about ...an article after being in the club less than a month! He knows how to get in my good graces!

The Lowbrow Library

I am pleased to announce that the Lowbrow Library has found a home that will make it accessible to all members during normal business hours. John Causland has graciously provided a nice bookshelf just outside of his office at his Main St Footprints Store. Any item or items may be checked out for as long as is needed; simply by signing out the item(s). Please remember to return them when you are done. The library contents are listed below:

ToolKits
Glass & Mirrors
Telescopes: Eyes on the Universe
Supernova
Galaxies
Shadows & Silhouettes
Planet Quest
Black Hole Survival Kit
Comet Making Kit
Exploring the Solar System

Publications / CDs / DVD's
Brother Guy: Are Asteroids Fluffy? (DVD)
Cosmos 7 Disc Collector's Edition (DVD)
The Universe -Season One (DVD)
Cosmic Voyage -IMAX (DVD)
A Sidewalk Astronomer - A film about astronomy, cosmolgy and John Dobson (DVD)
Mysteries of the Universe (3 VHS Tapes)
What is a Planet? (DVD)
400 Years of the Telescope (DVD)
December 2005 Sky at Night -BBC (CD)
McDonald Observatoy & Hobby-Eberly Telescope (VHS)
Destination: X-Ray Milky Way -Chandra X-ray Ob. (CD)
Unlocking the Mysteries: Science on the Edge of our Solar System (CD)
Hubble Source Video Collection 2005 (DVD)

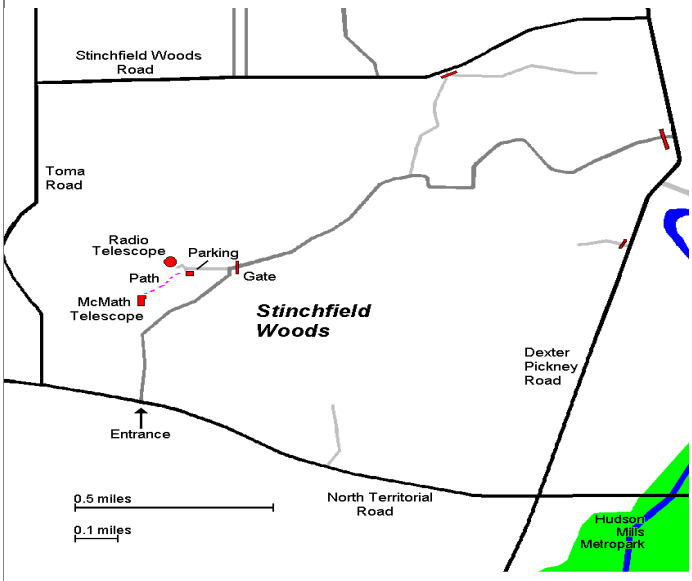
Books

Galaxies by Timothy Ferris
The Cambridge Photographic Atlas of Planets by G.A. Briggs & F.W. Taylor
The Mars Pathfinder: Approach to Faster-Better-Cheaper by Pritchett & Muirhead
Relatvistic Astrophysics & Particle Cosmology by Akerlof & Srednicki
Particles by Michael Chester
We Reach The Moon by John Noble Wilford
The Universe by Otto Struve
Astronomy / 365 Days by Bonnell & Nemiroff
Teacher's Guide to Astronomy: From the Earth to the Universe by Pasachoff
Relatvistic Astrophysics, Cosmology & Fundamental Physics by Barrow, Mestel & Thomas
Asimov on Numbers by Isaac Asimov
The Constellations Pocket Guide by Richard Dibon-Smith
Science & Superstition by Adler Planetarium
The Story of the Planets by Adler Planetarium
Time & Navigation by Adler Planetarium
What are Stars by Adler Planetarium
Astronomy by John C Duncan (1946)
The Comet is Coming! By Nigel Calder
Chaotic Phenomena in Astrophysics by Buchler & Eichhorn
Telescopes for Skygazing by Henry E Paul
Lights … Camera … Action: Getting Started in Astrophotography by Clayton Kessler
Exercises In Astronomy by Edgar Everhart
1975 Yearbook of Astronomy by Patrick Moore
The Look of the Universe by Patrick Moore
Report of the HST Strategy Panel: A Strategy for Recovery (Aug. - Oct. 1990)
Majestic Universe - Scientific American
Scale Model Rocketry: A Guide for the Historian-Craftsman by Peter Always
Foundations of Astronomy by Michael A. Seeds
Astronomy: Fundamentals & Frontiers by Jastrow & Thompson
Through Space & Time by Sir James Jeans
Astronomy American Nature Guide by Ian Ridpath
Relativity, Cosmology, Topological Mass & Supergravity by C. Aragone
Peterson First Guide Astronomy by Jay M Pasachoff
Frontiers of Astrophysics by Avrett
Interstellar Contact by Duncan Lunan
Mission To Mars: An Astronaut's Vision of Our Future in Space by M. Collins
Applied Optics & Optical Engineering Vols 1-5 by Kingslake
Burnham's Celestial Handbook Vol 1 by Burnham
Amateur Telescope Making Vols 1-3 by Ingalls (Scientific American)
The Realm of the Nebulae by Edwin Hubble
Red Giants & White Dwarfs by Jastrow
The Summer Stargazer: Astronomy for Beginners by Robert Claiborne
The Evolving Universe by Goldsmith
Supernova: The Violent Death of a Star by Donald Goldsmith
Gravitational Curvature by Frankel
Gravitation and Relativistic Astrophysics by Prasanna, Narlikar, Vishveshwara
Stars & Planets by Robin Kerrod
Practical Astronomy with Your Calculator by Peter Duffett-Smith
Discover the Stars: How to Use the Telescope by Johnson & Adler
New Handbook of the Heavens by Bernhard, Bennett, & Rice
Dictionary of Astronomical Terms (2 Copies) by Wallenquist
The RASC Observer's Handbook Yrs 1981, 1984, 1992, 1995, 2000, 2001

Places & Times

Dennison Hall, also known as The University of Michigan's Physics & Astronomy building, is the site of the monthly meeting of the University Lowbrow Astronomers. Dennison Hall can be found on Church Street about one block north of South University Avenue in Ann Arbor, MI. The meetings are usually held in room 130, and on the 3rd Friday of each month at 7:30 pm. During the summer months and when weather permits, a club observing session at the Peach Mountain Observatory 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" telescope which is maintained and operated by the Lowbrows. The observatory is located northwest of Dexter, MI; the entrance is on North Territorial Rd. 1.1 miles west of Dexter-Pinckney Rd. A small maize & blue sign on the north side of the road marks the gate. Follow the gravel road to the top of the hill and a parking area near the radio telescopes, then walk along the path between the two fenced in areas (about 300 feet) to reach the McMath telescope building.



Public Open House / Star Parties

Public Open Houses / Star Parties are generally held on the Saturdays before and after the New Moon at the Peach Mountain observatory, but are usually cancelled if the sky is cloudy at sunset or the temperature is below 10 degrees F. For the most up to date info on the Open House / Star Party status call: (734)332-9132. Many members bring their telescope to share with the public and visitors are welcome to do the same. Peach Mountain is home to millions of hungry mosquitoes, so apply bug repellent, and it can get rather cold at night, please dress accordingly.

Membership

Membership dues in the University Lowbrow Astronomers are $20 per year for individuals or families, $12 per year for students and seniors (age 55+) and $5 if you live outside of the Lower Peninsula of Michigan.

This entitles you to the access to our monthly Newsletters on-line at our website and use of the 24" McMath telescope (after some training).

A hard copy of the Newsletter can be obtained with an additional $12 annual fee to cover printing and postage. Dues can be paid at the monthly meetings or by check made out to University Lowbrow Astronomers and mailed to:

The University Lowbrow Astronomers

c/o Liz Calhoun

P.O. 4465

Ann Arbor, MI 48106

Membership in the Lowbrows can also get you a discount on these magazine subscriptions:

Sky & Telescope - $32.95 / year

Astronomy - $34.00 / year or $60.00 for 2 years

For more information contact the club Treasurer. Members renewing their subscriptions are reminded to provide the renewal notice along with your check to the club Treasurer. Please make your check out to: "University Lowbrow Astronomers"

Newsletter Contributions

Members and (non-members) are encouraged to write about any astronomy related topic of interest.

Call or Email the Newsletter Editor: **Mark S Deprest (734)223-0262 or msdeprest@comcast.net** to discuss length and format. Announcements, articles and images are due by the 1st day of the month as publication is the 7th.

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Lowbrow's Home Page

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Reflections & Refractions

Website
www.umich.edu/~lowbrows/

Charlie Nielsen demonstrates the care and feeding of the club's 10 inch Meade SCT on a Celestron mount? Don't worry there is a Losmandy dove-tail plate between them ... boy, those are some sturdy looking legs ... and the tripod looks adequate too!

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Check your membership expiration date on the mailing label