



President's Message

Our new members can sometimes inspire us with their enthusiasm. Take the recent MMM (Mini-Messier Marathon) discussion for instance. I am involved more and more with astrophotography and so do much less visual observing, instead spending my time watching a computer screen and the guide program controlling my mount, and the images I download as they are taken. This recent discussion, however, inspired me to leave the complicated photography rig at home and take out my trusty 8" dob for the Coffee House on the 12th. I arrived and set up, collimated and began looking for "faint fuzzies". I observed the Veil nebula with the OIII filter at low power, many of the fine globular clusters available this time of year and even a Carbon star or two. Later as the evening wore on, I was asked to join **Joe Derek** at his 17.5" scope. He was observing Stephan's Quintet (NGC7317, 7318A, 7318B, 7319 and 7320) in Pegasus, the brightest of which is Mag 14.0, which is beyond my 8", even at YFOS. I climbed the ladder and peered into the eyepiece and found I could see four of the Quintet, one of the galaxies is in front of another member and appears as one. I studied the grouping for a while, noting the shapes and sizes of the far off galaxies I was seeing, and marveling at the notion of seeing light that had taken over 300 million years to travel across the universe before it entered my eye! I was glad I had left the cameras and all the other stuff that is astrophotography at home, the simple pleasure of visual observing being renewed. Thanks guys!

★ Gardner Gerry
NHAS President 2007

Highlights for this Month

We've had a full calendar of public observing events scheduled over the past month. New England weather being what it is, many had to be cancelled or postponed. But some have taken place.

Our "Astro 101" series of presentations for members on elementary topics in Astronomy continues through the fall. And the first couple of "Astro 201" talks on more advanced topics are coming up soon. These sessions are a lot of fun and a great way to learn more about our hobby.

Also, it's membership renewal time. Dues remain \$15 per year, and entitle you to discount subscriptions to *Sky and Telescope* or *Astronomy* magazine. Contact our Treasurer, **Chase McNiss**, to renew your membership, or send in the membership form you can find on the NHAS website.

★ Paul Winalski
NHAS Secretary 2007

Tessier Moosier Messier Marathon (TMMM)

The first Tessier Moosier Messier Marathon (TMMM or TM3):

The marathon took place at Great Northern Moose Lodge, Dummer, NH, **Richard Tessier**, proprietor. It took place on Friday night October 12, and Saturday night October 13.

Naming this event the TMMM is tentative but makes a lot of sense. TM3 also sounds pretty snappy.

Since we are not supposed to reveal numbers of Messier objects (as the MMM people have requested) we won't. Leave us say that more Moosier objects were observed than messier objects. This part is clear.

Some of the Moosier objects actually observed the Moosier observers. In fact I'm thinking that one component of one

a double Moosier object actually glared !!! I'll leave it at that.

Since Moosier observing has comparable operation (yet) at YFOS we feel free to reveal numbers. We bagged at least 9 observers and at least 6 Moosier objects. 2 of the observers were moose hunters and they subscribed to the MMM doctrine of not revealing numbers of Moosier objects.

The NHAS out of town Moosier observers (4) consisted of **Brian and Joyce Icaza**, and **Larry and Linda Lopez**. Richard Tessier, his son and daughter also participated but because of their special relationship with the Moosier objects they did not feel that they should reveal numbers. Two hunters, one from Nashua and one from Chelmsford, were also co-opted for the Moosier Marathon since it was clear they were more expert Moosier object hunters.

There was no conflict since they were only scouting at this point. It should be pointed out that the hunters are so advanced that they can find Moosier objects during the daylight. They clearly are much advanced in this and we can only play catch-up.

The NHAS group seemed to specialize in double Moosier objects (this classification has some parallels in Messier objects (M31 and M32, or M85, M86 and M87). They observed 6 Moosier in total. Out of these 6 objects two sets of double objects were especially noted. One pair we were not able to visually separate until the headlights of the KIA increased separation. The second pair of Moosier objects seemed to have a parent child relationship. These were fairly easy to separate. There is some theoretical basis, I am told, to believe that the first double object and the second double object are somehow related but I feel that I shouldn't comment on this in the current venue.

We are thinking of naming this outing TMM or Tessier Messier Marathon. We actually got the scope set up before it clouded up again.

We were clouded out both days although the weather toyed with us the second day. This is in the finest Messier Marathon tradition.

★ Larry Lopez

Mini Messier Marathon

October 13th was beautiful during the day, light cloud cover and moderate temperatures; it seemed that after a dreadful week of rain, the October Mini-Messier-Marathon might actually come off. However, the weather forecast was pathetic, “mostly cloudy,” but the Clear Sky Clock only showed 10 or 20 percent for cloud coverage. Weather.com was saying 10% chance of rain from 1 am on. So why not pack up the equipment and head to YFOS?

There were two attendees for the October Mini-Messier-Marathon, **Paul Cezanne** and **David “Rags” Gilmore**. David was doing it the “old” way, without a Goto scope; I had Goto. Both were using Celestron 8" SCT OTAs.

Chase McNish kept herd on a group of more experienced observers. I arrived right around the beginning of sunset, so I only had about half an hour before my alignment stars would be visible. I quickly unloaded the wagon and started setting up. I had been looking forward to this for quite some time. Ever since I got the new scope, I've been having all sorts of novice problems. I thought I had them all licked ... and so this would essentially be “first light” for me.

Before the event I had downloaded an October sequence from a helpful astronomer I found at the Astromart forums. I inserted this into the McNish web code so I was prepared. I had hoped to grab some of the Sagittarius Messier objects with binoculars, since I had done many of them already earlier in the year. M4 was first on the list. I've actually bagged this from Manchester (which was difficult) so I thought it wouldn't be a problem tonight. Jupiter was first up and I soon found Antares with the binoculars against the still-light blue sky. I knew I wouldn't get the dim M4 against the blue sky so I went back to getting the scope set up.

That was eventually done. Vega was now out now, as was Antares. Oh, my, look how low Antares is against the trees! No way would M4 be achieved. Arcturus was out, Caph was out. I did a quick but careful alignment, then put my 8mm-21mm zoom eyepiece away. (It is a cheapo I bought on Astromart just for alignments.) The cheap B&W Optik 30mm 82 degree eyepiece would stay locked in the diagonal for the rest of the night. (BTW, this is a great eyepiece for the price. It is soft around the edges but I only paid \$50 for mine used. It is cloned by many manufacturers and can now be had for a bit more than \$70 new. Don't worry, Al Nagler isn't worried about this one.

M5? Nope, the west was all clouded over.

I still couldn't see any of the teapot so I knew I wouldn't be able to star hop with the binoculars. Punch up M6 on the Goto. Whirr, whirr. Got it! Well, I got 2/3rds of it. The rest was in the trees. M7? Trees. Shame, it is one of my favorite objects.

Whirr. M22. Whirr. M28. This is easy! Whirr. M8.

M8 was looking good, distinctive nebulosity. I was tempted to observe some but this is a marathon. It isn't about seeing, it is about making the checkmark in the log book. Check! For some reason now I looked at my scope. Oops! I had not yet attached the counterweight bar or the weights! My poor motors. I quickly screwed them on. M8 was no longer centered, but it was still visible. I realigned on it, then off to M20.

M20, hmm, I see something off to the side of the viewfinder. I move down to it. Looks like a cluster, but M20 isn't a cluster. I re-center the Goto, for the briefest moment I thought I had some nebulosity. Got it! (It was only in writing up this report, looking at photos of M20, that I saw that M21 was right next to it! This is one of the failings of a Goto scope. You see things but you don't know where they are.)

Whirr. M21. Whirr M23. Whirr. M24.

M24? M24 was the next one in the sequence but the clouds were getting nasty.

We retired to the warming hut with the others to wait it out. A while later, parts

of the skies cleared, but I found myself lost. I couldn't get back into the sequence. I found a few more that I knew, but I couldn't find others since I didn't know the skies. (Memo to myself: memorize the sky!) M45 was up and looking beautiful, but that is coming from my Manchester perspective. It looked about as good as it does downtown, maybe a bit better but not much. I did another of my favorites, M81 and M82. I love seeming them together in the eyepiece of this eyepiece. Rags couldn't get them, he had trees in the way. M51 was visible but only with averted vision. I had started using paper charts now. What else is in the Dipper. M40? Whirr, whirr...

Hmmm, nothing there. What does McNish say? “The double star Winnecke 4—separation of 50 arc seconds near Megrez in the Big Dipper. The most disappointing of the Messier objects.” Okay, that makes sense, there is a double right off the center of the eyepiece. I turn to record it. Chase in now at my eyepiece and I play a little trick on him. “Which Messier is it, Chase?” I ask. “I don't see one,” he replies. “M40, the double star.” I may have cackled, I'm not sure, I hope not. “Ahhh.” was the response.

M97, whirr, whirr... Nothing. That was all she wrote, the skies were full of clouds. The Dipper was vanishing, one star at a time.

I went over to see what Rags was up to. But he was looking through his eyepiece then. “Paul, I'm dewed up, I can't see anything,” he said. “David, stop,” I said. “Look up, the stars are gone.”

And so were we. We packed up around 9 pm. When I got home it was clear again. I figured I could bag a few more from my backyard with binoculars. M31, got it. (It had always been clouded up at YFOS.) And just the previous night I had M36, 37, and 38. But no such luck, the clouds were here to stay. At least I could watch the second half of the Red Sox game ... but, sadly, they had about as much luck as we had. Am I happy I did it? Certainly. I confirmed that the technical aspects of my new scope were working at 100% and that Goto makes a marathon almost easy. I also learned

that my home binocular viewing is extremely helpful but I need to learn more. Once I was in an unfamiliar section of sky I was completely lost. I'm so looking forward to the March event. Larry, save me a space, will ya?

★ Paul Cezanne

Great Bay Discovery Area Sky Watch, Greenland, NH

This was to have taken place on 6 October. Alas, it was not only overcast, but there was heavy rain, so **Paul Winalski** gave an indoor presentation on "what we would have been looking at, if it weren't raining outside", along with an indoor telescope display, to a handful of the public. There were a bunch of good questions on various topics Astronomical. Folks seemed to enjoy the presentation, and the organizers want to try this again (I suggested scheduling a rain date in advance next time).

★ Paul Winalski

Robinson Pond Sky Watch, Hudson, NH

This was held at the rain date of 18 October. **Chase McNiss** organized the event, with **Paul Winalski** assisting. There were maybe 20 total older Scouts and students from the Nashua Children's Home. Alas, the skies didn't cooperate, but we were able to focus on some ground objects across the pond to give an inkling of what the scopes were capable of. Many of those present were already quite telescope-savvy and asked some good questions.

★ Paul Winalski

Membership and Astro 101/201

Five new members have joined since our last meeting. **Bill Steele** and **Thomas Villemure** of Manchester, **Kathleen Stein** of Concord, **Scott Fillion** of Barrington and **Yusuf Abudi** of Amherst. If you see any new faces at the NHAS sky watches or meetings please introduce yourself.

Two Astro 101 Courses were offered by members for members since last meeting.

On Sept 21st, **Chase McNiss** gave both a presentation on Lunar Observing and

hosted a follow-up observing session at YFOS.

On October 12th, Chase and the NHAS Officers presented a formal Introduction to Youngs Farm Observing Site, the NHAS Dark Sky Observatory. Six recent members took advantage of this introduction.

Additional Astro 101 Sessions are currently scheduled for the balance of the year and are noted below. (also posted on Resources page and in the Club Calendar):

On October 20th at 1:00PM, **Rich DeMidio** will present Solar Observing at YFOS. If skies permit, the presentation will be followed by actual solar observing. Registration (by reply) is appreciated as it will help with handout counts.

On November the 9th, at 7:00PM, Paul Winalski will present Deep Sky Observing at YFOS. The presentation will be given regardless of sky conditions. If sky conditions permit we will observe afterwards. Registration (by reply) is appreciated as it will help with handouts.

Our first Astro 201 course is scheduled for 7:00PM, November 2nd at Exeter Academy. The topic is Photometry, presented by **John Blackwell**. This will involve math, there is a limit of 14 people, (there are currently 6 seats available). Registration is required by email to acshirey@comcast.net.

Our second Astro 201 course is scheduled for 7:00PM on November 10th at YFOS. The topic is on the use of our clubs Titan Mount. There is a limit of 10 people for this course, there are currently two seats still available. Registration is required by email to acshirey@comcast.net.

We will not have Astro 101/201 courses scheduled in December but I will schedule courses beginning in January of 2008.

★ Alan Shirey

Astro Photons

There has not been a meeting of the AP committee lately, so if there is demand for one (e-mail Gardner at the Astrophotography Chair's address on the "Contacts" page of the website) we will put one on the schedule. The usual suspects and a few new ones continue

to show new work in the forums on the club's website. Please go check out the Pictures forum to see what's happening.

★ Gardner Gerry

Radio Astronomy

Last newsletter we talked about attempting the radio detection of meteors again during the Leonid meteor shower in November. It peaks on Monday, November 19th. We went through a good bit of detail on this proposal last year at this time, some of which can be referenced in those past newsletters.

This year let's try to verify the reception of a signal with an actual meteor by visually capturing the event. This means recording the received audio on to a cam-coder tape. This is somewhat less ambitious than some of our more scientific proposals we discussed but it might serve as a confirmation of the concept. A good bit of this is meteor thing is uncertain or speculation. Last year it was an audio recording only. This year the attempt is to catch video at the same time. This is all dependent on good weather, lots of luck and some theories being true.

★ Bob Sletten

Public Observing

See previous articles for accounts of some of our actual and attempted public observing events over the past month. More events are upcoming for next month, so keep an eye on the Club Calendar at the NHAS website, and on your email mailbox, for notices of events in November.

★ Paul Winalski

How They Figured It Out, Part III

We know a great deal about the sizes and distances of the rest of the solar system, but we now use radar and other high-tech methods. But you don't need that technology to make a series of very good guesses. While the ancient world didn't always get it right, they very often got quite close to the modern figures, and they almost always got the order of magnitude correct. What was their process?

Let's start with something easy: what is the shape of the Moon? Many pre-technological peoples initially assumed that a crescent Moon was a real crescent; some even have myths which assert that each month the sky gets a completely new Moon. It can be very poetic, with eggs hatching and so on. But even as long ago as Babylon, astronomers knew that the Moon was a sphere. Near New Moon, you could see the rest of the satellite by Earthshine, so it was clear the rest of the Moon hadn't vanished (though the world had to wait for Galileo to explain that Earthshine was actually from the Earth!). The Moon's phases were obviously best explained as the illumination of a sphere by the Sun.

What about the Sun? Total eclipses proved it is further away than the Moon. But it wasn't clear that it was a sphere. One other model was that the Sun was a hole in an outer opaque shell, and through that hole we could see parts of a Universe of flame!

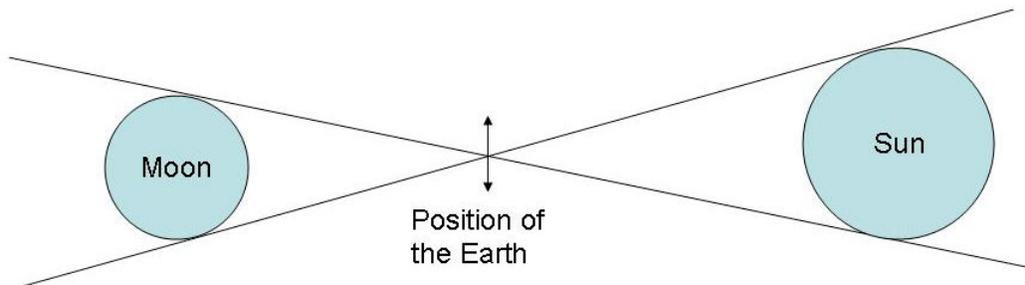
There were various theories about the markings on the Moon as well. One popular one in the Greek world, before it was clear to the relatively backward Greeks that the Moon was a sphere and it was thought to be a disk was that the Moon was a mirror. In it you could see the reflection of the Aegean Sea and the lands surrounding it.

The match is actually quite good. *Tranquillitatis* and *Serenitatis* look like the Black Sea with *Crisium* as the Sea of Azov. *Oceanus Procellarum* is the eastern Mediterranean with various craters standing in for the Greek islands (Copernicus is Crete and so on). However, a trip away from the Greek heartland would quickly show that the Moon wasn't a mirror, as it looked the same from Egypt or Italy, where it should have been reflecting a different part of the world.

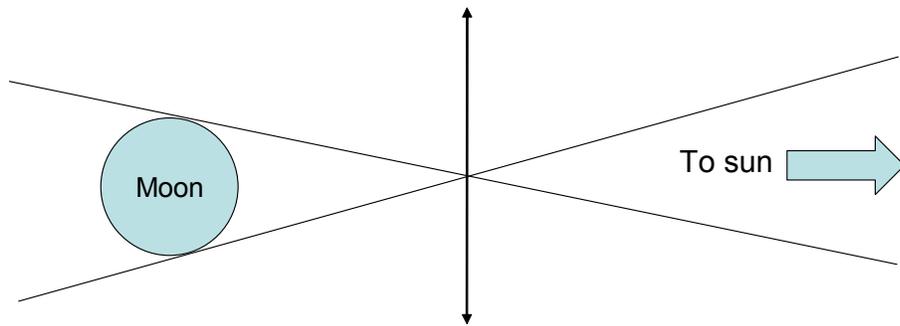
If the Moon is a sphere, what is the shape of the Earth? The ancient consensus from a long way back was that it was a sphere, too. The proofs were various, but the one which nailed it was based on lunar eclipses, once people had realized that a lunar eclipse was the shadow of the Earth on the Moon. Every time you looked at the shadow of the umbra on the Moon, it was a segment of a circular arc. It was circular no matter where you were in relation to the Moon, whether the Moon was on the Eastern horizon, the Western horizon or directly overhead. That meant that the body casting the shadow made a circular shadow no matter what its orientation. There's only one solid shape which always casts a circular shadow—a sphere!

If the Moon is a sphere and the Earth is a sphere, can we measure their sizes? Eclipses were again the key. If you wonder at the large number of time eclipses are used in these arguments you should remember that the moment of an eclipse is a line-up of three items. This means that much simpler geometry can be used, and thus makes it far easier to understand what's going on.

Let's diagram the relationships during a total lunar eclipse. We mark the position of the Earth in the center and put the Sun a bit further away than the Moon at some arbitrary distance. The Sun and Moon are contained inside a pair of lines representing an angle of half a degree. Since we are only concerned with relative sizes, we can exaggerate this to several degrees—or, if you like, we are using a different vertical scale than horizontal scale. At this point, we don't know how big to draw the Earth.

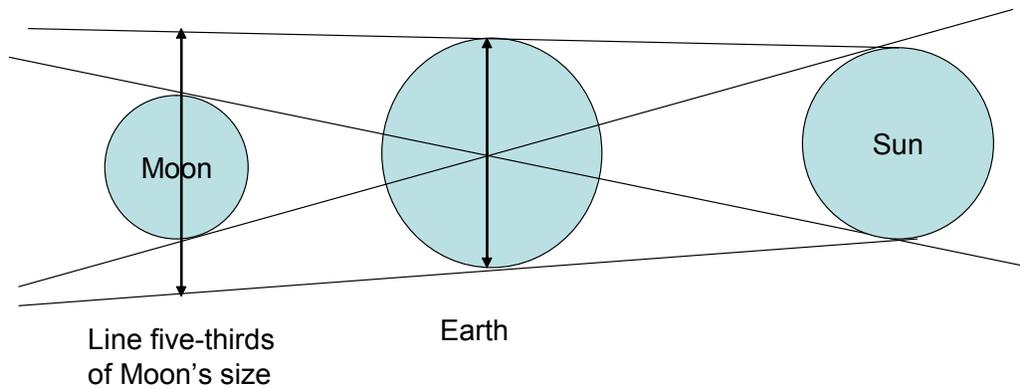


In this first diagram, we see the Moon on the left and the Sun on the right; the Sun is a bit further away than the Moon, but not much. The Sun is represented as a sphere (here a circle) but that isn't a requirement. An alternative diagram shows the Sun as infinitely far away:



Position of the Earth

In the next diagram, we draw in the lines from the Sun to the Earth which outline the umbral shadow cone cast by the Earth. In this diagram, we draw the umbra as five-thirds the size of the Moon itself at the distance of the Moon. While that's not the exact value, it is the accepted estimate the ancients made when comparing the arc of the Moon with the arc of the umbral shadow as they watched it cross the face of the Moon. We can now draw in the actual size of the Earth, as we know it is casting the shadow.



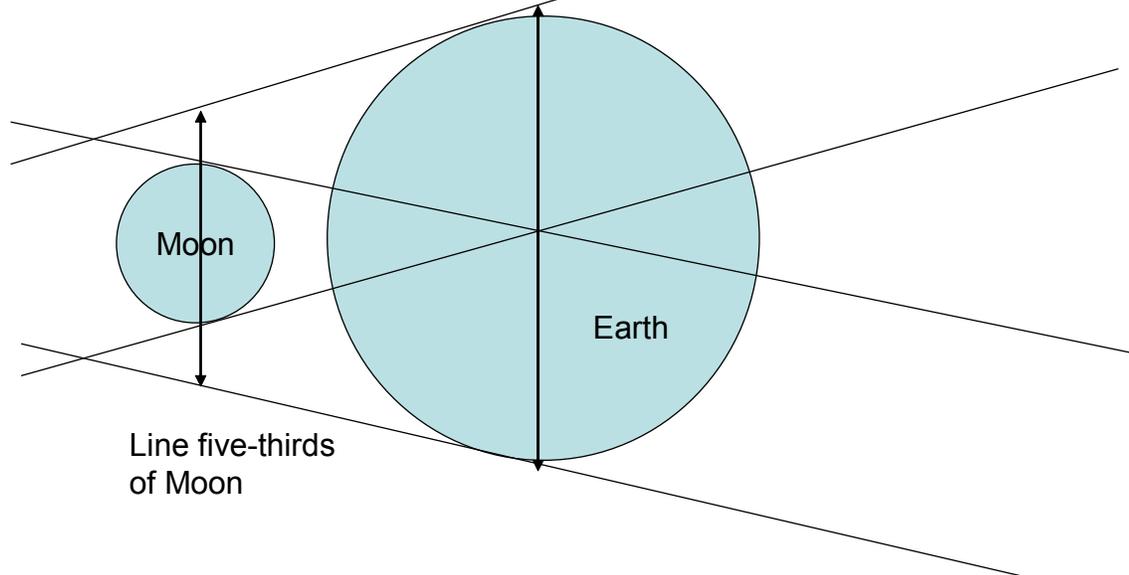
At this point we know the relative sizes of the three objects: if we don't know geometry we can measure the diagram; if we do we can do a simple calculation and determine that the Earth is about four-thirds the size of the Moon.

But we assumed that the Sun was just a tiny bit further and just a tiny bit bigger than the Moon. If we make the most opposite assumption – that the Sun is infinitely far away and infinitely bigger, we get this diagram:

**The one stop shop
for all of your astronomical product needs**

Rivers CAMERA SHOP

454 Central Ave Dover, NH 03820 742-4888
69 North Main St. Rochester, NH 03867 332-5652



Again, a little geometry gives the Earth's size as eight-thirds the size of the Moon.

Since the two extreme assumptions the minimum and maximum sizes, we know the true answer must be in between (the true answer is more than eight-thirds, as the umbra is bigger than they thought it was. Note that the Sun is effectively infinitely far away compared to the Moon).

The size of the Earth was known to be (in modern measurements) eight thousand miles in diameter. That meant that the moon was between three thousand and six thousand miles across. But for an object of that size to appear as a disc of half a degree, the Moon must be between 342,000 and 684,000 miles away, or as they expressed it, between 43 and 86 Earth diameters away. This figure was bigger than the other measurements of the distance to the Moon, which ranged from 25 to 35 diameters, with the consensus figure of 31. But it was clearly in the same ball-park, and considering the uncertainties in the method used, it was taken as a confirmation of the other measurements.

Now that you know how far away the Moon is, how far away is the Sun? That'll be the next installment!

★ John Bishop

NHAS September 2007 Business Meeting

ATM

Chase McNiss and **Joe Derek** are doing a dob conversion on one of the club scopes.

YFOS

Larry Lopez reports that mowing season seems to be over.

Membership

Alan Shirey reports several new members. Astro 101 classes continue, and the first Astro 201 class (Photometry) will be coming up in November. We are looking for further Astro 201 ideas.

Public Observing

The group for which we tried to set up a sky watch at Mt. Washington

Hotel gave us \$100. There are lots of events coming up.

Web Administration

No report.

Radio Astronomy

Bob Sletten discussed the effort to try to observe a meteor shower in radio frequency. He still has a big antenna from last year's attempts. This year we will try a recording at 10KHz frequency. He needs to move the antenna.

Black Forest Star Party

Ed Ting was the keynote speaker at this event. There were about 500 attendees at an impressively dark location in rural Pennsylvania. There were several interesting scopes, including a Meade 20" RCT, a \$30,000 Takahashi Ritchey-Chretien, a Tak FSQ 106, Tak

TOA130, AP 160/Mach 1, and lots of Obsessions.

Object of the Month

Paul Winalski passed around a meteorite that has been in his family for nearly 50 years.

Scope of the Month

Tom Cocchiaro presented a William Optics FLT 110 TMB f/7 refractor. It has a 4" focuser on the back

Mike O'Shaughnessy presented a Vixen 80mm refractor telescope on a TeleVue TelePod mount.

Miscellaneous Business

The trip to Dummer is upcoming [see Moosier Marathon report elsewhere in this issue of the Observer].

Volunteers are needed with solar scopes for the upcoming Astro 101 Solar Observing event.

A new observatory is being built in the Adirondacks.

Now is the time to register for the Winter Star Party in Florida.

Gary Doody thanked the membership for their helpful tips on astronomy contacts in Hawaii. He got to tour the observatory complex at Hilo while there.

A proposal by the Officers and Board of Directors to raise the club dues to \$25 sparked a lengthy, lively, and wide-ranging discussion of the objectives of NHAS as an organization and how best to fund them.

It was pointed out that while the Board has reasons for seeking an increase (insurance for YFOS equipment and buildings; projectors and laptop PCs for presentations), it has not presented a concrete and itemized justification for this amount—the membership should know exactly where the new monies are planned to go.

The history of YFOS, and how and why it was built, was reviewed, the point being that NHAS’s main mission is public education, and not the maintenance of YFOS.

There was discussion of alternative methods to obtain funding for projects, such as soliciting contributions for new purchases such as the proposed presentation equipment.

The possibility of a tiered membership structure, with price breaks for students, was discussed.

In favor of the dues increase, it was observed that equipment donors expect their donations to be properly cared for, and if we don’t insure expensive items and they are lost or damaged, it will be all the more difficult to get donations to replace them.

The dues increase proposal was withdrawn. The Officers and Board will study the matter further, will solicit a bid on property insurance for the NHAS club assets, and will make a more concrete presentation to the membership, should

crunching the numbers indicate that a dues increase is indeed warranted.

Evening Program

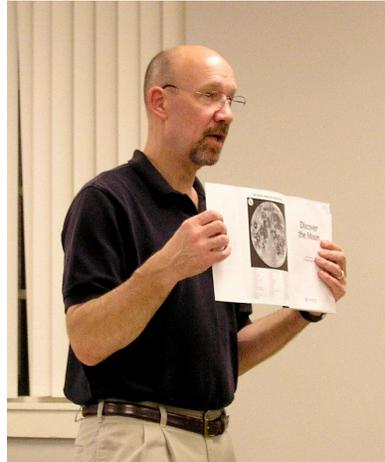


Photo by Bob Sletten

Chase McNiss gave an excellent Astro 101 presentation on Lunar Observing.

★ Paul Winalski

Club Scope Conversion Completed



Chase McNiss reports completion of the conversion of the club’s 8” GEM Newt to a Dob base. Thanks to **Joe Derek** for all his time, equipment and hard work.

The scope will be a loaner, available to club members for several months at a time.

It has a 25mm Meade MA eyepiece and Chase picked up a 10mm Meade SMA today at Rivers for cheap if we want to put it out as a loaner scope.

★ Chase McNiss

The Bottom Line

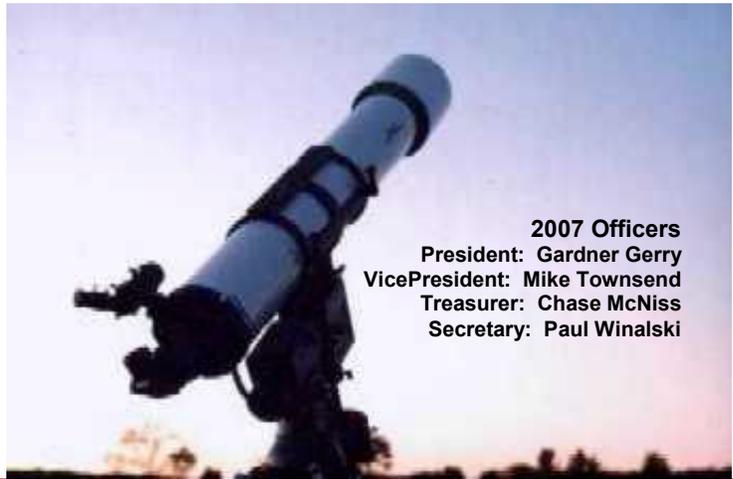
Starting Balance:	\$4468.61
Deposits/Credits:	328.61
(Membership, petty cash deposit, interest)	
Accounts/Paid:	-54.87
(Peerless, stamps)	
Net Account Balance:	\$4742.35
Petty cash drawer:	\$200.00
Cash Balance:	
\$4842.35	

2007 Membership: 23

New members:

- Daniel Welch, Pittsfield, NH
- Yusuf Abudi, Amherst, NH
- Scot Fillion, Barrington, NH
- Kathleen Stein, Concord, NH
- Thomas Villemure, Manchester, NH
- Bill Steele, Manchester, NH

★ Chase McNiss



2007 Officers
President: Gardner Gerry
VicePresident: Mike Townsend
Treasurer: Chase McNiss
Secretary: Paul Winalski

DEADLINE November 2007 Issue: 5 PM November 13

E-mail articles to the Editor.

CHANGE OF ADDRESS – Notify the Treasurer of changes to postal or e-mail address.

How to Join N.H.A.S.

Write to us:

NHAS
 P.O. Box 5823
 Manchester, NH 03108-5823
 Attn: Treasurer

Send E-mail to:

info@nhastro.com

Use our web site:

<http://www.nhastro.com/>

This month's contributors:

Gardner Gerry, Larry Lopez, Paul Cezanne, Alan Shirey, Bob Sletten, John Bishop, Chase McNiss, Paul Winalski

New Hampshire Astronomical Society
P.O. Box 5823
Manchester, NH 03108-5823



NHAS Upcoming Events

Event	Date	Time	Location
Cub and Girl Scout Sky Watch	Nov 1	7:00 PM	First Parish Church, Derry, NH (Nov. 8 rain date)
CMP Public Sky Watch	Nov 2	7:00 PM	Christa McAuliffe Planetarium
Astro 201: Photometry	Nov 2	7:00 PM	Phillips-Exeter Academy
Nottingham West Sky Watch	Nov 8	7:00 PM	Nottingham West Elementary School, Hudson NH
Coffee House Night	Nov 9	5:00 PM	YFOS
Astro 101: Deep Sky Observing	Nov 9	7:00 PM	YFOS
Astro 201: Titan Mount Training	Nov 10	7:00 PM	YFOS
NHAS Business Meeting	Nov 16	7:30 PM	St. Anselm College
Operation Night Light Sky Watch	Dec 3	7:00 PM	Pleasant Street Methodist Church, Salem, NH
CMP Public Sky Watch	Dec 7	7:00 PM	Christa McAuliffe Planetarium