Gemini

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OCTOBER 2000 | volume 25 | number 5

OCTOBER 2000 Month at a Glance NOVEMBER 2000

All times listed are CDT, 2400 hour format, until October 29th, then CST.

6 Mercury is at greatest eastern elongation, 26 degrees from the Sun: evening sky.

7 The Moon appears 1.3 deg. south of Neptune: evening sky.

8 The Moon appears 1.5 deg. S. of Uranus: evening sky.

16 The Moon appears 1.6 deg. S. of Saturn: 0100.
The Moon appears 2.0 deg. S. of Jupiter: 1900.

21 Jupiter appears 5.0 deg N. of Aldebaran: 0001.
Orionid meteor shower peaks.

24 The Moon appears 3.0 deg. N. of Mars: morning sky.

26 Venus appears 3 deg. N. of Antares: evening sky.

29 Mercury is at Inferior Conjunction, in front of the Sun.
Daylight Savings Time ends at 0200. FALL back an hour to regular time = GMT – 6.

30 The Moon appears 4.0 deg. N. of Venus: evening sky.

Check out the Andromeda Galaxy, high overhead this month. At a distance of 2.5 million lightyears (that's 15,000,000,000,000,000,000 miles) it is the most distant object that you can see with the naked eye and the only one that is not in our own galaxy.

Moon
First Quarter: **5th** Full: **13th** Last Quarter: **20th** New: **27th**

Planets
Mercury: Libra/Virgo. Find it early in the month on the WSW horizon just after sunset in the first week of the month, coming around to be in front of the Sun by month end.

Venus: Libra/Scorpius/Ophiuchus. Low in the southwest just after sunset all month long.

Mars: Leo/Virgo. Low in the east just before dawn.

Jupiter: Taurus. Rising ENE after 2100 early in the month, just after sunset by month's end.

Saturn: Taurus. Rising just before Jupiter in the ENE, but not as bright.

Uranus: Capricornus. Low in the Southwest after sunset. Setting by 11:30 at month's end.

Neptune: Capricornus. Just West of Uranus setting about an hour earlier.

Pluto: Ophiuchus. Setting just after the Sun, moving behind the Sun by month's end.

All times listed are CST, 2400 hour format.

3 The Moon appears 1.6 deg S of Neptune in the evening sky.

4 The Moon appears 1.8 deg S of Uranus in the evening sky.

12 The Moon appears 1.6 deg. S. of Saturn in the early morning sky.
The Moon appears 2.0 deg. S. of Jupiter in the evening sky.

15 Mercury is at Greatest Western Elongation, 19 deg. from the Sun: morning sky.

17 The Leonid meteor shower peaks.

19 Saturn at opposition: evening sky.

21 The Moon passes 4.0 deg. N. of Mars in the early morning sky.

24 The Moon passes 3.0 deg. N. of Mercury in the early morning sky

27 Jupiter is at opposition: evening sky.

29 The Moon appears 2.0 deg. N. of Venus in the evening sky.

30 The Moon passes 1.8 deg. S. of Neptune in the evening sky.

Check out the gas giants!! Saturn and Jupiter side by side in the sky! At opposition this month – the closest they will get this year and Jupiter's closest approach to the Earth in the last 12 years.

Moon
First Quarter: **4th** Full: **11th** Last Quarter: **18th** New: **25th**

Planets
Mercury: Libra/Virgo. Swinging around to the morning sky by mid-month.

Venus: Scorpius/Sagittarius. Climbing higher into the evening sky, getting easier to spot.

Mars: Virgo. Climbing higher into the morning sky.

Jupiter: Taurus. Moving across the southern sky throughout the night.

Saturn: Taurus. Moving across the southern sky slightly ahead of brighter Jupiter.

Uranus: Capricornus. Off to the southwest at sunset. Sets by early evening.

Neptune: Capricornus. In the southwest, sets by early evening, leading Uranus to the horizon.

Pluto: Ophiuchus. Lost in the glow of twilight. Setting with the Sun by month's end.

Gemini

Editor
Thor Olson
Circulation
John Treadwell

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thor.olson@mn.efi.com

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P.O. Box 583011
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Subscriptions alone cost $4.50 annually for members of astronomy clubs or $9.00 for other persons. Materials for Gemini are due on the 10th of the month preceding the month of publication.

Patron Members

MAS offers a patron membership to anyone who wants to help support our activities by paying a slightly higher annual membership fee ($40 instead of the regular $16). We would like to thank the following patron members who helped support MAS during 1999:

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Now Showing!

Compiled by Ron Schmit

Minneapolis Planetarium: 612-630-6150

"***Journey to the Stars***": Saturday and Sunday at 1415. Thursdays: 1900.
Join us for a fantastic voyage from the Earth to the edge of the universe.

"***Honey, I Shrunk the Solar System***": Saturday and Sunday: 1300.
Discover the latest and greatest about our nearest neighbors in space!

"***Romancing the Stars***" 2nd Saturday of each month: 19:00.
Sit back and enjoy an evening of love stories under the stars.

"***Minnesota Skies***", 2nd Wednesday of each month: 1200 & 1900
A close look at the best sky sights of the month.

"***Starlight, Starbright…***" October 14th & 28th, November 11th: 1100
A charming show designed for children ages 3-5.

"***Spooky Skies***", October only! Fridays at 1900, Sat. & Sun. at 1530.
A close look at the best sky sights of the month.

Cost for most shows: $4.50 for adults, $3.00 for kids 12 and under.
The above schedule is good until November 24th when the Holiday Programs begin.

Eisenhower Observatory: 612-988-4077

Come view the night sky through a powerful telescope on top of the Eisenhower Community Center in Hopkins, MN. Viewing time varies throughout the month and is open to the general public. There is no charge, although a $2.00 donation is requested. Space is limited, so call Diane for reservations: 612-988-4077.

MAS Officers

President: Ben Huset
651-639-9109 (H) 651-633-7337 (W)
benhuset@skypoint.com

Vice President: Dave Olmstead
612-559-5940
david@davidolmstead.com

Secretary: Bob Schmidt
612-869-0988 rhschmidt@visi.com

Treasurer: Chuck Jorgensen
612-332-1140
jorg0140@tc.umn.edu

Board Member: John Treadwell
651-645-7581(H) 612-624-4007 (W)
j-trea@maroon.tc.umn.edu

Board Member: John Connery
612-544-5786
jmcon@mninter.net

Announcements etc.

MAS Elections

Elections for the positions of President, Secretary, and Board Member will be held in December. Submit your nominations to President Ben Huset who will forward them to the nominations chairperson.

Underground Astronomy

Bill Glass
photos by Rich Brown

On August 26th, approximately 40 members of MAS went to Tower, Minnesota to tour theUniversity of Minnesota's research facility in the Tower Soudan mine. The mine itself is an interesting piece of Minnesota history. From 1880 until 1962, it was operated by U.S. Steel as a source of iron ore. Unlike the large open pit mines that are common in northern Minnesota, this one is entirely underground. Over the years, as the miners followed the vein of ore, the mine reached a depth of almost a half mile below the surface.

In 1962, the mine was shut down because it had become unprofitable (there's still a lot of ore in the vein). A year later, U.S. Steel donated the mine to the state and today it is run by the Department of Natural Resources as a state park. There is a visitors center with a small museum and outdoor displays as well as an undergound tour of the mine.

But starting in the 1980's, the mine began to attract interest for another reason. Physicists had become very interested in neutrinos. Neutrinos are sub-atomic particles that are electrically neutral and seldom interact with other matter. Their existence had first been postulated in the 1930's, but it wasn't until the 1950's that they were actually detected. Neutrinos are very elusive particles - they can easily pass through the entire earth without being absorbed. Because of this, any neutrino detector has to be quite large in order to have any reasonable chance of catching them. But a large detector creates many problems - one of which is that it will also pick up cosmic rays and other stray radiation. Since the detector may only pick up one neutrino per day (or less), it is very important to shield it from all other sources of radiation. The solution - put it underground - far undergound.

And that brings us to Tower Soudan. In many respects, it's an ideal location for a neutrino detector. The bottom level is 2400 feet underground, the native rock has virtually no natural radioactivity, there are no mining activities to disturb the equipment, and the state is paying the bills to keep the mine open (the electric bill alone is over $50,000 per year - primarily to pump out the water from small leaks). The University of Minnesota began by
constructing a small experiment on the 24th level of the mine which was unused at the time. After a few years, they outgrew the space and they got funding to excavate a new cavern on the 27th level to house their equipment. This experiment has now been in operation for several years and was the primary focus of our tour.

We began by picking up hard hats and heading for the hoist. There's only one access path into the mine - it's the same one used by the miners and was also used to haul out the ore. The hoist operates a pair of cages running on parallel tracks - one goes up while the other goes down. Each cage has two levels and can hold a total of about 20 people. A large steel cable runs from the top of the cage over some pulleys to another building where the hoist motor is housed. It's an interesting piece of old machinery that has been somewhat modernized with electric motors, but otherwise operates much the same as it did a century ago. After loading up the cage, we began the three minute journey down the shaft.

The shaft isn't quite vertical - it was dug to follow the direction of the ore vein. Thus, in order to reach the 27th level (the bottom of the mine), you travel about 2700 feet, but the vertical distance is only 2413 feet. The cage travels on steel rails with steel wheels and is quite noisy. Although it seems like it is traveling quite fast, in reality, the top speed is about 10 MPH.

At the bottom of the mine are the electric cars used to conduct the tours of the mine, but we didn't need those. After a short walk along the main tunnel, we made a turn to the left and went through the doors into the cavern that houses the Soudan II experiment. Here, we met up with Professor Marvin Marshak - our host and tour guide.

The Soudan II detector is constructed of 224 modules - each slightly larger than a telephone booth (remember, everything must fit into the cage to come into the mine) and weighing over 4 tons. The modules are stacked two high in an array that is 8m wide and 15m long and fills one end of the cavern. Each module is filled with over 15,000 tubes filled with argon gas and electronic detectors. When a particle (such as a neutrino) interacts with the gas, it is possible to determine the position in three dimensions. Thus, by looking for simultaneous events in adjacent tubes, it is possible to determine if the event is caused by a particle that is passing thru or one that originated within the detector.

The detector is completely surrounded by a muon shield. Muons originate primarily from cosmic rays and a few are capable of penetrating through a half mile of rock. The purpose of the muon shield is not to stop the muons, but simply to detect their presence. Any event in the main Soudan II detector that occurs at the same time as a an event detected by the muon shield is ignored.

Professor Marshak enjoyed telling us about some of the problems encountered in building the detector.

Professor Marvin Marshak, the host and guide for the "neutrino tour".

An cavern deep underground, filled with neutrino and muon detectors.

For example, because they wanted to eliminate all possible sources of radiation, circuit boards had to be built out of Kevlar because the standard fiberglass material is slightly radioactive. Similarly, when they needed lead, ordinary lead was unacceptable because it is slightly radioactive from exposure to cosmic rays. The solution was to bring up lead from the bottom of the Carribean than had been used as ballast for Spanish galleons that had sunk 300 years ago.

The detector was completed in 1993, but it began operation in 1989 when it was only one-fourth complete. The original intention of the experiment was to search for evidence of proton decay (one theory is that protons decay after a very long time - if this is true, all matter in the universe will eventually turn to energy). So far, it has failed to produce any evidence of proton decay (they had expected to see about one event per year). But over the years, the purpose of the experiment has changed. Originally, neutrinos were a nuisance and great effort was made to remove their effects. But with lack of evidence for proton decay, neutrinos gradually became more important. As Professor Marshak put it - "Remember that stuff that we used to say was noise? Well it turns out that the noise is really interesting."

Today, neutrinos are a very hot topic for several reasons. One subject of interest is whether or not neutrinos have a mass. This is important in determining the fate of the universe. It is well known that the universe is expanding, but wasn't isn't known is whether or not there is enough mass in the universe to ultimately stop the expansion through the effects of gravity. Currently we can observe only about 10% of the necessary mass. But if neutrinos have a mass (even though it would be very small), they may account for a significant portion of the "missing mass" because there are so many of them. Another reason for interest in neutrinos is to get a better understanding of how our Sun operates.

Physicists have theories that they believe explain how fusion takes place in the core of the sun. But those reactions should produce neutrinos and so far we have been unable to detect as many neutrinos as the theory predicts. Perhaps our understanding of the basic physics is wrong, or perhaps the thermonuclear reaction in the core of the sun has shut down and we're just living on borrowed time.

In order to answer these questions, another experiment is about to be constructed in the Tower Soudan mine. The new cavern has already been excavated (over 8000 trips were made with the hoist to haul out the rock), but it's still off limits to visitors. It will house the detector for the MINOS (Main Injector Neutrino Oscillation Search) detector. This detector will have 10 times the mass of the old Soudan II detector. In addition, rather than looking for neutrinos that occur naturally, the neutrinos for this experiment will originate at FermiLab accelerator (near Chicago) and will be sent through over 700km of rock to arrive at Tower Soudan. Fermilab is building their own detector to measure the neutrinos as they leave the Main Injector.

Neutrinos come in three different versions: called electron, tau, and muon neutrinos. In the past, only electron neutrinos could be detected. But one new theory is that neutrinos can change from one type to another (this process is called oscillation). If that's true, then this could explain why we don't see the proper number of neutrinos coming from the sun (they change types during the journey). Also, in order for oscillation to occur, the neutrinos must have a mass and that would help answer the "missing mass" question. By comparing the measurements of the detector at FermiLab with those from Tower Soudan, the physicists hope to be able to determine if the neutrinos are oscillating during their brief journey.

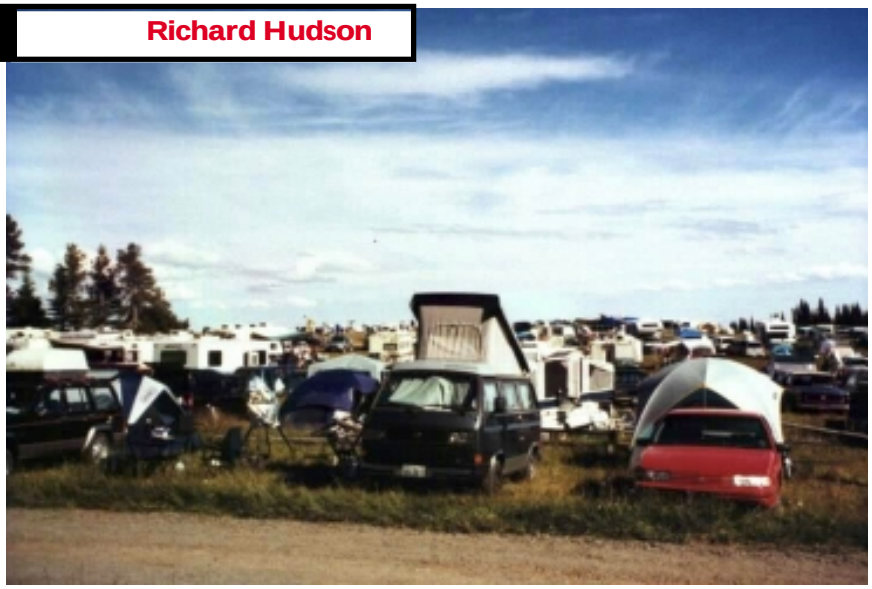
All in all, the next few years should be very interesting at Tower Soudan. The new MINOS detector should be operational in a couple of years and there are plans to have a permanent visitors gallery built so that it will be a lot easier for the general public to visit the facility.

Bill Glass

Editors note: Additional photos by Rich Brown and notes by Ben Huset can be found at: http://freemars.org/mnfan/mas/tower-soudan/

Table Mountain Star Party

Richard Hudson



On the last weekend in July, enroute to a family reunion, I attended the Table Mountain Star Party, about two hours southeast of Seattle.

The site sits atop Table Mountain, about 6400 feet, near Ellensburg, Washington. There's a bit of sky glow from Ellensburg, but otherwise it's a very dark site. It's "primitive camping" – no water or electricity – but plenty of Porta-Pottys. And it does draw a crowd – somewhere between 1200 and 1500, plus an avenue of vendors offering scopes, accessories, books, jewelry, etc. Yet the party was very well managed, so it didn't feel as large as it was. There were daily talks, workshops, and activities for kids. Meals were provided on-site, and there was round-the-clock caffeine from a "Seattle's Best" booth.

Table Mountain is beyond comfortable driving range for Minnesotans, unless you're on the way to a west-coast vacation, but it's an easy two-hour drive from the Seattle airport. I travelled light, with an ETX and a pair of binoculars, plus camping gear. As you can see from the photo of the observing field, there were plenty of big scopes to look through.

I was there for three nights, and all were clear. I spent most of my observing time in Sagittarius and Scorpius, which I cannot see at all from my own back yard. In the large scopes, I enjoyed galaxies and colorful planetaries. (The infamous '36" Yard Scope' was on-site, for photograph-like views.) The aurora was splendid on one of the nights, and I had my first views of some brilliant iridium flares.

If you have the opportunity, I recommend this event. The website is www.tmspa.com. – Richard Hudson

Identifying Planets

GG> I'm a very, very amateur nightwatcher; I'd have to agree with you about what I saw not being Mars or Venus as I have no way to verify it- do I?

Hello, GG!!

You can identify a planet in two different ways. You can compare its position to calculated or published predictions of its position, and/or you can compare its appearance to published descriptions of its appearance. In practice, it is virtually always a combination of both.

When you see some bright light in the sky, you will probably first classify it as either a star or a UFO. Most UFOs turn out to be aircraft. Some stars and some UFOs turn out to be satellites (sometimes hard to distinguish from high-flying aircraft), some turn out to be meteors (those usually require only a fraction of a second to identify because of their speed and brief visibility), some turn out to be balloons (I've seen two giant skyhook balloons -- quite interesting), and some turn out to be planets.

If a light in the sky *looks* like a planet (it's about the right brightness and doesn't appear to be moving), your first check to determine if it really *is* a planet is to see if it is near the ecliptic, or zodiac. If it is in this band of the sky, it has a good chance of turning out to be a planet.

If your suspect looks really, really, incredibly, unbelievably bright, it may be Venus, which gets pretty bright when it is near greatest elongation (greatest apparent distance from the Sun). In that case, your first check is to see if it is near the western horizon in the evening, or near the eastern horizon in the morning. Very far from either of these locations, and it can't be Venus.

On a road trip from Iowa to Minneapolis in the middle of the night, I saw a red light on the horizon. I kept watching it as it brightened. It looked like a big red-orange dot. I was really mystified as to what it could possibly be. It was much too bright to be Mars. One of my travelling companions is also an astronomy buff (he is currently president of the Minnesota Astronomical Society). I casually asked him, "what is that?" He watched it for a bit and said, "an aircraft on final." (Meaning "final approach to an airport.") We continued to watch. I was skeptical of the aircraft identification. That was one *long* final approach! What airport could it be coming into in the middle of Iowa? Why was only one light visible? We kept on driving and it was still on our right, though higher in the sky. And brighter. And less red.

It must have slowly dawned on all of us, ten minutes or more after I first noticed it, that the light was on our right as we headed north, meaning that it was in the east, and it was later at night than I thought (not having any reason to keep track of the time). It was after 4 am. At the next rest stop my friend got out his binoculars (cheap 7x35, much used and abused) for a close look. It was chilly and I shivered too much to hold the binoculars steady, even when braced against a sign post, but he said he could make out a crescent shape. Venus. It looked red when near the horizon because of dust put into the upper atmosphere by eruptions of Mount Pinatubo in the Philippines a year or so earlier.

Basically, if you see something that looks like a planet, you check to see if is in the right place. If you want to find a planet, you first determine where to look and then scan there for something that looks right.

Both descriptions of the physical appearace of planets with binoculars and telescopes and data on their positions during the current year can be found in the Observer's Handbook, published by the Royal Astronomical Society of Canada in -- surprise! -- Toronto. Another handy reference would be the Golden Field Guide, Skyguide. There are many others.

For a visual reference on planet locations current, past, and future, nothing can beat a computer program. There are several good ones for DOS, Windows, and MacIntosh. Some are freeware, some shareware, and some come in a box. Current locations of the planets can also be found at various sites on the Internet. I've seen one site which plots the current positions of over a thousand asteroids and periodic comets on a map of the solar system with the Sun at the center. It is updated daily.

A general astronomy textbook is also extremely helpful. Most any bookstore will have some very good ones, but check your local university bookstore, too. They might have something that fits your particular needs even better.

Sky & Telescope and Astronomy magazines are especially useful, showing what to look for in the night sky each month.

-- Jeff, in Minneapolis

Science Museum of Minnesota Astronomy Classes: 651-221-4511

The Science Museum offers classes in "entry level" astronomy for both families and adults. Classes may be taken individually or all together. Call for details!

Astronomy for Families

The Night Sky: Friday, October 13, 1900-2100.
A look at what's out there, what it looks like, and how you can find it.

The Planets: Friday, October 27, 1900-2100.
A visit with our neighbors the planets. So alike but so different…

The Tools: Friday, November 10, 1900-2100.
The tools of the trade – what equipment do you need to do astronomy?

The Sky is Falling!: November 17, 1900-2100.
Asteroids, meteors, and comets! Oh, my! Come watch a meteor shower.

Adult Programs

The Sky is Falling!: November 17, 1900-2100.
Asteroids, meteors, and comets! Oh, my! Come watch a meteor shower.

Solar Max: Tuesday, November 23rd, 1900-2100.
A look at our Sun during the peak of its activity. Learn about aurora!

The Night Sky: Friday, December 1, 1900-2100.
A look at what's out there, what it looks like, and how you can find it.

The Planets: Friday, December 8, 1900-2100.
A visit with our neighbors the planets. So alike but so different…

Passport to the Sky: Friday, December 15, 1900-2100.
The tools of the trade – what equipment do you need to do astronomy?

2000 Star Parties

Star parties are held on Friday if weather permits, otherwise on Saturday. Call (651) 649-4861 after 6:00 PM on a star party date to hear whether it will be held.

Metcalf

Metcalf is the grassy parking lot of Metcalf Nature Center, about 20 miles east of St. Paul along highway 94. About 6 miles E of the 694 / 494 crossing is county road 15 (Manning Ave.). Turn right, then left onto the frontage road and continue east, crossing over county road 71. Turn right (south) onto Indian Trail; follow it 1.1 miles to an chicken-wire gate on the right, (marked by three blue reflectors), opening onto a dirt driveway, which is the entrance to Metcalf.

Baylor Regional Park

Baylor Regional Park is roughly 25 miles W of the SW corner of 494. Head west on highway 5, through Waconia, to Young America. Turn right onto county road 33 and follow it about 2 miles to the park, a right turn. The observing site is through the gate and roughly 100 yards beyond. Card-carrying MAS members may observe at Baylor at any time; call the park keepers in advance at 448-6082.

Cherry Grove

Cherry Grove is about 20 miles south of Cannon Falls. Head south on Hwy 52. Around 6 miles south of Cannon Falls, take a right onto Goodhue County 1 and follow it around 16 miles, where it ends in a T with Dodge County A. The observatory and warming house are at your right, nestled in the corner of the T.

Date	Site	Sunset	Moon
1-Sep	METCALF	19:55	sets 19:54
22-Sep	ONAN/BAYLOR	19:10	rises 0:03
29-Sep	CHERRY GROVE	18:57	sets 20:20
6-Oct	METCALF	18:44	sets 1:06
20-Oct	ONAN/BAYLOR	18:19	rises 0:43
27-Oct	CHERRY GROVE	18:08	rises 7:51
3-Nov	METCALF	16:58	sets 22:51
17-Nov	ONAN/BAYLOR	16:42	rises 22:46
24-Nov	CHERRY GROVE	16:37	rises 5:45
1-Dec	METCALF	16:33	sets 21:38
15-Dec	ONAN/BAYLOR	16:33	rises 20:31

Parking at Onan Observatory

We are requested by Marty Walsh, of Baylor Regional Park, our host for the Onan Observatory, that MAS members NOT park on the grassy areas next to the observatory (or any other grassy areas for that matter).

This is a matter of being considerate to the park, its caretakers, and other visitors, so when you attend your next outing at Baylor, PLEASE PARK in the PARKING AREA.

how to pay your dues

Your MAS membership expires at the beginning of the month shown on your Gemini mailing label and your membership card. Send your payments to the MAS treasurer (Chuck Jorgensen) at 1615 E. River Rd. Minneapolis, MN 55414-3627. Make checks payable to MAS. The current annual membership dues and subscription fees are:

Regular membership	***$ 16.00***
Patron membership	***$ 40.00***
Student membership	***$ 10.00***
Subscription to Gemini for members of other astronomy clubs	***$ 4.50***
Subscription to Gemini for other persons	***$ 9.00***

To subscribe to the MAS e-mail list send e-mail to:
mas-request@mnastro.org
with the single line
subscribe
in the body (not subject) of the message.

The list has about 40% of the membership on it.

To Renew Your Sky and Telescope Subscription

If you get *Sky and Telescope* at the club's discounted rate, you must renew your subscription through the club. When you get a renewal notice from S&T, send the notice along with a check for the amount indicated on the notice (currently $29.95) to the MAS Treasurer (Chuck Jorgensen). Make checks payable to MAS. If desired, you may renew your MAS membership at the same time, and write one check to cover both payments.

GEMINI

MN ASTRONOMICAL SOCIETY
P.O. Box 583011
Minneapolis, MN 55458-3011

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