Gemini

a publication of the Minnesota Astronomical Society

OCTOBER, 1991 **VOL. 16, NO. 5**

UPCOMING EVENTS

October

1 Regular MAS meeting, SMM.

4-5 Star party at Metcalf.

7 New moon.

11-12 Star party at Baylor.

18 Post-eclipse meeting for those who went to Baja.

21 Orionid meteor shower. Good Oct. 16-20; rates to 25/hr.

22 Full moon.

November

1-2 Star party at Metcalf.

3-12 Taurid meteor shower. Rates to 10/hr. with fireballs.

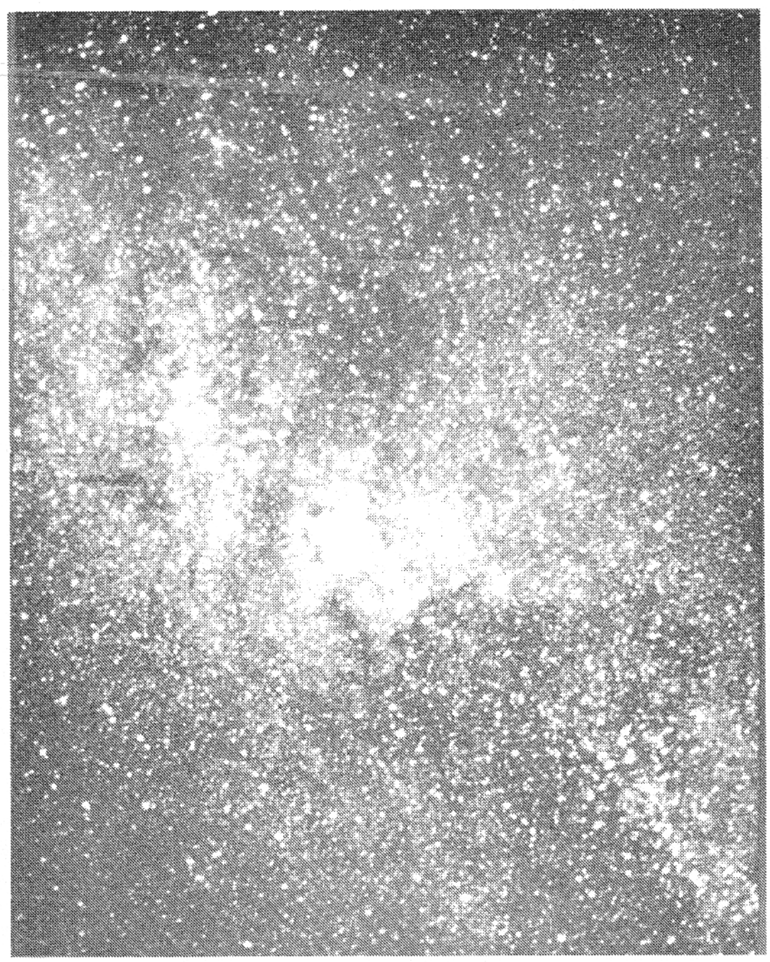
5 Regular MAS meeting, SMM.

6 New moon.

8-9 Star party at Metcalf.

17 Leonid meteor shower. Unpredictable rate: 15/hr. and up.

21 Full moon.



Cover photograph: The summer Milky Way in Cygnus is an easy subject for beginning astro-photographers. This photograph was taken during July at a dark site in Wadena County, 175 miles northwest of the Twin Cities. A 50mm, f/1.8 Olympus lens and T-Max 3200 was used for this 2-minute exposure. Longer exposures, longer focal lengths and filters can yield spectacular results. See page 326 of the July issue of *Sky & Telescope*.--**Photo by the editor**

ANNOUNCEMENTS

Compiled by Max Radloff, MAS secretary

Upcoming programs:

Tuesday, Oct. 1: A presentation by the MAS members who viewed the July 11 total solar eclipse in Mexico and Hawaii. The program will feature sides and videos of the eclipse as well as descriptions of eclipse and travel experiences.

Friday, Oct. 18: Post-trip meeting for those who went on the SMM eclipse trip to Baja, including an opportunity to order pictures and videos of the eclipse.

Nov. 5: Max Radloff will talk about how distances are measured in the universe. It will be a non-technical presentation about how the size of the solar system and the distances to the galaxies were discovered.

All programs will begin at 7:30 p.m. in the auditorium of the Science Museum of Minnesota. Please call the recorded message at (612) 643-4092 for any last minute changes.

The three magazines form Kalmbach Publishing are available through the club at reduced rates. The cost for *Astronomy* is $20 and *Telescope Making* and *Deep Sky* are $12. If you wish to subscribe, you must have your money to our treasurer, Richard Nelson by Oct. 15.

We regularly get questions about membership renewal. The MAS does not sent out renewal notices. About three or four months before your membership expires, you will receive a card rom *Sky & Telescope* informing you that your subscription is about to expire. To renew your membership, return this card along with your dues to our treasurer, Richard Nelson. *Sky & Telescope* will eventually send a second notice, but by then it will be difficult to get your magazine on time. The current dues for regular members are $33.

GEMINI

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1991 Star Parties:

Oct. 4 or 5	Metcalf
Oct. 11 or 12	Baylor
Nov. 1 or 2	Metcalf
Nov. 8 or 9	Metcalf

Star parties are normally on the Friday closest to the new moon. If it is cloudy on Friday, the star party will be held on Saturday. If the weather is questionable, the decision whether or not to hold the star party will be made after watching the early weather report. This information will normally be on the recorded phone line, (612) 643-4092 after 6:30 p.m. on the evening of the star party. If the information is not the line, you can call Lauren Nelson at 644-1254.

The phone number for Baylor park that was published on the maps has been changed yet again and is now a local number. The new phone number is (612) 448-6082.

MEETINGS

Regular meeting of Aug. 6, 1991: A slate of candidates for Astronomical League offices was presented. Because both candidates were unopposed incumbents, it was decided by acclamation to cast the club's ballot for those candidates.

Board Meeting of Aug. 27, 1991: Kalmbach Publishing has increased the prices for their magazines. After discussion, it was decided to set the cost to members at $20 for *Astronomy* and $12 for *Deep Sky* and *Telescope Making.*

A long discussion was held about how to proceed with the observatory project. The fund raising efforts have not been successful. We will have to proceed with the money we currently have and try to raise any additional funds after a smaller project is operational.

Tom Lindquist and Chuck Schein conveyed an invitation from Leanne Ronning to build on their property east of Cannon Falls. The consensus after the discussion was to keep Baylor as the first option with a scaled-down building. We will have the option of building at Ronning's if the Baylor project cannot be built for any reason. If the primary building is done at Baylor, we may still build a smaller observing site at Ronning's.
Because the September 13-14 star party could not be held at Frontenac State Park, it was held at Ronning's so members could examine the site.

Don Day reported on the optics of the 16-inch stored at Dick Bauer's, which he and Lauren Nelson had recently tested. It has good but not superior optics, with the disk of a star being somewhat larger than an arc second. The optics probably would be improved by masking off the turned edge on the primary.

OBSERVING SITE COORDINATES

Metcalf site:	44° 56' 16" N. + or - 3" 92° 49' 19" W. + or - 5"
Baylor site:	44° 48' 34" N. + or - 3" 93° 56' 23" W. - or - 4"

THE VOICE IN THE WILDERNESS

Thoughts on the Baja Experience

By Harold Doweiko

The Eclipse of 1991 has come and gone, and it was well worth the time and energy involved in viewing it. The weather cooperated perfectly, at least in the La Paz area of Mexico. Temperatures were in the 90° range, and there was not a single cloud in the sky. Totality was a bit brief (it only lasted for about six minutes or so), but, with that exception, the eclipse was picture perfect.

Now is the time to start to think about the next time.

The "next time"?

Yes. The experience of Baja was enough to make this writer seriously think about becoming an "eclipse chaser". The thrill of watching the sun wink out, and the corona burst into view, was better than winning all of the money in Las Vegas (well, almost!). It also was a great opportunity to learn some lessons, which may be used for the next total eclipse of the sun.

First, and I cannot emphasize this enough, one should take time to actually look at the eclipse! In the race to take pictures, focus one's camera, look at a point of interest through a telescope, watch the local wildlife, and so on, it is very easy to forget to look at the beauty of the eclipse itself. The sun is not static, and even in the few minutes of totality, one could note changes in the corona, and the solar prominence that was visible at the one o'clock position of the sun's disk. This was an unexpected treat, as the moon's disk was positioned in such a way as to block most prominences from view, according to predictions, so nobody expected the prominence to be visible.

A second point to remember is never, never attempt to change film while the eclipse is in progress. One should start totality with a fresh roll of 36 exposure film in the camera, and should plan on using only that roll of film during totality. (A *Sky & Telescope* article said that totality would last long enough to allow for the use of more than one roll of film. Speaking from experience, do not believe it!

A third point to remember is to bring a tape recorder. Better yet, bring a pair of tape recorders. One tape should have a "countdown" on it, giving the time remaining before the end of the eclipse. You can then use the second recorder to record your observations, or background sounds, with the countdown in the background giving you a great way of judging when each observation was made. Set both recorders up, and key them to begin to play or record when totality begins.

A final point to remember is you will be running on pure adrenaline during the final moments before totality, and throughout totality. To keep yourself calmed down, you would need a Valium tablet the size of a manhole cover, so don't even try to avoid the "rush". That is part of the experience of totality, and it should be savored.

With these lessons in mind, when is the next eclipse? Unfortunately, the next total eclipse visible from North America will not be for many years; however, if one is willing to travel a bit, there are total eclipses visible in different parts of the world in the next decade.

One will be visible from parts of England and France in a few years, not to mention a chance to visit Siberia to see a total eclipse of the sun in the next decade. (After Siberia, even Minnesota might not seem so bad...).

Now is the time to start making plans... If only I could find some way to break the news to my wife......

DEEP SKY EYE

By Max Radloff

The total eclipse was, as expected, the highlight of the trip to Baja in July, but there also was a variety of other interesting observing.

Observing in the evenings started very close to home, in the earth's atmosphere, with the vivid volcanic sunsets. The sun set very early in La Paz, at about 7:10 MST, and 75 minutes later it was totally dark. In between, we were treated to a gaudy show of yellows, reds, pinks and violets as the reddened sunlight reflected off the clouds of volcanic ash in the stratosphere.

The clouds of ash themselves were much more prominent then I expected, appearing much like high, thin cirrostratus with prominent billows. As the ash spreads worldwide, some of the effects could be seen here in Minnesota by early Sept. It will be interesting to observe them, but because the ash is thinner, I expect the intensity of the colors to be much less prominent then on the Tropic of Cancer in July.

The solar system provided the next part of the show, with Venus and Mars in a close group with Regulus, and Mercury rapidly closing in on and then passing Jupiter. All four planets were joined by the crescent moon with the prettiest view on Saturday and Sunday night.

After it was dark, the zodiacal light could be seen as a broad cone of diffuse light, extending at least 50 degrees along the ecliptic before it disappeared. It was both larger and fainter than what I expected based on the other times I have seen it. Fall is a good time to see the zodiacal light in the morning before dawn in Minnesota.

Among the first stars to appear was Alpha Centauri, just five degrees above the southern horizon. The telescope showed two yellow suns of unequal brightness. Beta Centauri was easily spotted to the west, but Crux could not be seen in the twilight at the horizon.

The night viewing was done about 30 miles south of La Paz on the centerline of the eclipse at a site that had been developed for a group of French astronomers. It was a piece of the desert from which the vegetation had been cleared and on which some primitive shelters had been erected. The desert soil was a powdery tannish dust and there was something special about viewing the stars over the cactus.

There were three nights of viewing scheduled. The first had to be abandoned after an hour because clouds moved in. The second was better, but again there was a period of about 90 minutes that was bothered by clouds. The third night was the best, no clouds and the clearest, darkest skies. We did not stay as late as planned, returning at about 1:00 a.m. This did not allow observation of most of the objects east of the Milky Way, but was late enough for us to see the Big Dipper start to set. The seeing was excellent all three nights and the views of Saturn were spectacular.

For equipment, I had 9X63 binoculars and a C8, generously loaned for the trip by Ivan Policoff. I was able to see many of the objects described in the last column, but missed those that could only be viewed near morning. Shapley 1, the faint planetary, could not be found; probably being too faint or perhaps needing an OIII filter.

Among the deep sky objects viewed, two of the globular clusters were especially memorable. Omega Centauri is easily

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CELESTIAL SHOWPIECES
Part Two
By Dave Siskind

A few issues ago, I wrote of notable and easy-to-find multiple stars suitable for public showings and other events where the sky's most accessible deep-space objects are wanted. This part two lists galaxies, nebula and clusters.

GALAXIES	MAGNITUDE	MIDNIGHT MERIDIAN DATE	DESCRIPTION
M 81 Ursa Major	8	2-15	Star-like center in cloud of "mist." Companion M82, nearby, is irregular and will take high power.
M65/66 Leo	9.5/8.8	3-1	Twin galaxies, 66 being irregular.
M 104 Virgo	8.7, high surface brightness	4-1	"Sombrero." Dust lane is visible; far south; 41 million light years.
NGC 4565 Coma Berenices	10.5	4-1	Edge-on; long and narrow; 15 X 1.1'.
M 51 Canes Venatici	8	4-15	"Whirlpool." Bright center; face-on view; spiral arms visible in 12".
M 101 Ursa Major	9.6, low surface brightness	4-15	Face on; larger and dimmer than M 51.
M 31 Andromeda	4.8, but very spread spread out	9-15	Andromeda galaxy at only 2 million light years; two small companions visible; bright, star-like center.

NEBULAE	MAGNITUDE	MIDNIGHT MERIDIAN DATE	DESCRIPTION
M 8 Sagittarius	6	6-15	"Lagoon." Large fuzzy patch with dark lane; near southern horizon.
M 20 Sagittarius	9	6-15	"Trifid." Near M8, but much smaller.
M 42 Orion	4, spread out	12-15	"Orion Nebula." Green to most observers; color visible in big scopes; quad stars inside (Trapezium).

PLANETARY NEBULA	MAGNITUDE	MIDNIGHT MERIDIAN DATE	DESCRIPTION
M 57 Lyra	9.3, high surface brightness	7-1	"Ring Nebula." Small with dim central star.
M 27 Vulpecula	7.6, bright	7-15	"Dumbbell." Large and easy; once found.

OPEN CLUSTERS	MAGNITUDE	MIDNIGHT MERIDIAN DATE	DESCRIPTION
M 46 Puppis	6	1-15	Faint stars. Also has a small planetary.
M 44 Cancer	3.7	2-1	Very spread out; binoculars best.

OPEN CLUSTERS	MAGNITUDE	MIDNIGHT MERIDIAN DATE	DESCRIPTION
M 11 Scutum	6.3	7-1	Rich and condensed; Milky Way object.
NGC 869/884	4/5	11-1	"Double Cluster" near Cassiopeia. Need a wide field.
M 45 Taurus	1.6	11-15	"Pleiades." Naked-eye object or best in binoculars. Reported home of UFOs?
M 35 Gemini	5	12-15	Bright and scattered. "Ghostly" planetary near (NGC 2185).
M 37 Auriga	6.2	12-15	Rich with many stars; brightest is red.

GLOBULAR CLUSTERS	MAGNITUDE	MIDNIGHT MERIDIAN DATE	DESCRIPTION
M 3 Canes Venatici		6.4	4-15Small but rich with stars. Try high powers.
Omega Centauri Centauri		4-15	Bright! Only visible from south, at least Texas.
M 13 Hercules	5.7	6-1	Bright and rather large. Best of its kind in northern sky.

THE LIGHTS IN THE SKY

By Thomas L. Ruen

Introduction:

In the ordinary world of day where light is everywhere, light can easily be taken for granted and ignored; however, when the sun goes down, light becomes rare and, therefore, precious. The strong contrasts between the tiny lights of the night and the dark voids between them completely changes the visual quality of the world. Without the night, humanity may have never questioned the existence of the universe beyond the earth.

What is this about?

I am writing this probably long article to explain some of my ideas about calculating the brightness of stars and planets. I will try to make it short and simple as I can, but if I have truly failed, feel free to skip any boring parts if you like. The final formula for the magnitude of the planets is an original result as far as I know.

Why does the intensity of light varies with the inverse square of the distance?

In the empty vacuum of space, light travels at a very fast but finite speed. When light leaves a source like a star, it travels radially outward in all directions. All the light leaving a star at any instant forms an expanding sphere of light centered on that star. The total energy in this expanding sphere of light remains constant, but the surface area of the sphere is continually increasing; thus the light energy density decreases with increasing distance from the star.

At a distance of R, the sphere has a surface area of "4 x pi x R^2". The light energy density is inversely proportional to the area the light is spread over and, therefore, light intensity changes with the inverse square of the distance.

How do you compute the apparent brightness of the stars?

Looking at stars in general, we have two basic parameters, the absolute brightness and the distance. The absolute brightness is usually called the luminosity. It is proportional to the total power output from the star, which is usually, except for variable stars, a constant.

Luminosity adds linearly, allowing two equally bright stars together to have double the individual luminosity. Together with the distance parameter, the relative apparent brightness of any star can be computed:

$$\frac{B^*}{B_{sun}} = \frac{L^*}{L_{sun}} \times \left(\frac{R^*}{R_{sun}}\right)^{-2}$$

"B" is the apparent total brightness, "L" is the luminosity and "R" is the distance away. The "*" stands for any star while "sun" stand the sun.

This just says the apparent brightness is proportional to the luminosity and inversely proportional to the square of the distance. The sun, being the closest star, is best suited for converting the proportions to an equation form. The sun could

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be replaced by any other star.

What is the relation between brightness and magnitudes?

Brightness is a simple linear parameter for describing the intensity of light, but it is kind of messy to talk about even the brightest star, Sirius, with an apparent brightness of 0. 0000000-0008 suns. The development of a logarithmic brightness scale was inevitable.

The brightness of stars was first systematically recorded by the Greek astronomer Hipparchus in the second century B.C. He classified the brightest stars as first magnitude down to the faintest stars visible as sixth magnitude. This formed the basis of our magnitude scale.

The magnitude scale was defined mathematically in the 19th century by the astronomer N. R. Pogson. He found that the brightness ratio between first and sixth magnitude stars was about one hundred and proposed this relation be the basis for defining star magnitudes.

The star Vega was eventually defined to be the standard for a zero magnitude star. These definitions give the follow conversion formula between brightnesses and magnitudes:
M* = Msun - 2. 5 x log10(B* / Bsun).

Substituting the definition of (B* / Bsun) gives:

M* = Msun - 2. 5 x log10(L* / Lsun) + 5 x log10(R* / Rsun).

What are absolute magnitudes?

This magnitude is more specifically called an apparent magnitude, just like apparent brightness. There is also the absolute magnitude. It is defined as the magnitude of a star viewed at a special distance of 10 parsecs. A star with an apparent magnitude "M*" at a distance of "R*" parsecs will have an absolute magnitude "A*" of:

A* = M* + 5 x (log10(R*) - 1).

For example, the sun with an apparent magnitude of -26. 73 at a distance of 1 A. U. (4. 85 x 10^-6 pc) has an absolute magnitude of 4. 84.

What do you need to compute planetary brightnesses?

Now with the basic relations of star light out of the way, I can get on with more interesting ideas. The apparent brightnesses of planets and moons can be computed by calculating the ratio of sunlight seen reflected off the planet compared to sunlight seen directly from the sun.

There are two new main parameters needed to compute planetary brightness. These are phase and albedo. The sun only lights up half of a spherical planet, and obviously what direction you view it will effect the total brightness of the planet.

Also there is a question of what fraction of sunlight hitting a surface is reflected. Since the planets are pretty much in temperature equilibrium, on average around the whole planet, a conservation of energy law tells us that the total light emitted by a planet should equal the incoming light. The problem is that light exists which we can not see. Since visual albedo is always less than one for planets, I would assume planets emit more of the invisible wavelengths, such as infra-red, than they receive.

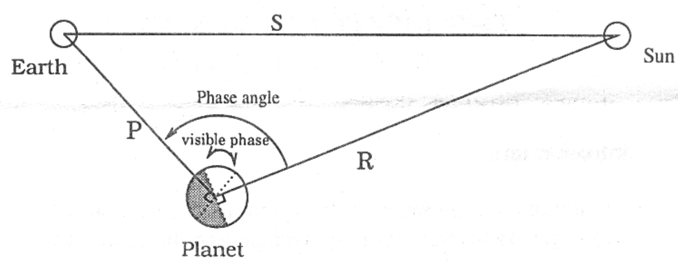
What does reflected light look like?

Light seen from reflecting off of planets is much more complicated to compute than light from stars because the phase causes us to need to look in detail at how much light is sent in each direction. The simplest model for reflecting light just assumes that the direction of the reflected light is independent of the direction of the light source.

For example, a sheet of paper has the same surface brightness for any direction you look at it; however, such a simple model cannot accurately cover all types of planet surfaces. Rocky worlds, which have sharp irregularities on their surfaces, should cause some light reflecting with low surface angles to hit other rocks; therefore, small-phase views of the planet will be less bright than a perfect random reflection model would suggest.

Cloud covered worlds can reflect more light at small phases because the light near the phase edge penetrates the clouds and can leak out around the dark side of the planet. Because I want a general planet brightness relation, I will ignore these problems.

Geometry of my planetary brightness model



What is the model?

Here is my basic model for planetary brightness. Light is emitted from the sun and some fraction of that light collides with the surface of a planet of radius "r" at distance "R" from the sun. Then a fraction "albedo" of that light is reflected off the planet. The surface brightness depends on the angle the sun is above the horizon, which is different for different parts of the planet's surface.

Thus I need to break the planet surface up into small pieces and add the light from all the pieces. For each tiny piece of the planet's surface, the light expands in a hemisphere outward to a distance "P" where a fraction of that light will hit a detector on earth of area "D". The total reflected light from the planet hitting the detector can be computed by adding all the lit areas on the planet visible from the detector.

How did I derive the planetary magnitude formula?

The constants needed are:

R = the distance from the sun to the planet.
P = the distance from the planet to the earth.

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S = the distance from the sun to the earth.
r = the planet radius.
albedo = the average visual albedo of the planet (reflectivity).

Some derived variables are:

D = the area of a light detector placed on earth.
pa = phase angle of the planet (0 for full, pi radians for new phases) area = area of a small piece of the planet.
sa = The sun angle from vertical on a piece of the planet surface.
ea = The earth angle from vertical on a piece of the planet surface.

The phase angle can be computed from the law of cosines: S^2 = P^2 + R^2 - 2 x P x R x cos(pa).

The first question is how much light hits a small piece of the planet with an area "area" and sun angle "sa"?

The perpendicular component to the area is area x cos(sa). The sunlight is spread over a sphere of area (4 x pi x R^2).

Thus the fraction of sunlight hitting the area is: f1 = area x cos(sa) / (4 x pi x R^2).

Next, the fraction of reflected light to received light is: f2 = albedo.

Still looking at the small surface area on the planet, the reflected light travels outward over a hemisphere but not uniformly. The light is brightest perpendicularly out from the surface and approaches zero as the view approach the tangent plane to the surface. This factor is related by the cosine of the angle to earth from the surface normal.

After adding a double integral of all possible light directions with I found the fraction of reflected light entering a small detector at angle "ea" is: f3 = cos(ea) x D / (pi x P^2).

Now it is clear that the total fraction of light reflected into the detector to total sunlight received is the product of these fractions: fp = f1 x f2 x f3 = area x D x albedo x cos(ea) x cos (sa) / (4 x pi^2 x P^2 x R^2).

The fraction sunlight which could enter the detector directly from the sun at a distance "S" is: fs = D / (4 x pi x S^2).

Thus the ratio of the sun brightness to the planet small area is: df = fp / fs = area x albedo x cos(ea) x cos(sa) x S^2 / (pi x P^2 x R^2).

Note: The area of the detector "D" has canceled out.

Lastly, the total fractional brightness of the planet to the sun can be computed by adding the fractions for each visible and lit small section of the planet. This is done by evaluating a double integral over the planet's surface defined in spherical coordinates.

The resulting total light fraction between the planet and sun becomes:

$$f = \frac{2 \times S^2 \times r^2}{3 \times P^2 \times R^2} \times albedo \times phase$$

where phase=[(pi-pa) x cos(pa) + sin(pa)] / pi.

and pa=arccos((P^2 + R^2 - S^2) / (2 x P x R)).

The phase is one when the phase angle is zero and zero when the phase angle is pi radians.

The magnitude of the planet can now be easily computed relative to the sun's magnitude:

Mp = Msun - 2. 5 x log10(f)

Does it work?

Now I will compute the magnitudes of the planets for recent dates and compare the results with *Astronomy* magazine planetary table.

Constants: The earth-sun distance (S)=1. 0 au, and Msun=--26. 73.

The conversion 1 au=1. 49598x10^8 km is needed for the radius.

NOTE: The trigonometric angles are define as radians <u>not</u> degrees.

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Planet	albedo	radius (km)	date	R (au)	P (au)	-- Magnitudes -- Comput	Actual	delta
Mercury	0.106	2439	Aug 1	0.466	0.763	-0.35	+0.8	-1.15
Mercury	0.106	2439	Aug 31	0.345	0.738	0.16	+1.6	-1.44
Venus	0.65	6052	Aug 1	0.728	0.353	-3.70	-4.4	0.70
Venus	0.65	6052	Aug 31	0.728	0.296	-2.33	-4.2	1.87
Mars	0.15	3393	Aug 15	1.644	2.477	2.08	1.8	0.28
Jupiter	0.52	71400	Aug 15	5.349	6.335	-1.32	-1.7	0.38
Saturn	0.47	60000	Aug 15	9.959	8.999	1.28	0.2	1.08
Uranus	0.51	25600	Aug 15	19.485	18.713	6.08	5.6	0.48
Neptune	0.41	24300	Aug 15	30.198	29.385	8.37	7.9	0.47
Pluto	0.5?	1500?	Aug 15	29.768	29.730	14.19	13.7	0.49

Why doesn't it work?

The model over estimates magnitudes for small phases with rocky Mercury, which is consistent with my failure to approximate irregular surface details for small phases. It also under estimates the brightness of small-phase, cloudy Venus, consistent with my failure to include light leaking under and through the cloud surface around the phase border.

For Saturn, I did not include the light from the rings, which causes it to under estimate Saturn's brightness. For the remaining planets, all are near full phase and the model seems to be consistently under estimating their brightnesses by 0. 3 to 0. 5 magnitudes, which is a significant error. This implies more light is being reflected at higher angles that my random reflection model assumes.

Conclusion:

I have never seen a general formula for computing the brightnesses of planets, although I have not looked too hard. It may be that no simple geometric model is accurate enough to predict planet brightness for all the special case differences between the planets. Clearly, my solution is only an order of magnitude result!

The best method probably would use more observational data, measuring the magnitude under various distances, and phases and interpolating the data for current parameters. I hope my fairly long explanation was not too boring. My purpose was to try to do a reasonable job of explaining a neat formula I spent a long time deriving.

I have tried to give enough details so the interested reader could repeat the derivation and possibly improve upon the model. The only useful purpose for the formula I have found is for a computer program which computes the positions of all the planets. Everyone can now feel grateful I do not understand planetary elliptical orbits well enough to demonstrate how to derive them.

DEEP SKY EYE

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visible to the naked eye and a comparison with binoculars showed that Omega Centauri's diameter was about 4 times that of M 13. In the telescope the field was covered with resolved stars, many times the number of stars that can be seen in any other globular. Almost as large but nor as rich was NGC 6397 in Ara. This is the closest globular and as expected, it appears quite large and is easily resolved.

There was a consensus among the observers that the most spectacular object was the Milky Way. With both the naked eye and in binoculars, the brightness and the extent of the star clouds was stunning with numerous dark nebulae and dust lanes separating and delineating the star clouds. Many of the familiar Messier objects could be seen with the naked eye.

Below the great Sagittarius star cloud, smaller star clouds extended to the horizon. A large faint bulge extended westward to Antares and, below this, a large dust lane, a shorter compliment to the great rift in Cygnus, cut in from the west before the Milky Way again became one band near the horizon. Our galaxy was most impressive at midnight when it arched through the zenith stretching from horizon to horizon.

If you are ever able to travel to more southerly latitudes, be sure to take along at least a pair of binoculars and get out to dark skies to view the Milky Way. We can only get a hint of its true glory from the northern latitudes.

Good luck and clear skies.

MINNESOTA ASTRONOMICAL SOCIETY STAR PARTY ETIQUETTE

If this is your first star party with us, or it has been a while since you've been to one, please take a few moments to review these guidelines.

1. Please avoid the use of white lights. It takes the human eye over thirty (30) minutes to fully "dark adapt" and white light starts the cycle all over again. A dim red light (i.e., a flashlight with a red filter) is your best bet.

2. Please, no headlights until you are well away from the observing area; use your parking lights only. If possible, turn off all internal and accessory lighting as well: trunks, interior lights, etc.

3. Plan your departure; backing into a parking space will avoid the need to back up and flood the observing area with white light (your back-up lights). Whenever possible, park your vehicle based on your departure plans. If you know you'll be leaving early (or if you don't have a telescope to observe with) try to park away from the main observing area.

4. Please, no pets or small animals at star parties.

5. Children are welcome at star parties when accompanied by a responsible adult. Consider carefully the child's age and overall attention span before bringing them along to a star

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ETIQUETTE

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party. Please supervise children at all times; there is a lot of equipment, accessories, people, etc. scattered around in the darkness, "accidents waiting to happen".

6. Do not litter. If you brought it, take it with you when you leave.

7. Please be considerate of others: no loud radios or music; only smoke near your own observing area/equipment; always ask permission before touching or using someone else's equipment.

8. Respect others. The Minnesota Astronomical Society is open to all ages regardless of gender, ethnic background, religious persuasion, etc. Inappropriate comments or actions will not be tolerated, and after a suitable warning, offending parties will be asked to leave.

9. If you are new, ask questions. Generally, the membership of the MAS enjoy talking about their hobby and will be more than willing to share their love of the universe with you.

Thanks for your attention. Enjoy the star party!

VOLCANIC SUNSETS

The eruption of Mount Pinatubo in the Philippines carried vast amounts of dust into the stratosphere and we can expect to see more dramatic sunsets in the coming weeks. About 30 minutes after sunset, look for a sheet of red tapering to orange and lilac. This will be followed about an hour later by an intense red afterglow.

In early September, the effects were starting to be seen. How intense they will become and how long they will last is uncertain. For a complete description of volcanic and other atmospheric effects, read *Sunsets, twilights, and evening skies* by Aden and Marjorie Meinel.

HOW TO DO ANYTHING

How to pay your dues:

Send a check made out to "MAS" to: Richard Nelson, 1774 Bayard Ave., St. Paul, MN 55116. The correct amount is:

Regular member with *Sky & Telescope*	$33
Student member with *Sky & Telescope*	26
Student membership without *Sky & Telescope*	9

Include your renewal notice from *Sky & Telescope*, if applicable. If your address or phone numbers (home and work) have changed, or if MAS may not have the correct information, include that also.

How to change your address and/or telephone number:

Send or give your name, address, home telephone number and work telephone number (if applicable) to Carl Harstad, Gemini editor, 2015 Stevens Ave. S., Apt. 3, Minneapolis, MN 55404-2548. You may also give a change of address to any officer of MAS, who will see that it is forwarded.

How to renew your *Sky & Telescope* subscription:

This is the same as paying your dues, because all regular members of the MAS and most student members receive *Sky & Telescope* at a discount through the Society as a part of their membership. Follow the procedure listed under "How to pay your dues."

How to call the MAS information line:

Call (612) 643-4092 for a recorded message.

How to order astronomical software:

Contact the MAS software coordinator, Mike Kibat, 4717 Nord Circle, Bloomington, MN 55437, telephone (612) 884-0039, for most astronomical software. Publications available on diskette, such as the Floppy Almanac, are usually available through the MAS secretary, Max Radloff, 759 19th Ave. N., South St. Paul, MN 55075, telephone (612) 451-7680.

How to order publications:

Contact the MAS secretary, Max Radloff, at the address listed under "How to order astronomical software."

How to order anything else:

All other items available through MAS, such as registration forms for out-of-state astronomical events, are usually available through the MAS secretary; however, specific items may be available through other MAS members. Contact Radloff, who usually has these items or knows where items may be obtained.

How to obtain books, slides and materials from the MAS library:

The MAS secretary, Max Radloff, is also the current MAS librarian. Contact Radloff.

How to submit an article or photograph for Gemini:

Deadline for publication: 10th of the month prior to the month of publication; usually the deadlines are Jan. 10, March 10, May 10, July 10, Sept. 10 and Nov. 10.

Computer formats: Submit articles on computer diskettes if possible. If this is your first submission in a specific format, enclose hard copy also. Acceptable formats are IBM or IBM-compatible, MacIntosh, and most CP/M computers on any capacity of 5 1/4-inch or 3 1/2-inch diskette.

Word-processing software: Files should be in one of the following formats: IBM Wordperfect; IBM Wordstar ver. 3.3; IBM MultiMate Advantage II, MacIntosh Word, MacIntosh MacWrite I or MacWrite II. If you do not have one of these formats, export your copy to an ASCII text file and send the text file on diskette.

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Graphics software: It is best to print graphics yourself on a laser printer or high-quality dot-matrix printer and submit the hard copy. Size does not matter; it can be enlarged or reduced as needed. If you want to submit a graphics file on disk, there are several acceptable formats. Contact the editor for more information.

Hard-copy formats: Typewritten and preferably double-spaced, except for very short items such as for sale ads. The margins, fonts, and so forth are immaterial because all hard copy is retyped.

Photographs: All photographs should be black and white, glossy 5X7s or 8X10s. Write your name on the back so the photograph can be returned to you. Gemini cannot be responsible for what printers may do to your photograph (i.e., fingerprints, etc.) while publishing Gemini. All photographs must be in sharp focus and have good contrast.

Submitting your article or photograph: Send your submission to Carl Harstad, Gemini editor, 2015 Stevens Ave. S., Apt. 3, Minneapolis, MN 55404-2548 or place it in a manilla envelope, write his name on it, and leave it on top of the mailboxes in the entry of his building. If you are dropping something off, please call Harstad beforehand at (612) 872-4114 to make sure he is available and he expects your material.

How to get information on programs and star parties:

Call the MAS information line at (612) 643-4092. If necessary, contact Program Director Lauren Nelson, (612) 644-1254.

FOR SALE

Meade 16-inch deep-sky telescope with three eyepieces, Barlow, 2-inch focuser and roller base. Asking $1,400. Call Jamie Cameron at (612) 477-5577.

Homemade 6-inch, f4.24 rich-field telescope (RFT); very sturdy and stable equatorial fork mount of steel and pipe construction with babbitted R.A. bearing; finder 'scope; 20mm orthoscopic eyepiece included; no clock drive, but one could be installed. This telescope has superior optics, both primary and secondary; aluminized by E&W Optical one year ago. Maximum field of view is approximately 2.5°. Asking $350. Contact Carl Harstad, (612) 872-4114.

CLASSIFIED ADS

All MAS members may run non-commercial classified ads in Gemini free of charge for items related to astronomy such as telescopes, star atlases, etc.

All ads received will normally appear in the next edition of Gemini, which is published bi-monthly. The deadline for ads is the 10th of the month prior to the month of publication.

GEMINI
C/O CARL HARSTAD, EDITOR
2015 STEVENS AVE. S. APT. 3
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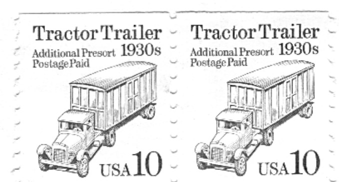

BULK RATE

WILLIAM GLASS
5721 YORK AVE S
EDINA, MN 55410