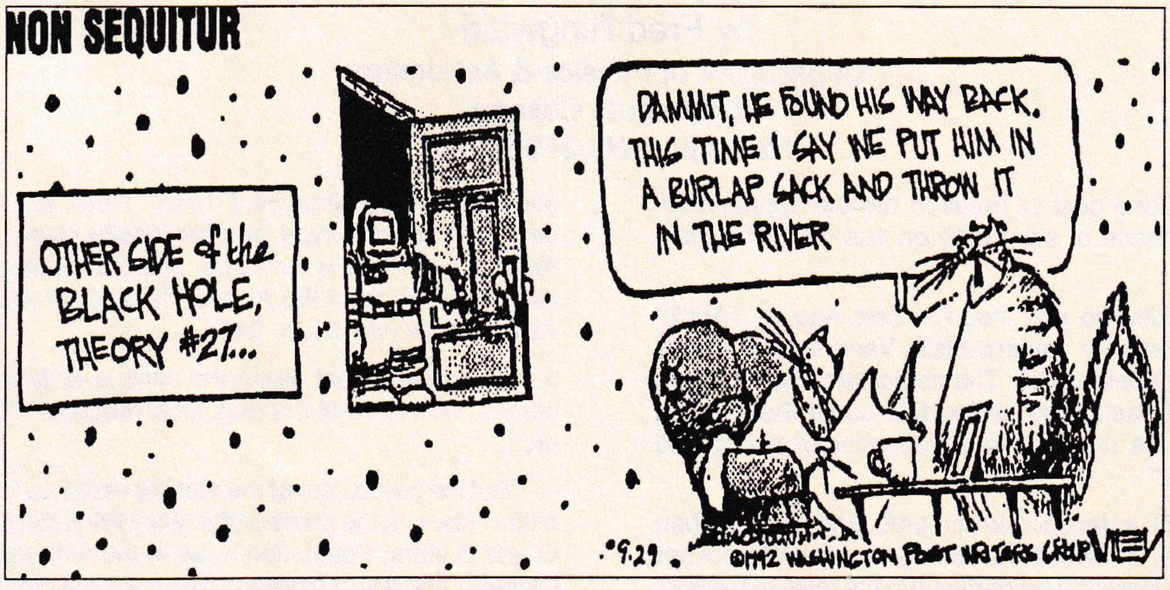
REFLECTIONS



October 1992 OK, maybe it's not the best theory, but if you get too hard-core about your astronomy you'll lose your sense of humor, and then where would you be? **Kurt Hillig Editor**

University Lowbrow Astronomers

The University Lowbrow Astronomers is a club of astronomy enthusiasts which meets on the third Friday of each month in the University of Michigan's Detroit Observatory at the corner of Observatory and Ann Streets in Ann Arbor. Meetings begin at 7:30 PM and are open to the public. For further information, call Stuart Cohen at 665-0131.

This Month:

October 17 – Meeting at the **Detroit Observatory** in **Ann Arbor**. On the agenda: Astrofest! A report by Fred Schebor on the biggest telescope makers' gathering in the midwest. Also scheduled is the selection of gatekeepers for the next few open houses – show up or risk being volunteered!

October 16-18 – Antique Telescope Convention and Show at the **U.S. Naval Observatory, Washington D.C.** Walt Breyer, 30 Green Valley Road, Wallingford PA 19086.

October 24 – Public Open House at the **Peach Mountain Observatory** (on North Territorial Road, 1.1 miles west of Dexter-Pinkney Road). The 24" scope is operational!

October 31 –Public Open House at **Peach Mountain.**

Next Month:

November 2 – Computer Subgroup Meeting at **Roger Tanner's** house (a Monday - note the date change). Roger and John Laffitte will talk about the computerized drive and display systems that they've built for their scopes.

November 17 – Meeting at the **Detroit Observatory** in **Ann Arbor**. Dr. John Clarke of the U of M Space Physics Research Lab will talk. Title TBA.

November 21 –Public Open House at **Peach Mountain.**

November 28 –Public Open House at **Peach Mountain.**

A Note on This Month's Articles

One of the great benefits of the computer revolution is the advent of easy, world-wide electronic communication: E-mail, bulletin boards services, networks, etc. One of the oldest, furthest-flung, and unstructured of these is the UseNet, developed in the early days of the Unix operating system by graduate students who wanted to exchange files and mail across the country using telephone lines late at night. One of the earliest distributed conference / bulletin board systems which evolved from this is *UseNet News*.

Of course, communication technology has advanced in the past two decades, and instead of 300 baud modems many computers are now connected to the Internet – really a collection of interconnected networks – which currently has more than six million nodes. As the network has grown, Usenet News has grown, with many tens of thousands of subscribers to about a thousand news groups.

In my work at the University, I susbscribe to several of the computer-related news groups; to pick up helpful hints, bug reports, etc. and to ask questions in a forum where an expert is almost certain to respond. After hours, though, I dial in and participate in the newsgroups "sci.astro" and "alt.sci.planetary" – devoted to astronomy, cosmology, astrophysics , and planetary science.

In this month's issue of *Reflections*, I've gathered and edited a small sample of items posted to these newsgroups in the past few weeks – though I've left out many interesting and/or bizarre ones. I hope you enjoy them. – Ed.

Spectral Abundances? and why OBAFGKM?

by Fred Ringwald
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> Could someone post or Email to me the approximate relative abundance of stars both on and off of the main sequence?

What exactly do you mean? Zero-Age or TAMS? Subgiants, giants, or supergiants? Versus what types? Cluster stars or field stars? The particulars matter. Stars are complex beasts, and asking this about them is like asking "what are the relative abundances of young and adult animals?"

But all right: a decent rule of thumb, and no more than a rule of thumb, is that number density (number of stars per unit volume) ought to be proportional to the relative lifetime. Therefore, about 90% of the G stars should be on the main sequence, since they live for about 10 billion years, and spend about one billion years evolving onto and off of the main sequence. But this is oversimplified: in this example, they will be cooler off the main sequence, and so will not be G stars then. But, to give you a succinct and shamefully oversimplified answer, a-few-to-about-10%.

This is for the middle of the MS. In a volume-limited, high-Galactic-latitude sample, this ratio is much less for cool stars, since M dwarfs have evolutionary timescales longer than the age of the Universe, and so, practically, do not evolve at all. But, evolved stars are bright, and so can be seen a long way, and so will be more numerous than they ought to be in bright star catalogs (i.e., magnitude-limited samples). The evolved ones will not have evolved from M dwarfs, of course, but from earlier types, which evolve faster. The ratio should be roughly the same for hot stars, which form, live, and burn out quickly; also, for full-tilt, million-Solar-luminosity O types, it's not as clear what main sequence and evolved mean, since they evolve rapidly back and forth over the top of the H-R diagram. This is why, in perfect hindsight, it should not have surprising that SN 1987A came from a luminous blue star, and not a red giant.

Tell you what: two good sources of this type of material are these books:

C. W. Allen, Astrophysical Quantities, 3rd ed. (1973)

and a much newer one,

K. R. Lang, Astrophysical Data: Planets and Stars (1992).

Both have extensive tables of what's what, which you can peruse yourself.

> I would also like the approximate abundances of Binary and Trinary star systems.

So would we. This is a controversial matter: numerous attempts to determine this in the past can only agree in that binaries are in the majority (most likely 60 - 80%, although some studies have gotten close to 100%), and that triples are less common (maybe 5-10%). Here, too, the results vary with spectral type and luminosity class. The best reference on this is probably still the review article by Helmut Abt, in the 1983 Annual Review of Astronomy and Astrophysics (vol. 21, p. 343).

> I do not care what group the sample is taken from just please include what it is (e.g. local neighborhood, galaxy, etc.).

But the particulars of the sample matter, a LOT. Population I stars, in the plane of the Milky Way, have a lot more O and B stars; Population II, as in the halo and Globular Clusters, show a lot more evolved red stars, and practically no O and B stars, since there has much less recent star formation.

> I do not need great accuracy (definitely no more then 2 significant figures), I am just trying to get a feel for relative star abundances.

You will not get great accuracy: this is astrophysics, remember? If one can get any result to within 10%, one is a happy person. Then again, considering the subject matter, if one *can* get any result, RELIABLY, to within 10%, one *ought* to be a happy person. Besides, many of the quantities you want are controversial in the first digit, or even order of magnitude (for brown dwarfs or black holes, for instance).

> Now a serious question. How was this lettering scheme picked to define stellar spectral class? Why wasn't something like A,B,C,D,E,F,etc picked instead?

This part is much easier. When Annie Jump Cannon was classifying the objective prism spectra of 225,300 stars brighter than 11th magnitude for the Henry Draper Catalogue, at Harvard College Observatory, starting in 1896, her first cut at classification was to judge by the strength of the hydrogen lines. Therefore, A, B, C, etc. This was strictly empirical: it was not understood how stellar spectra form, only that they display certain characteristics. It wasn't until 1925 that Cecilia Payne-Gaposchkin, in her Ph.D. thesis, the first in astronomy at Harvard, showed that spectral types are a temperature sequence. The hydrogen lines increase in strength with temperature up to the A stars, but they decrease in strength for hotter stars, since the hydrogen ionizes. This was what unalphabetized everything, with the O and B types before A, after which come F, G, K, and M.

Then, too, some types were deemed superfluous and removed. For example, type H was found to be identical to type K, observed under favorable conditions. Net result: the alphabet soup of the Harvard classification, now deeply entrenched, so there is no chance of changing it.

> How are stars that are little larger than brown dwarfs but large enough to undergo fusion and be on the main sequence classified? Spectral type M?

Yes, although until recently, there was confusion about standardizing the spectral classification that far down. But now, see Kirkpatrick, Henry, and McCarthy, 1991, ApJS, 77, 417, which covers from K5 V all the way down to M9, putting them all on the Boeshaar system, which is extended past M 6.5. M5.5 - M6 V stars, at about 0.1 Solar masses, are not terribly uncommon. They are faint, but not unduly so, the brighter ones being about R = 13.

> How large (in solar masses) and hot is the smallest main sequence star known?

The theoretical hydrogen burning minimum mass is about 0.08 Solar masses (about 80 Jupiter masses), at spectral type about M7 V, at temperatures below 3200 K. But Kirkpatrick et al. (1991) don't quite claim to have spectra of brown dwarfs; they do stress the importance of obtaining reliable mass estimates farther down than M7 V.

Also, theoretical models of red dwarf spectra still have problems (see Dorman, Nelson, and Chau 1989, ApJ, 342, 1003). The cool spectra are so blanketed with molecular bands, it's hard to define a continuum. Most stellar atmosphere calculations compute the continuum first and then treat the lines as a small perturbation, not so here. So temperatures are uncertain.

Besides, temperatures and luminosities of these objects will depend greatly on their composition and age: D'Antona & Mazzitelli, Lunine, and others have had several papers in the last few years on brown dwarf cooling sequences. After 10^9 years, a Solar-composition brown dwarf might cool down to 1500 K. With no fusion, it's not making energy, just running off its residual heat.

> Also, how large and hot is the largest?

About 60 Solar masses, depending on composition. This is a manifestation of the Eddington limit, where radiation pressure becomes so strong, it counteracts the force of gravity and the star comes apart. This jibes roughly with the hottest main sequence stars known, which are of O3 type, at 45,000 - 60,000 K, at a luminosity of about a million Suns, as much as a good-sized globular cluster (!). Off the main sequence, there are the Wolf-Rayet stars, which have expanding atmospheres. These could also be thought of as fierce, optically-thick winds. Their spectra are dominated by helium: apparently, these massive, hot stars are not holding together too well, and most of their hydrogen has already escaped. The Eddington limit, by the way, is a good calculation for a sophomore or junior astrophysics course; try it.

Every so often, there are theoretical attempts at circumventing this, largely with relativistic effects on stellar structure, these objects being called supermassive stars. But the observational evidence for their existence is only so-so. One of about 3000 Solar masses was proposed for the energy source of the Eta Carinae nebula, but one of the first Hubble Space Telescope images showed it was an unusually dense cluster of smaller, relatively normal, hot stars. Also, supernova 1961L is supposed to have been one that exploded, but this is controversial.

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1992 QB1

D. Jewitt, University of Hawaii; and J. Luu, University of California at Berkeley, report the discovery of a very faint object with very slow (3"/hour) retrograde near-opposition motion, detected in CCD images obtained with the University of Hawaii's 2.2-m telescope at Mauna Kea. The object appears stellar in 0".8 seeing, with an apparent Mould magnitude R = 22.8 +/- 0.2 measured in a 1".5-radius aperture and a broadband color index V-R = +0.7 +/- 0.2.

1992 UT	R.A. (2000)	Decl.
Aug. 30.45568	0 01 12.79	+ 0 08 50.7
30.59817	0 01 12.19	+ 0 08 46.9
31.52047	0 01 08.37	+ 0 08 22.7
31.61982	0 01 07.95	+ 0 08 19.9
Sept. 1.35448	0 01 04.90	+ 0 08 00.6
1.62225	0 01 03.76	+ 0 07 53.3

Computations by the undersigned indicate that 1992 QB1 is currently between 37 and 59 AU from the earth but that the orbit (except for the nodal longitude) is completely indeterminate. Some solutions are compatible with membership in the supposed "Kuiper Belt", but the object could also be a comet in a near-parabolic orbit. The particular solution below is the direct circle (but a retrograde circle some 15 AU larger in radius also fits); Jewitt and Luu note that a cometlike albedo of 4 percent then implies a diameter of 200 km and that the red color suggests a surface composition rich in organics. Further precise astrometry during the late-September dark run should eliminate some possibilities, but a satisfactory definition of the orbit will clearly require follow-up through the end of the year. The object's phase angle reaches a minimum of less than 0.01 deg around Sept. 22.5 UT.

Epoch = 1992 Aug. 26.0 TT   Arg.lat. = 0.335
Node = 359.440   2000.0
a = 41.197 AU   Incl. = 2.334

1992 TT	R. A. (2000)	Decl.	Delta	r	Elong.	Phase	V
Sept.15	0 00.09	+ 0 01.7	40.200	41.197	172.5	0.2	23.4
25	23 59.33	- 0 03.1	40.195	41.197	177.5	0.1	23.4
Oct. 5	23 58.58	- 0 07.9	40.220	41.197	167.5	0.3	23.5
15	23 57.87	- 0 12.5	40.275	41.197	157.4	0.5	23.5

1992 September 14   (5611)   Brian G. Marsden

A Comparison of Filters in the Observation of IC5146

by Ethan VanMatre

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[IC5146 is also called the Cocoon Nebula, an emission / reflection nebula about 12' across in Cygnus, at 21^h53^m5 +47°16'. The RASC Observer's Handbook says "faint and diffuse; use H-Beta filter; 20 – 25 cm min. aperture." - Ed.]

In the September issue of *Sky & Telescope*, Walter Scott Houston asked for someone at a star party to gather up a collection of filters and turn towards IC 5146. I took him up on this at the 1992 Oregon Star Party, held Aug 27-30 1992 at a dark sky site in the Ochoco Mountains of central Oregon. The OSP was sponsored by the Rose City Astronomers of Portland, OR. and the Oregon Museum of Science and Industry. (Contact Chuck Dethloff 503-629-2145).

The site is located near Indian Springs some 60 miles east of Prinville, Oregon. At 5000 feet, and in the rain shadow of both the Cascades and the Ochoco mountains, there is no dew all night long, and the stable air gives great seeing. This report is based on 5 hours of observing IC 5146 through 4 different filters on two successive nights.

The first hour or so was spent locating IC 5146 and just getting a feel for the area. Instruments were 7x50 binoculars, a 13.1" Coulter and a 24" f/5 Newtonian. Somewhere along the way I realized that the question was not "could you see the nebula?" but "how well could you see the nebula?"; after a few more hours observing the question became "what are the differiences between the filters on the nebula?". Having spent 3.5 hours on IC 5146 to that point I decided that to answer this question I would need a fresh night, only one telescope and the filters.

For the comparision I selected my Coulter over the 24" because I could use it while standing on the ground, with all of the filters handy to thread into the Teleview WF 32mm that was the only eyepiece I used for this. The Coulter was collimated as the sun was setting and then left alone until midnight to cool down. I should add that this 13.1" (33.25 cm) f/4.5 scope has an enhanced secondary from Lumicon, a Novak spider and a Tectron focuser. Filters to be tested were all from Lumicon and 48mm in diameter. My observations were as follows:

No Filter   The nebula could be seen with averted vision as a soft glow inside the open cluster. This was surounded by a dark blob with a dark lane heading off to the NE. A faint dark lane was sometimes seen crossing the nebula from the SE to the NW. I took to calling this the primary dark lane.

Deep Sky Filter The nebula was much easier to see. The primary dark lane took on some shape, though it still had soft edges. There was a hint of a secondary dark lane leaving the center of the primary dark lane and running to the edge of the nebula in a NE direction.

UHC Filter   The loss of image brightness was more than counterbalanced by the gain in contrast. The primary and secondary dark lanes were clearly there to direct vision. Their edges took on a specific shape, in a diffierient place from the edges seen with the Deep Sky filter. Some dark globules could be seen. One globule was L-shaped and in the southern edge of the nebula. The other was an elongated blob at the SE end of the primary dark lane.

O III Filter   The nebula was basically not seen. It was very dark and required a dark cloth over my head to be able to see anything. No filter at all was better than this.

H-Beta Filter   The outer edges of the nebula were better defined and distinct, although the Deep Sky filter gave better dark lane views. The globules were not seen at all, and the secondary dark lane was seen with difficulty. The whole image was very dark.

Summary:

No filter	The nebula was seen with averted vision, but with little detail.
Deep Sky	The nebula was seen with direct vision, and dark lanes were seen with averted vision.
UHC	The nebula was seen with direct vision, dark lanes were also seen with direct vision; dark globules were visible as well.
O III	The nebula was not seen, as the view was too dark.
H-Beta	The nebula was seen with direct vision, but the whole view was dark.

Computer Subgroup Report

The Computer group met at Kurt Hillig's house; five members attended. The prime topic for discussion was on computer control of telescopes. Roger is currently working on an equatorial mount for his 17" scope, but he's found that it's hard to accurately polar-align something this big – at least if it's to be portable and not permanently mounted. However, given that computing power is inexpensive these days, it should be feasible to have a computer correct for alignment errors and keep the scope tracking. What this requires is a good way of determining the scope's position,either with a good set of angular position encoders on the RA and Dec axes, or in an open-loop fashion by counting steps for a stepping motor drive system.

In either case, the alignment error could be calibrated by sighting in on a small set of known target stars and having the computer measure their apparent positions. It could then calculate the proper motion around the axes needed to find and/or track any object; alternatively, by keeping track of where the scope is pointing it could provide an accurate position readout to help pinpoint unknown objects.

The drawback to the open loop method is that it only works if the scope is only moved by using the motors; it's hard for someone used to a conventional mount to resist the urge to nudge the scope by hand. On the other hand, with stepping motors it's easy to program the scope to point anywhere in the sky. Combine this with a CCD camera, and you can do your astronomy without going outside! Encoders, on the other hand, will indicate the position regardless of how the scope gets there, but the control software to use these with DC servo motors is considerably more complex. The best solution is to use both encoders and stepping motors, if you can afford them.

We went on to kick around more ideas about the long-term project to computerize the 24" McMath scope, but the discussion drifted toward the mechanical side (how to hook up an RA slew motor, proper lubricants for the worm gear, how to attach the encoders to the RA and Dec shafts, etc.). The computing part of this will have to wait until we can get Steve Musko to come to a meeting, as he's been working on that side of things.

The next Computer group meeting will be held at the home of Roger Tanner in Canton, at 7:30 PM on Monday November 2, 1992 (note the changed date!). On the agenda: more on digital telescope control, led by Roger (who hopes to have his new scope drive system running by then) and by John Laffitte (who's already gotten one to work). Also, we hope to have more information on local dial-in access to UseNet News. For more information or directions, call Roger Tanner at 981-0134.

WELCOME to our newest member!

Mira Christina Nelle, born October 3, 1992

Status Report on the McMath Telescope

Two months ago, we installed the optics in the newly-renovated McMath 24" telescope at the Peach Mountain Observatory (*Reflections*, Aug. 1992). That night it was discovered that the lower polar axis bearing block had slipped in its mount, and the RA drive was jammed.

Later that month, the scope was repositioned and a retainer plate was installed to keep it from slipping again; the RA drive was checked and found to work properly.

After the September meeting, a large group of both old and new members headed up to Peach Mountain for some training on the care and feeding of the scope (and some star gazing once we were checked out). D.C. Moons played the part of drill sergeant, as he ran us though the checklist (which he promises will be ready in printable form for next months *Reflections*). However, after several hours both the RA drive and DEC slew drive stopped working.

Stu Cohen went out a week later and got the DEC drive working – it was just a wire that had pulled loose – but found that the RA drive problem was mechanical. During the renovation of the scope, a pipe had fallen from the observatory roof and had hit the edge of the four-foor worm gear of the RA drive, denting three of its teeth.

On October 3, Tom Ryan and Kurt Hillig repaired the damage by scraping the teeth, a few thousandths of an inch at a time, until they ran freely through the worm. We believe that the effect on tracking accuracy will be negligible; as far as we can tell, all that's left to fix is the optical alignment.

ASTEROID'S ORBIT "CLOSES IN" ON EARTH

One of the largest near-Earth objects, the asteroid Toutatis, will make a close Earth approach on Dec. 8, 1992, passing by at about 3.6 million kilometers distance.

Dr. Donald Yeomans, Head of the Near Earth Object Center at NASA's Jet Propulsion Laboratory, Pasadena, Calif., said the object, formally known as Asteroid 4179 Toutatis, passes Earth less than one degree above Earth's orbital plane every 4 years, making it an excellent object for study. The asteroid, at 3.5 kilometers diameter, is one of the largest to cross the Earth's orbit on a regular basis.

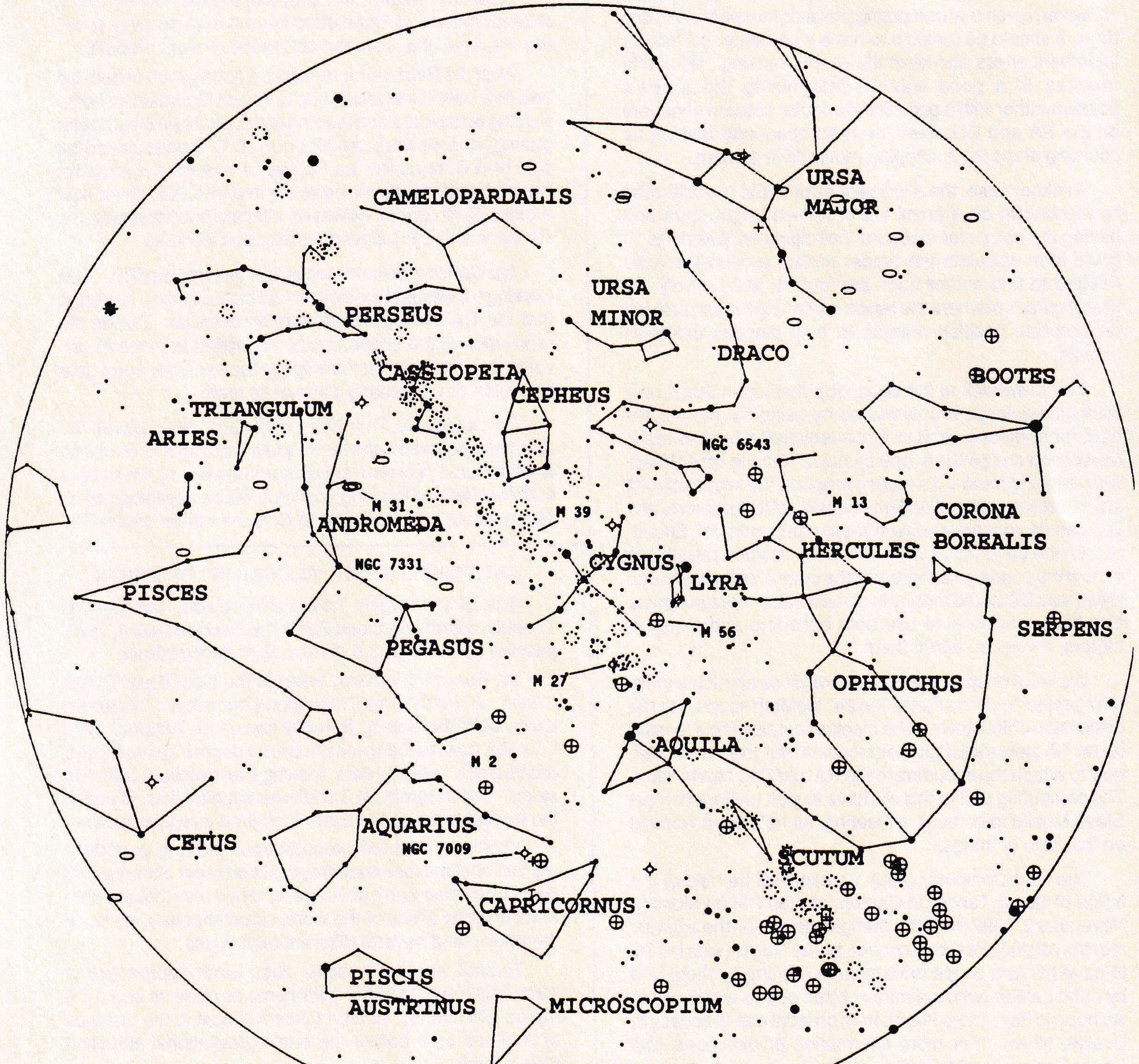
Yeomans said the ground-based viewing conditions will be excellent for infrared optical and radar observations during the close Earth passage, and he notes that astronomers in many areas of the world simultaneously will study the body using several different techniques.

Toutatis again will make close Earth approaches in 1996 and 2000. In 2004, it will come as close as about 1.6 million kilometers. Its orbit takes it almost to the distance of Jupiter's orbit before the sun's gravitational attraction pulls it back.

The approach of Toutatis this year and the one in 2004 represent the two closest Earth passages of any known asteroid for the next 30 years, said Yeomans.

Toutatis was discovered Jan. 4, 1989, by Astronomer Christian Pollas at Caussols, France, and was named after a Gallic deity called "protector of the tribe."

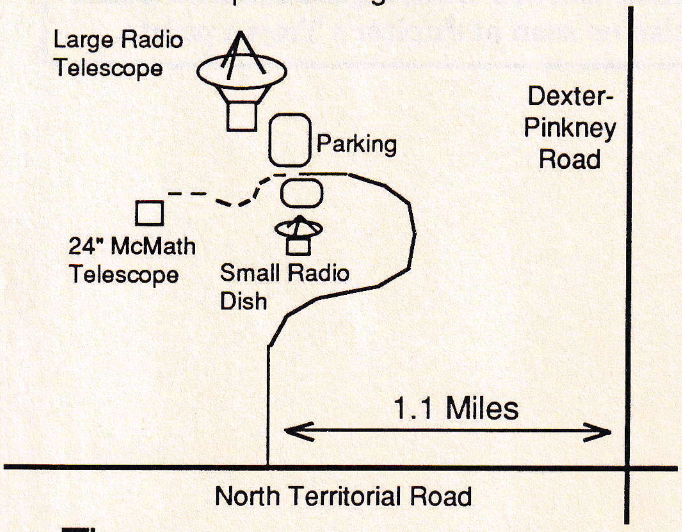
Star Chart for October 17, 1992 10:00 PM EDT



☞ Places:

The Detroit Observatory is in Ann Arbor, at the corner of Observatory and Ann Streets, across from the old University of Michigan hospital and between the Alice Lloyd and Couzens dormitories. The Detroit Observatory is an historic building which houses a 19th century 12-inch refractor and a 6-inch transit telescope.

The Peach Mountain Observatory is the home of the University of Michigan's 20-meter radio telescope, and the McMath 24-inch telescope maintained and used by the Lowbrows. The observatory is located northwest of Dexter; the entrance is on North Territorial Road, 1.1 miles west of Dexter-Pinkney Road. A small maize and blue sign marks the gate. Follow the gravel road one mile to a parking area near the radio telescopes. Walk along the path southwest (between the two fenced-in areas) about 300 feet to reach the McMath telescope building.



☞ Times:

The monthly meetings are held on the third Friday of each month at 7:30 PM at the Detroit Observatory. During the summer months, and when weather permits, a club observing session at Peach Mountain will follow the meeting.

Public Open House / Star Parties are held on the Saturdays before and after each new moon at the Peach Mountain Observatory. Star Parties are cancelled if the sky is cloudy at sunset – call 426-2363 to check on the status. Many members bring their telescopes; visitors are welcome to do likewise. Peach Mountain is home to millions of hungry mosquitos – bring insect repellant, and wear warm clothes, as it gets cold at night!

☞ Dues:

Membership dues in the Lowbrow Astronomers are $20 per year for individuals or families, and $12 per year for students. This entitles you to use the 24" McMath telescope (after some training). Dues can be paid to the club treasurer, Ron Avers, at a meeting or by mail at this address:

9394 Anne
Pinckney, MI 48169-8912

☞ Magazines:

Members of the Lowbrow Astronomers can get a discount on these magazine subscriptions:

Sky and Telescope: $20/yr
Astronomy: $16/yr
Odyssey: $10/yr

For more information, contact the treasurer.

❒ Sky Map:

The sky map in this issue of *REFLECTIONS* was produced by Doug Nelle using *Deep Space 3D*.

✎ Newsletter Contributions:

Members (and non-members) are encouraged to write about any astronomy-related area in which they are interested. Please call the newsletter editor (Kurt Hillig, 663-8699) to discuss length, format, etc. Announcements and articles are due 14 days before each monthly meeting. Contributions should be mailed to Kurt Hillig, 1718 Longshore Dr., Ann Arbor, MI 48105.

☎ Telephone Numbers:

President:	Stuart Cohen	665-0131
Vice Pres:	Doug Nelle	996-8784
	Paul Etzler	426-2244
	Fred Schebor	426-2363
	Tom Ryan	662-4188
Treasurer:	Ron Avers	426-0375
Observatory:	D. C. Moons	254-9439
Newsletter:	Kurt Hillig	663-8699
Membership:	Steve Musko	426-4547

Peach Mountain Keyholder:

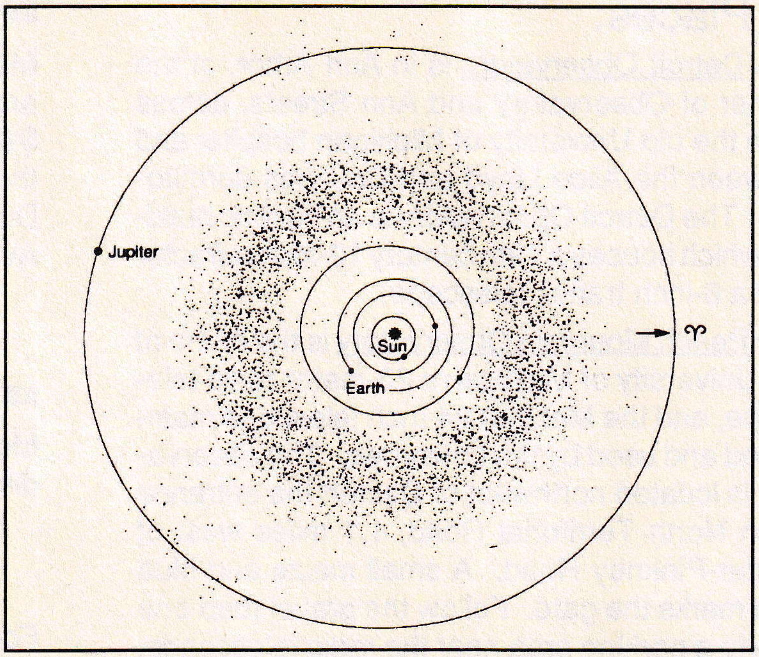
Fred Schebor 426-2363

Monthly Meeting:

A Report on AstroFest 92 by our own Fred Schebor

October 16, 1992 at 7:30 PM

At the
Detroit Observatory in
Ann Arbor



A plot of the inner solar system showing the positions of the 5011 known asteroids. 12 can be found inside Earth's orbit; higher concentrations can also be seen at Jupiter's Trojan points.

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