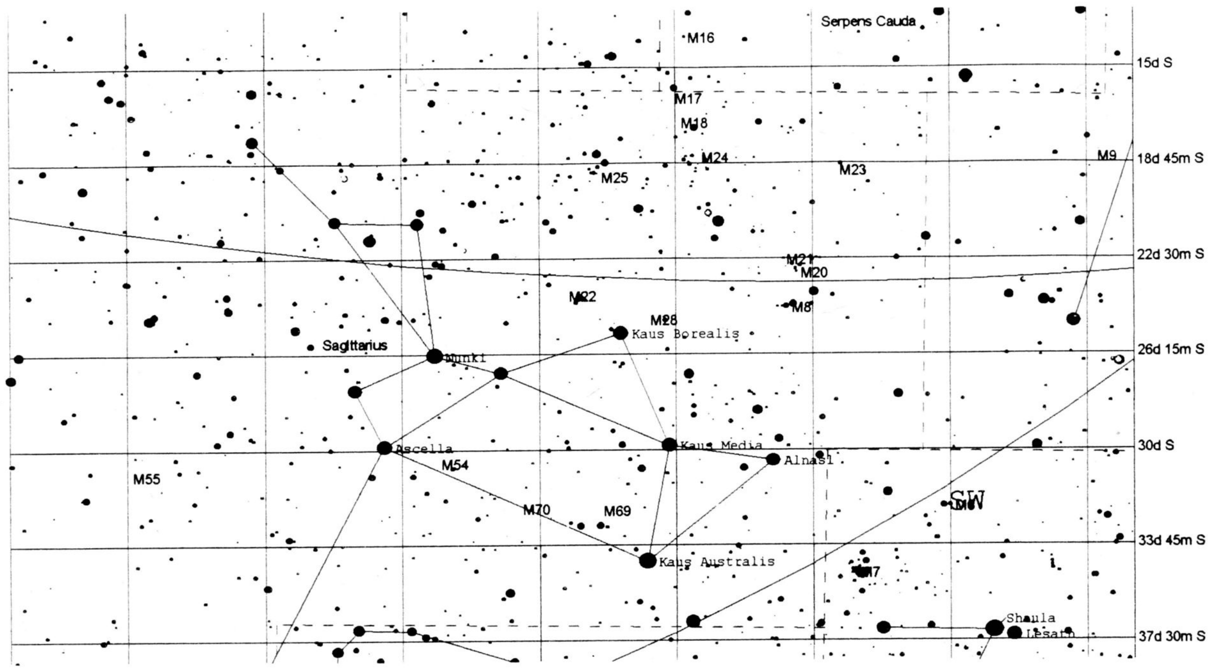
REFLECTIONS REFLECTIONS

September 1997



The University Lowbrow Astronomers

is a club of enthusiasts which meets on the third Friday of each month in the University of Michigan's Physics and Astronomy building (Dennison Hall, Room 807). Meetings begin at 7:30 PM and are open to the public. Public star parties are also held twice a month, weather permitting, at the University's Peach Mountain Observatory on North Territorial Road (1.1 miles west of Dexter-Pinkney Road; see inside for directions) on Saturday evenings before and after the new moon. The event may be cancelled if the sky is cloudy. For further information, call (313) 480-4514.

This Month

Sept 6	Open house at Peach Mountain.
Sept 13	" A Night on Peach Mountain "
Sept 19	Meeting at 807 Dennison. Astrofest Talk and Slides
Sept 21	ATM meeting. Time and location TBA.
Sept 27	Open house at Peach Mountain.

Next Month and Beyond

October 4	Open house at Peach Mountain.
October 11	Leslie Science Center Open House
October 17	Meeting at 807 Dennison. Speaker TBA.
October 19	ATM meeting. Time and location TBA.
October 25	Open house at Peach Mountain.
November 1	Open house at Peach Mountain.
November 21	Meeting at 807 Dennison. Speaker TBA.
November 23	ATM meeting. time and location TBA.

JUST SMURFY!

by Doug Scobel

On August 6th and 7th, I attended the Southern Michigan Unorganized Regional Festival of Stargazers, otherwise known as SMURFS. SMURFS is an annual star party, sponsored by the Genesee Astronomical Society (GAS), at a remote site near Hillman in northeastern lower Michigan. The event is held at a former landing strip (owned by the family of a GAS member) located north of Mio and west of Alpena. It is advertised to provide the darkest skies available in the lower peninsula.

The event was attended by I would guess well over a hundred people. Lots of people from the Ford Amateur Astronomy Club (FAAC), Warren Astronomical Society (WAS), GAS, and others, but very few Lowbrows. Only myself and Doug Bock (who was there with his family, and this was just a pit stop on their way to the Nebraska Star Party). It was held August 6 through 10, Wednesday through Sunday morning, but I had to leave Friday due to other commitments.

The event is very informal. No talks. No flea market. No vendors. No accommodations. Just a large field on which to camp and set up your telescope, a single 40 amp circuit feeding a spaghetti maze of extension cords, and a single faucet providing water you can draw and carry to your campsite. For showers, they set up an old, rusty shower stall just inside the woods, with a couple of old shower curtains hung in strategic locations for privacy. They ran a water hose into a thirty (or so) gallon steel tank that was painted flat black, and then another hose from the tank to the shower stall. The shower head was a hand held garden sprayer propped up in the corner of the shower stall. After sitting in the sun for a couple of hours, the water in the black tank warmed up enough to provide a nice, warm shower.

The sky was clear as a bell Wednesday morning and throughout the three and a half hour drive, and I was anxiously hoping it would remain so that night as well. After popping up the camper and setting up the telescope, I wandered around looking for anyone I might know. Nope, no one familiar, but I introduced myself to some very nice people from the Ford club who were set up nearby. We just sort of hung out, waiting for nightfall, which seemed to take forever to arrive. But when it did, we were not disappointed.

In a word, the skies there are indeed DARK. Certainly darker than any I have seen down here. The Milky Way looks like someone took a can of white paint and splashed it up across the starry dome. The Great Rift isn't just a suggestion, it is a distinct, black, chasm, dividing the galaxy in two. Numerous bright and dark knots are obvious along its entire length. Elsewhere in the sky, so many more faint stars are visible that it makes it a little difficult to make out some of the constellations. I often found myself simply looking up at the sky naked eye, just to take in all the beauty.

With optical aid, things get even better. Through 10 x 50 binoculars, the North American nebula was easily seen, and so was the low surface brightness galaxy M33 in Triangulum. I even saw the Veil nebula in binoculars and in my 8 x 50 finderscope.

But the views through the 13 inch were what really blew me away. Everything looked better. Just as more fainter stars were visible naked eye, so were more visible through the telescope. Sweeps through the Milky Way were much richer in the number of visible stars. Even globulars looked better, such as M13 and M92, since more faint stars were visible, particularly in the outlying regions.

Low surface brightness objects showed the most improvement. M51, also known as the Whirlpool galaxy, showed its spiral arms WITHOUT AVERTED VISION! You could just look right at them and there they were, staring right back. M101 and M33 also plainly revealed their spiral patterns, M31, the great galaxy in Andromeda, showed two dust lanes, where I have only seen one previously. I was also able to see some other very low surface brightness galaxies in the Caldwell list (such as NGC 6822, or Barnard's galaxy) that had eluded me up to then. While looking low in the northwest at M100, another face on galaxy, the sky background looked brighter and the contrast was poor. I looked away from the eyepiece expecting to see some hazy clouds, but was surprised to see an aurora instead. It only extended about 30 degrees above the northern horizon, and wasn't particularly bright, but enough so to hinder deep sky views in that area.

Bright diffuse nebulae, such as M17 (the Omega nebula), M8 (the Lagoon), and M20 (the Trifid) looked almost as good without a filter as they do down here with one. And with an OIII filter, the view was incredible! For instance, the dark lanes in the Trifid looked like someone had drawn them in with black ink, the contrast was so high. The nebulous part of the Eagle nebula (M16) was seen without a filter, where it has always been invisible without one down here.

But it was the Veil nebula in Cygnus that was the star of the show. (Actually, it's the show of the star, after it blew up a few tens of thousands of years ago.) With an OIII filter it has always looked great, but this defied description. The filaments and striations throughout this supernova remnant looked exactly like the photographs you have seen (excepting maybe those from Hubble - but just maybe). All the fainter wisps throughout the area that have been hinted at previously were now obvious. The bright, narrow portion of the nebula that passes through fifth magnitude 52 Cygni looked just like the nebula's namesake. I could have spent the whole night just looking at this one object.

I spent the rest of the night reviewing low surface brightness favorites, and picking off a few Caldwell objects that had previously eluded me due to the poorer skies I've been observing under. I had fully intended to stay up all night, but the Mountain Dew didn't seem
to be doing the trick and I ended up turning in around 3:00. Tomorrow would be another night I mumbled to myself as I stumbled to the camper. To my horror and disgust, the next morning I found out I had been drinking CAFFEINE FREE Mountain Dew. No wonder! You IDIOT!!
AAARRRGGHH!!!

Thursday morning it was still crystal clear, but as the day went on the clouds rolled in. There would be no observing tonight. Unfortunately, I had to leave Friday morning, so I never got another chance. In speaking later with others who stayed, there was some clearing Friday night and Saturday night was clear again.

If you are interested in doing some deep sky observing under really dark skies, I urge you to consider SMURFS next year. I should warn you though, you might get spoiled. Deep sky observing in southeast Michigan will never be the same.

- SMALL COMETS FAQs -

http://smallcomets.physics.uiowa.edu

Some time in mid-summer I heard a TV report about "mini-comets" pelting the Earth at rates that were mind bogling - every minute or so an "ice ball" impacts the Earth's upper atmosphere and deposite a quanity of water vapor 50 km up. The discover of these cometary objects was Dr. Louis A. Frank a Space Physicist from the University of Iowa. Ever on the look out for a scoup on astro related articals for the Reflections I managed to find Dr Frank's E-mail address and decided to drop him a line and request some info. Well it seems Sky & Telescope got the scoup first and thier artical appears on page 29 of the August issue (check out their artical and then come back to this one.) I did get a response from Patrick Huyghe, co-author with Dr. Frank's book The Big Splash Published by Birch Lane Press, 1990. Below is a "shortened version"of FAQ on small comets and info on how Amature Astronomers can even see these objects - that is if you believe in this therory. (submitted by Chris Sarnecki)

What is the difference between these small comets and the large comets like Hale-Bopp and Halley's?

The small comets are a million times smaller than these more famous comets. The small comets also contain little dust and lack the iron and other metals necessary to make them glow brightly and produce a tail like the larger comets. But what they have in common--and the reason they were dubbed "small comets"in the first place--is that they are both largely made of water.

Why hasen't the space shuttle and our satellites been

hit by these small comets?

In low Earth orbit, where the space shuttle flies, astronauts can expect to run into the cometary water clouds from the small comets once in every 200 orbits. At the shuttle's altitude a small comet has already disintegrated in a cloud; it is no longer a solid object and the collision with a cloud is benign. So the astronauts have probably flown through these things and not known it. But at high altitudes, an impact of a spacecraft with a small comet would be disastrous. Since these comets are small and the collision frequency is low, an average-sizes spacecraft would only be struck once in every 50,000 years or so. This means that one spacecraft in every thousand will be struck in high Earth orbit every 50 years. Has it happened yet? No one knows. But some spacecraft have been lost and no one knows why.

Why hasn't the Spacewatch Telescope seen the small comets?

It has. In 1988, Clayne Yeates, the late Jet Propulsion Laboratory physicist and science manager for the Galileo project, used the Spacewatch Telescope in a "skeet shooting" mode to obtain some stunning optical images of very faint streaks from the small comets. The objects he photographed had the same motion in orbit, the same speed, and were about the size, darkness, and frequency as the atmospheric holes themselves, or could be deduced from the known characteristics of atmospheric holes. Reference: L.A. Frank, J.B. Sigwarth, and C.M. Yeates, "A Search for Small Solar-System Bodies Near the Earth Using a Ground-Based Telescope: Technique and Observations," Astronomy & Astrophysics, 228, 522, February 1990.

How long have the small comets been bombarding the Earth?

We do not know. But if the present influx of small comets is assumed to be true for the past 4.5 billion years as well, then the small comets may be responsible for all the water in the oceans and in our atmosphere.

How do we know that these objects are depositing water in our atmosphere?

This startling conclusion comes from trying to account for the presence in the images of the "atmospheric holes," those dark spots where the ultraviolet dayglow has been absorbed overareas of 50 to 100 km in diameter. This is a large area and requires a lot of material. For the wavelength range viewed by the Polar and Dynamics Explorer cameras, water is the only common gaseous substance in the solar system that can efficiently absorb the dayglow along the line-of-sight of the cameras. No one has ever offered an alternative mechanism or substance. The absorption cross section of the water molecule is large and very well known. The total water cloud mass is still large, in the range of 20 to 40 tons. In addition, one of the Polar cameras for visible wavelengths was used to independently verify that the objects contained large amounts of water by viewing the intensities of OH radical emissions at 308.5 nm, which is the standard proxy for water in the studies of large comets. The OH is produced by the dissociation of water molecules in the sun's light and the OH radical fluoresces very brightly in the sunlight. This finding is a great achievement and is beyond the capabilities of any other camera flown to date. There is a large amount of water in these cometary gas clouds. The final closure was provided by the remarkable fact that the frequency of the OH trails is very similar to the occurrence frequency of atmospheric holes.

How much water do the small comets add to the Earth's surface?

At a rate of one 20-to-40 ton comet every three seconds, this influx of small comets into the atmosphere would add about one inch of water to the Earth's surface every 20,000 years or so. The implications of this added water for long range global climate, global warming, and pollution mitigation will need to be examined by the experts in those fields.

The amount of water added to the atmosphere by the small comets seems to conflict with well-established evidence that the stratosphere is extremely dry. How can you explain this?

The influx of water into the stratosphere from the small comets is insufficient to provide a "wet" stratosphere. The problems lie in the lower thermosphere and upper mesosphere. Simple models of water transport by eddy diffusion could not support the cometary water influxes if the upper boundary were taken above these regions. But the small comet's momentum carries the water into the mesosphere and thus provides a low percentage of water vapor in the atmosphere. This effect could accommodate the cometary water influx into the atmosphere without exceeding the known densities. To date no one to my knowledge has used such a source term in the standard atmospheric models. Below the menopause at about 50 miles there is a general pattern of atmospheric circulation that extends into the troposphere. The cometary water would be carried in this circulation pattern. The stratosphere is dry because the "cold finger" near the tropopause precipitates the water into the troposphere. This cometary "rainfall" is insignificant relative to the rest of the water being transported at these altitudes.

Are noctilucent clouds produced by small comets?

The influx of small comets into Earth's atmosphere can explain the composition and extreme height of noctilucent clouds. These strange and quite beautiful clouds can be seen over the polar regions during the summer months. They are thin clouds, wavy or banded, colored silver or bluish white. They form at an altitude of about 55 miles, in the coldest part of the upper atmosphere, a relatively unexplored boundary known as the mesopause. No other cloud occurs so high in the sky. They are called noctilucent clouds because they can only be seen against a dark sky when illuminated by the setting sun. These clouds require considerably more water vapor than can be expected from ocean evaporation. No one understands why these clouds exist. But rocket-borne experiments sent up by aeronomers--those who explore the upper atmosphere--to probe these clouds have shown that the clouds are composed of ice crystals formed around meteoric dust particles--a finding that suggests small comets might indeed be responsible.

Do the small comets contain organic material that may be responsible for seeding life on Earth?

The small comets may contain organic materials, though this is only speculation at the moment. If they do, they would seem to be ideal vehicles for carrying organics safely through the atmosphere; they do not burn up the way meteors do, and their icy interiors may protect the organics just long enough to slip safety to Earth on a cushion of water vapor.

Are all the small comets the same size? Is there any variation in their flux at the Earth?

The size of the "small comets" no doubt varies somewhat. Most are thought to be in the 20-40 ton range, but there will also be some even smaller comets--and some occasional larger ones. Some of these larger ones may be responsible for such things as anomalous ice falls that have been reported in the literature. And just as there are variations in the sizes of these objects, there have probably also been peaks and valleys in the influx of small comets on Earth over time.

Why do the small comets break up and turn into clouds of water vapor?

The small comets are giant, loosely packed "snowballs"with some kind of thin shell, made perhaps of carbon, that holds them together as they travel through interstellar space. But as they approach the electrically charged Earth, the electrostatic stress on these objects causes them to break up at an altitude of about 800 miles above Earth. Rapid electrostatic erosion appears to be the mechanism responsible for stripping the thin protective mantle from the water-snow core of a small comet. By the time the fragments of the comet have descended to about 600 miles, the "snowball" fragments have been vaporized by the Sun's rays.

Could the water vapor from the small comets account for the "fireflies" that John Glenn and other astronauts saw on the early orbital missions?

No. By the time of Scott Carpenter's flight three months later, NASA had determined that those brilliant little specks floating around outside the spacecraft were caused by tiny ice crystals fluttering out from beneath the rippled heat shingles of the Mercury capsules.

Do the small comets also impact the Moon? If so, where are these impacts and why don't we see dust clouds on the moon when the comets hit? Why didn't the Apollo seismometers record their impacts? Where is all the water on the Moon?

If you remember that the small comets are like fluffy snowballs--not rocks--the Moon does not present a problem to the existence of small comets. It's the difference between throwing a rock at your car and a snowball; one will leave a permanent mark, the other will not. Because the Moon is one thirteenth as large as the Earth it should receive about thirteen times fewer objects than the Earth. But the seismometers that were set up on the Moon during the Apollo missions recorded only about 2,000 events a year. How to account for this apparent discrepancy? The small comets do impact the Moon, but the seismometers were calibrated by looking at the seismic signature of everything from nuclear explosions to bullets shot into loose sand. No one ever worked out what effect a large snowball would have on the lunar surface. The small comets that strike the Moon will not make impact craters;they probably kick up some lunar dust and produce strange glows, and indeed these kinds of anomalous events have been reported by lunar observers for centuries. It is the seismometers' lack of sensitivity to the impact of small comets that accounts for the discrepancy in the low number of large objects detected on the Moon relative to the number of such objects that are seen falling into Earth's atmosphere. But if small comets strike the Moon, where is all the water then? The lunar gravity is such that practically all the water vapor from the impact of small comets simply flies off, though some ofthe water molecules may wander around and eventually condense in the crevices near the poles--exactly where it has been reported of late.

Can the small comets help resolve the long standing controversy about the difference in impact rates on the Moon and into the Earth's atmosphere?

Yes, there is a well known discrepancy between the number of objects of a given mass which are impacting Earth's atmosphere as inferred from fireballs in the atmosphere and the number of objects of similar mass as detected by the Apollo seismic network. Even taking in account the fact that the Moon is smaller than the Earth, the number of objects impacting the Moon has been found to be considerably less than those in our atmosphere. This major discrepancy has never been resolved, but the flux of small comets provides the solution to this problem. Because there is no dust in these small comets, their glow in the atmosphere must be estimated from the heat they produce when they hit the atmosphere at supersonic speeds. We have roughly estimated the visual magnitudes of the impacting small comets and find them to be in the range of -2 to -4. Remember, of course, that solar radiation is not available on the nightside of Earth to produce a large water vapor cloud as it does on the dayside where the atmospheric holes are observed. The number of fireballs in Earth's atmosphere with a visual magnitude of -2 is in the range of about 10,000 to 100,000 for each 24 hour period, according to D.W. McKinley, in Meteor Science and Engineering (McGraw Hill, 1961). And so the small comets do help explain the difference in the number of observed impacts on the Moon and in the Earth's atmosphere.

If the small comets are hitting Earth and the Moon, shouldn't they also be impacting the other planets in the solar system?

They do. But few small comets will survive inside the Earth's orbit because they will be destroyed by the Sun's heat. So there will be no small comets for Mercury, and maybe just a few for Venus. But the rest of the planets and their moons do get pelted by the small comets. While Earth gets about 10 million smallcomets a year, Mars receives less than a million and a half, Jupiter gets 16 billion,Saturn gets 4 billion, Uranus gets 260 million, Neptune gets 300 million, and Pluto only about 500 thousand a year. If the ice is not visible on the surface, as is it for many planetary moons, then the water and ice from the small comets probably lies beneath the planet's surface.

Where do the small comets come from?

The small comets do not come from the Oort cloud located far beyond the orbits of the planets, but from an inner belt of cometary material beginning just beyond the orbit of Neptune. To explain the constant bombardment of the Earth by small comets, a large, dark, as-yet-undiscovered planet must be regularly passing through the outer part of this comet belt where the small comets are thought to be located. The eccentric orbit of this dark planet is speculated to cross the comet belt once every 26 million years or so, sending swarms of small comets streaming into the inner solar system and toward the Earth itself.

Can the small comets be seen by the naked eye?

Yes, but you will need lots of patience--and a little luck. Too see a small comet you must stand out on a clear dark night until you see a short streak that quickly snuffs out. It will be about the brightness of Venus for about two seconds before it vanishes. But you will have to be out there for a hundred hours or so to see one. A hundred hours of clear night viewing does not happen often in the average lifetime.

How can amateur astronomers spot the small comets?

Amateur astronomers whose telescopes have mirrors or lenses measuring 12 inches or larger should be able to sight the small comets. During the course of a day there are two times for observation, each about one or two hours long. One ends about 45 minutes before sunrise; the other begins about 45 minutes after sunset. The small comets will be seen at a distance about 2,500 to 4,500 miles from the observer,so the telescope should be pointed in such a way that it is looking for them at these distances, just outside the Earth's shadow. Inside the shadow the objects are not illuminated by the Sun and are invisible. Every two hours or so a small, quite dim object will slowly move across your view, as long as your field of view is about four times the size of the Moon. The object will move at a distance equal to the Moon's diameter every five seconds or so. Several amateur astronomers have reported seeing such objects.

How do the new results from NASA's Polar satellite confirm the original Dynamics Explorer images from a decade ago showing "holes" in the atmosphere?

There is no question that the Polar images confirm the previous Dynamics Explorer observations of atmospheric holes. This includes the dimensions of the holes, their frequency of appearance over the sunlit atmosphere, and their east-to-west motion

across the sunlit atmosphere. The Polar detections are approximately several thousand per day and, accounting for viewing and image accumulation times, give a global rate in the range of 5 to 20 per minute. The database consists of 50,000 to 100,000 direct detections per month as clusters of darkened pixels. In many cases the holes are detected in consecutive frames, most are moving from east to west, and the effects of the camera platform motion (double vision) are present when the instrument computers do not compensate for this latter effect. The verification of the existence of atmospheric holes is completely secure.

How are the altitudes of the small comet trails in the Polar images calculated?

The approximate altitudes of the trails are determined by the apparent lengths of the trails between shutter closings of the camera and the fact that the apparent speed of the objects is about 10 km/s. Generally, the shorter the trail, then the greater distance between the trail and the Polar spacecraft.

C/1997 N1 (Tabur)

Last Updated: 25 July 1997

Reported observations:

1997 July 3.77 UT: m1=11.5, Dia.=2', DC=2...20cm L (76x)...Albert Brakel
(Canberra, Australia). [Slightly condensed, no tail visible. Moved about
2' in 30 minutes]
1997 July 6.92UT: m1=10.0, Dia=1.6',DC=4...20cm refl(x45)...Andrew
Pearce (Subiaco, Western Australia)[Coma moderately condensed with
fainter outer perimeter. Comet's position (2000 coords) RA 5h 18.5m -25 deg 32m]
1997 July 7.91 UT: m1=10.2, Dia=1.8',DC=3/...20cm refl(x45)...Andrew
Pearce (Subiaco, Western Australia)
1997 July 8.91UT: m1=10.4,

Dia=1.6',DC=3/...20cm refl(x45)...Andrew Pearce (Subiaco, Western Australia)
***1997 July 9.85UT: m1=10.5, dia=3',DC=2...20cmL(x44)...Michael Mattiazzo(Adelaide, South Australia)[Rather diffuse object with no visible tail]**
1997 July 10.91UT: m1=10.4, Dia=2.0',DC=4...20cm refl(x45)...Andrew Pearce (Subiaco, Western Australia)
1997 July 11.91UT: m1=10.3, Dia=2.0',DC=4...20cm refl(x45)...Andrew Pearce (Subiaco, Western Australia)
1997 July 12.85UT: m1=9.4, Dia=2',DC=4...20cmL(x44)...Michael Mattiazzo(Adelaide, South Australia)[DC and brightness have increased since July 9th observation. Conditions good.]
1997 July 13.85 UT: m1=9.6, Dia=2',DC=3...20cmL(x44)...Michael Mattiazzo(Adelaide, South Australia) [slightly hazy conditions.]
1997 July 14.91 UT: m1=10.0, Dia=1.5',DC=3/...20cm refl(x45)...Andrew Pearce (Subiaco, Western Australia)

C/1997 O1 (Tilbrook)
Last Updated: 2 September 1997

Reported observations:

1997 July 24.15 UT: m1=10.6:, Dia.=~2', DC=3 ... 20 cm L ... Alan Hale (Cloudcroft, NM) [low altitude (<= 10 deg), and fairly poor sky conditions; estimate has been corrected for extinction. NOTE: the position of the object I observed is consistent with an extrapolation from Gordon Garradd's data on IAUC 6705.]
***____**

Magazine Subscriptions :

As a member of the Lowbrows, you are entitled to substantial discounts on *Sky and Telescope* and *Astronomy* magazines. To qualify for the discount, however, you must submit all subscription requests through the club treasurer. Make the check payable to "University Lowbrow Astronomers."

The current magazine subscription rates are:

	Normal Rate	Club Rate	Savings
*Astronomy**	$34.95	$20.00	$14.75
*Sky and Telescope***	$36.00	$27.00	$9.00

*Club rate allowed on 1 or 2 year subscriptions.
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Charts: The Sky Astronomy Software

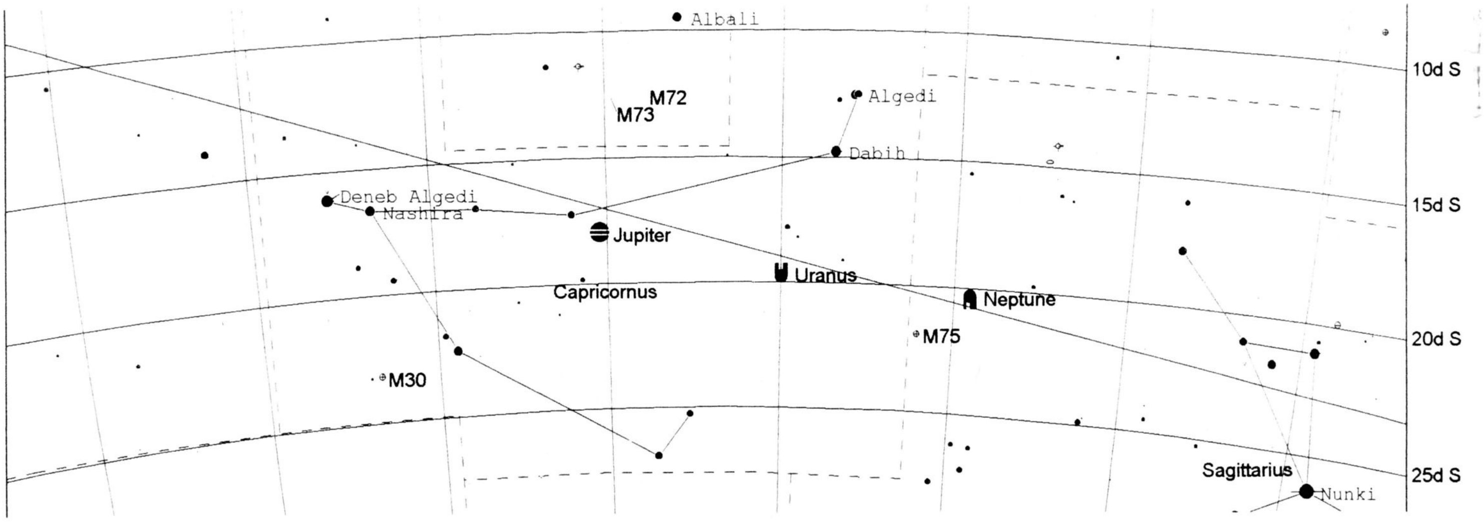
C/1997 N1 (Tabur)

Ephemeris

The following ephemeris is at intervals of five days. A daily ephemeris covering the same time interval is also available.

Check out recent magnitude estimates for this comet.

Date TT	R. A. (2000)	Decl.	Delta	r	Elong.	Phase	m1	m2
1997 09 19	12 58.64	+36 42.0	1.464	0.931	39.0	42.8	9.5	
1997 09 24	13 31.41	+37 59.2	1.489	1.026	43.4	42.2	10.0	
1997 09 29	14 03.84	+38 40.8	1.522	1.119	47.3	41.1	10.4	
1997 10 04	14 35.25	+38 51.4	1.564	1.210	50.7	39.8	10.8	
1997 10 09	15 05.10	+38 36.4	1.614	1.300	53.6	38.2	11.2	
1997 10 14	15 33.05	+38 01.7	1.673	1.388	56.0	36.6	11.5	
1997 10 19	15 58.94	+37 12.9	1.738	1.475	57.9	34.9	11.9	
1997 10 24	16 22.76	+36 15.3	1.811	1.560	59.4	33.3	12.2	
1997 10 29	16 44.62	+35 12.8	1.889	1.643	60.4	31.7	12.5	
1997 11 03	17 04.66	+34 09.0	1.972	1.725	61.0	30.2	12.8	
1997 11 08	17 23.05	+33 06.4	2.060	1.806	61.2	28.7	13.1	
1997 11 13	17 39.99	+32 06.6	2.151	1.885	61.2	27.4	13.4	
1997 11 18	17 55.64	+31 10.8	2.245	1.963	60.8	26.1	13.7	
1997 11 23	18 10.15	+30 19.8	2.342	2.040	60.2	24.8	13.9	
1997 11 28	18 23.68	+29 34.0	2.440	2.116	59.4	23.7	14.2	
1997 12 03	18 36.32	+28 53.8	2.539	2.191	58.5	22.6	14.4	
1997 12 08	18 48.19	+28 19.0	2.638	2.265	57.4	21.5	14.7	
1997 12 13	18 59.36	+27 49.7	2.738	2.338	56.2	20.5	14.9	
1997 12 18	19 09.91	+27 25.7	2.836	2.410	55.0	19.5	15.1	
1997 12 23	19 19.90	+27 06.7	2.934	2.481	53.7	18.6	15.3	
1997 12 28	19 29.39	+26 52.6	3.031	2.552	52.3	17.8	15.5	
1998 01 02	19 38.41	+26 43.2	3.126	2.621	51.1	17.0	15.7	
1998 01 07	19 46.99	+26 38.2	3.218	2.690	49.8	16.2	15.8	
1998 01 12	19 55.18	+26 37.4	3.308	2.758	48.6	15.5	16.0	
1998 01 17	20 02.99	+26 40.4	3.395	2.826	47.5	14.9	16.2	
1998 01 22	20 10.44	+26 47.2	3.480	2.893	46.6	14.3	16.3	
1998 01 27	20 17.55	+26 57.3	3.560	2.959	45.8	13.8	16.5	
1998 02 01	20 24.34	+27 10.8	3.638	3.024	45.1	13.3	16.6	
1998 02 06	20 30.81	+27 27.3	3.712	3.089	44.7	13.0	16.7	
1998 02 11	20 36.96	+27 46.7	3.782	3.154	44.4	12.7	16.9	
1998 02 16	20 42.81	+28 08.6	3.847	3.217	44.4	12.4	17.0	
1998 02 21	20 48.36	+28 33.1	3.909	3.281	44.7	12.2	17.1	
1998 02 26	20 53.60	+28 59.8	3.967	3.343	45.2	12.1	17.2	
1998 03 03	20 58.55	+29 28.7	4.020	3.406	45.9	12.1	17.3	
1998 03 08	21 03.18	+29 59.5	4.070	3.467	46.8	12.1	17.4	
1998 03 13	21 07.50	+30 32.0	4.115	3.529	48.0	12.1	17.5	
1998 03 18	21 11.50	+31 06.2	4.156	3.589	49.5	12.2	17.6	
1998 03 23	21 15.19	+31 41.8	4.192	3.650	51.1	12.3	17.7	
1998 03 28	21 18.53	+32 18.6	4.225	3.710	52.9	12.4	17.8	
1998 04 02	21 21.54	+32 56.6	4.254	3.769	54.9	12.5	17.9	



Monthly Meeting:

ASTROFEST
TALK and SLIDES

Sept 19, 1997
at
7:30 pm
Room 807 Dennison Building on the UM Campus

University Lobrow Astronomers
3684 Middleton Dr.
Ann Arbor, MI 48105

Check your membership expiration date on the mailing label!