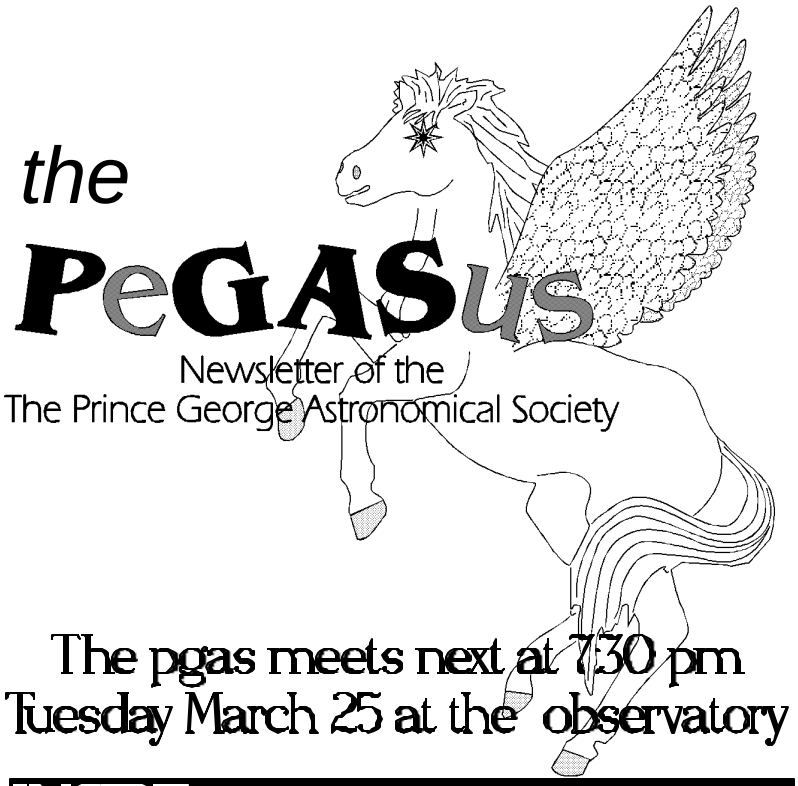
1997 MARCH ISSUE #73



the

PeGASus

Newsletter of the
The Prince George Astronomical Society

The pgas meets next at 7:30 pm
Tuesday March 25 at the observatory

INSIDE :

the PeGASus is published monthly by the *Prince George Astronomical Society*. Contributions to the newsletter are welcome.

Deadline for the next issue is April 18

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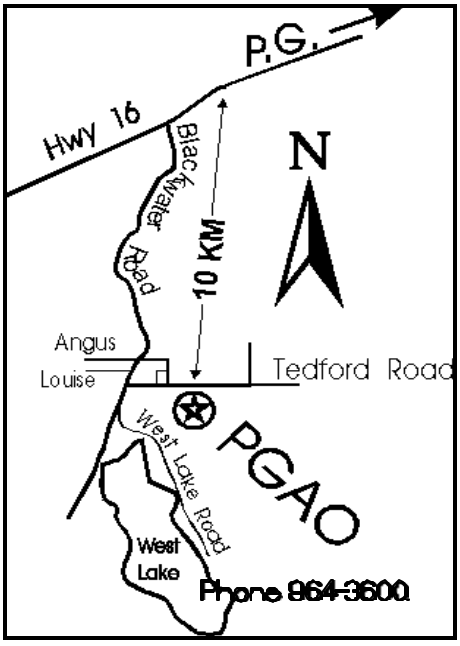

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Editorial

by Gil Self

Have you seen the comet ?

This is certainly a common question these days. We are once again in the middle of lucky circumstances this year. Last years comet won us many new friends and I expect this year to be even better. The many cold nights we spent greeting the public did not go unnoticed, the radio interviews the articles in the paper and not to forget the warm editorial in the Citizen. This may be the chance to finally never again hear "I didn't know we had an observatory in Prince George".

We are coming up on a schedule of openings that I expect we will be overwhelmed by the attendance. I remember those hectic evenings last year very well, so many eager people . Hot heads and partyiers don't usually venture out this far, so the folks we get are genuenlly curious and interested--just like us.

Our big weekend will be April 4-5-6 and I hope you can make it to help out. Even if you feel like you don't know enough you will be welcome.

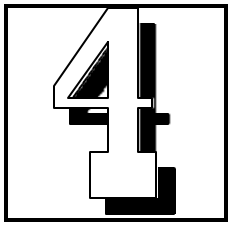
I have collected several short articles to help fill in the gaps on comet knowledge so you can have Hale-Bopp's details at your finger-tips. The first piece of good information- **this is a comet we can all spell and pronounce**.

We will again be offering photos of the comet for sale , but what I hear so far is maybe just one selected frame in various sizes to keep it a bit simplier.

There is a video at the observatory on comets we can run for people who are waiting to get up to the 24 inch and we can set up several small scopes outside .Perhaps we can demonstrate how to make magnitude and size estimates. One suggestion that has been made is not to have the 24 inch on the comet but rather on Mars, since it is close to oposition and very large, or the Orion nebula (always amazing). This would encourage people to view the comet outside on the small scopes where the view is much better and reduce the congestion on the observing deck.

Since we depend on the good will of the people and the businesses in our community for our continued operation, this is an oportunity to let more of those supportive people know we are here. We are entering an new era in our club, we must place much more effort in community relations , and treat every guest like he was the mayor out to decide if he will offer us a grant.

G.S.



Coming Events

If you are involved with any astronomical or otherwise scientific activity on behalf of the PGAS, please list the activity here.

March 20 -Vernal Equinox

March 25 -General meeting at the observatory

April 4,5,6 - Comet Weekend open to the public each evening

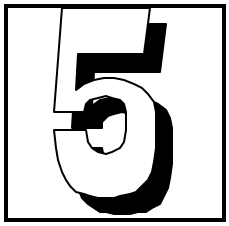
April 29 -General meeting at the observatory

Every Friday evening until the end of May we are open to the public

The Night Sky for March '97

by Bob Nelson, PhD

Well, every so often, spring threatens to make an appearance, then it's back to winter again. With spring equinox occurring this year on March 20 at 5:55 P.M. (PST), maybe we can pretend it's spring, even if the weather does not seem to reflect the calendar.



At the time of writing (Mar 18), it's mild out.

MERCURY, in Pisces, is at its best evening apparition for northern observers in March this year. At time of writing, it sets only about 30 minutes after the Sun does, but on April 6 (at greatest eastern elongation), it sets almost two hours after the Sun! Since the Sun is just past the ascending node, Mercury will be as high as possible in the sky for good evening viewing. Let's see if we can get some good photos!

VENUS, is on the far side of the Sun and is lost in its glare.

MARS, in Virgo, now rises at about 4:40 p.m. (local time) and sets at about 6:00 A.M.. It reached opposition on March 17 (St. Patty's day); but, as we mentioned before, this is an unfavourable opposition -- Mars only gets to be 13" in size (as opposed to some 24", as will occur on the opposition of 2003 August 12). So have a look at Mars, if you can stay up late, and perhaps around midnight, you'll see some interesting features. Unlike the favourable oppositions, where we see the south-polar regions, this time we should see the north pole.

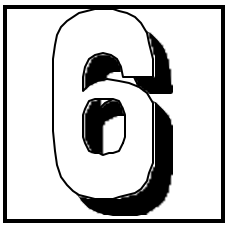
JUPITER, in Capricornus, is in the southeast at dawn (it rises at about 5:00 A.M.); its visibility in the morning sky will continue to improve as Earth catches up to it in its orbit.

SATURN, is lost in the glare of the Sun this month; it reaches conjunction on March 30.

URANUS and **NEPTUNE**, like Jupiter, rise at around 4-5 AM and are visible just before dawn.

Comet HALE-BOPP is getting better and better. It's now circumpolar and has been seen by many
of us in the northwest just after sunset. The following was taken from the Sky and Telescope bulletin for March:

"By most accounts, Comet Hale-Bopp (C/1995 O1) has reached magnitude 0.0, which means it is outshining Comet Hyakutake at its peak last year. And it's still three weeks until Hale-Bopp's perihelion on April 1st. Meanwhile, the comet is beginning its gradual slide in the east before dawn -- and beginning to poke above the northwest at sunset, especially for viewers at far northern latitudes [that's us!]. In fact, right now the comet never sets for those of you in Alaska or Scandinavia [or Prince George]. Hale-Bopp's gas tail can be glimpsed for some 20 degrees in
dark skies, and its dust tail is roughly half that long. To see Comet Hale-Bopp in all its



Hale -Bopp

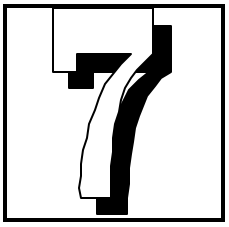
BY Gil Self

On **July 23 1995** two astronomers, within minutes of each other spotted an object near M-70 that they recognized as a comet. **Alan Hale** in New Mexico and **Thomas Bopp** in Arizona each reported it to The Central Bureau for Astronomical Telegrams and it was shortly announced as **"C/1995 O1** meaning -- this is the first (1),long period comet (c) in the second half month of July(letter O, the year is divided into 24 half months -Jan. is A and B, Feb. is C and D etc. ,I is left out and z is not needed.

This comet has a very peculiar orbit being almost perpendicular (89 degrees.) to the earth's orbit . About a year ago, mid-March 1995, the comet was passing through the planetary plane at about Jupiter's distance from the sun. During this last year, it has traced a great arc above the solar system. The comet is now heading back to intersect the plane of the ecliptic. At **7:30 p.m. PST on April 1**, the comet passes **perihelion** at a distance of .**91 AU** from the sun and it will be travelling at about **44km. per second.**

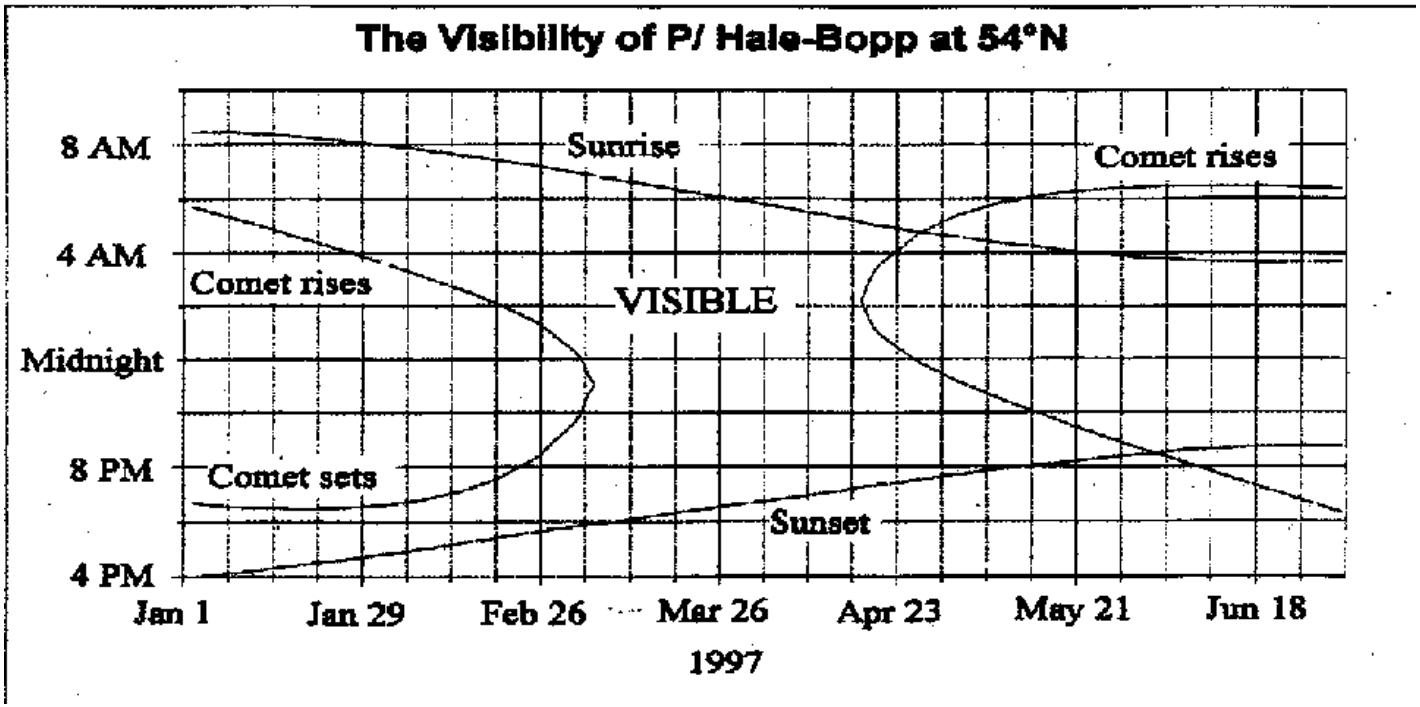
Due to early strong brightness measurements, there was much speculation in 1995-96 as to whether Hale-Bopp could keep up the strong start that it demonstrated as it entered the inner solar system. Many comets show strong emissions as they start to warm up while on their way to closest approach. Some comets fizzle early on- as the warming begins they shuck a lot of material. From early brightness measurements, determinations are made about the size of the comet. but by the time they have entered the solar system they have lost so much material that they are not the size it appeared they would be. For example. Comet Kohoutek, in 1973, blew off a large chunk of it's nucleus at about Jupiter's distance and by the time it reached the inner solar system, it was somewhat disappointing. Comet Hale-Bopp has not disappointed in any way. First passage comets often blow off a lot of loose material and also give false impressions of their size, Hale-Bopp has been around before (around 2214 B.C.) that's more than 4200 years ago. The comet's orbital period, however, has been affected by gravitational perturbations by the major planets. Calculations in late 1996 indicated that Hale-Bopp will return in 4377A.D. or 2380 years from now, although Kepler's Law shows the next appearance calculated from the orbital parameters should be 3977 years. These numbers will be refined shortly.

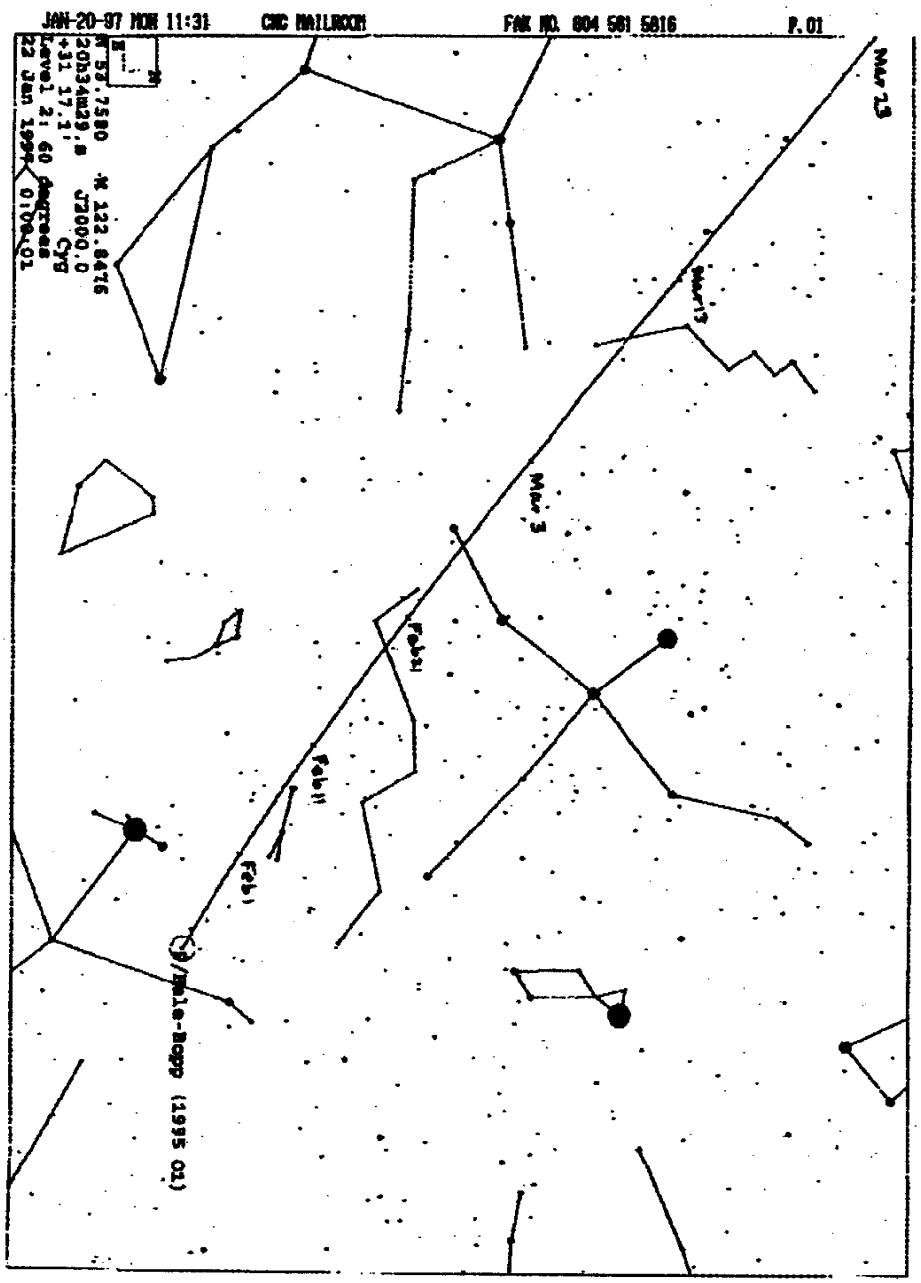
It must be remembered, when comparing this comet to last year's comet, Hyakautake, that although Hale-Bopp has an apparent brightness very close to what we saw mid-March 1996 of Hyakautake that Hale-Bopp is approximately 13 times further away. If Hale-Bopp made a similar close approach to the earth it would likely be visible in the daytime skies. This is a very bright comet.

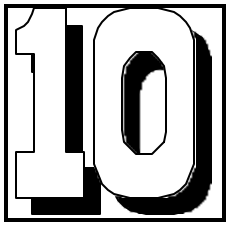


Another difference to take note of when comparing comets is that due to Hale-Bopps' orbital position, much of the tail is behind the comet nucleus and pointing away from the earth.
There were reports of 90 to 100 degrees of tail for comet Hyakutake (although this was probably a little optimistic), we certainly saw 70degrees of wispy tail at the PGAS Observatory. These measurements are somewhat subjective and depend a lot on sky conditions and the viewer's eyesight. With Comet Hale-Bopp, however, it would seem unlikely and we have yet to see a long wispy tail. What we do see, although somewhat more compact, is clear, bright and easy to see. The gas tail and the dust tail, under good skies, stand out quite easily covering up to about 30 degrees of sky at mid-March. On March 13th using the 24 inch telescope at the Prince George Observatory, over a three hour period, I observed what I will call multiple bow waves - a series of concentric rings with dark and light sections extending form the nucleus about four or five nuclear diameters. Early in the evening, I discounted this phenomena as atmospheric or optical aberrations. However, as the evening progressed, the image changed little and I was suspicious of my earlier conclusion. Later the same evening, I downloaded some photos taken at an Observatory on the East coast and saw the same bow waves.
They weren't aberrations, up close, the comet is putting on a very interesting display.

As the month progresses, and into April, the comet will reach it's peak brightness. This will probably be around April 1st. The comet is now circumpolar, it does not set until about the second week in April.
As the month progresses it will move slowly towards Orion in the Southern sky, passing the Pleiades around mid-April, and between Aldebaran and Capella near the beginning of May. The comet can easily be seen in the West under dark skies about 45 minutes to an hour after sunset. The best view, of course, would be away from city lights - which would give maximum contrast and enhance the detail in the tail. Late March and April viewing sees Hale-Bopp passing Cassiopeia in the constellation Andromeda. Cassiopeia is the "W" in the Northwest sky in March. The comet passes Capella in April. Capella being the very bright star in the Western sky at this time of the year . The other easy to spot star near the comet is Aldebaran, toward the horizon and not quite as bright as Capella, in the constellations Taurus. Another identifiable marker near this point is the Pleiades Cluster - a tight grouping like a little jewel box, of apparently 7 or 8 stars in the Western Sky. It has been suggested that this comet may be the best naked eye performance since Comet West in 1976. This could be debated due to the comet's extreme distance at it's brightest point. It is very likely that this will, in fact, be the brightest comet intrinsically (true brightness - not apparent brightness) in 400 years, since 1577 . There is no doubt that this will be the best observed comet in history simply because of the head start we all had with a great Comet last year and the long lead time for looking forward to this very special Comet.


The Visibility of P/ Hale-Bopp at 54°N
8 AM
4 AM
Midnight
8 PM
4 PM
Sunrise
Comet rises
Comet rises
VISIBLE
Comet sets
Sunset
Jan 1
Jan 29
Feb 26
Mar 26
Apr 23
May 21
Jun 18
1997


N 53.7580 W 122.8416
20h34m29.8s J2000.0
+31 17.1' Cyg
Level 2, 60 degrees
22 Jan 1997 0100.01
May 13
Mar 13
Mar 3
Feb 23
Feb 13
Feb 3
Hale-Bopp (1995 O1)



Five Dimensional Thinking

by Orla Aaquist

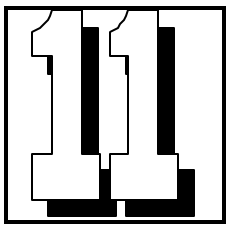
We are three dimensional creatures largely restricted to move on a two dimensional, spherical surface. We have a limited freedom to explore the third dimension by looking up, jumping or digging holes in the ground. Modern technology has given us the opportunity to jump higher and dig deeper holes; however, 99% of our waking life is still spent looking straight ahead, and few of us humans ever leave the surface of the Earth.

Supposedly, space goes on forever in all directions. That, at least, is the common impression. We don't believe that there is an edge to the universe because if there is an edge, then there must be something on the other side, which would be part of the universe. However, impressions are often wrong when you are stuck on a tiny planet in a small solar system, in an average spiral galaxy, in a small galactic cluster in the vast universe. For example, when you are stuck in a small town like Fort McMurray or Prince George, it is easy to come to the conclusion that the earth goes on forever. This especially seems true when you are trying to drive to someplace meaningful like Edmonton or Vancouver. However, because the earth is a sphere, it does not go on forever, nor does it have an edge. Similarly, it is possible for space not to continue forever and be without an edge.

The reason that the surface of the earth is finite yet has no edge arises from the fact that it's surface is a two dimensional sphere imbedded in three dimensional space. So, if our three dimensional universe was imbedded in a higher dimensional space, it too could be the shape of a sphere to a four-dimensional creature, and, hence, be finite yet have no boundary. One way to test this theory is to circumnavigate the universe.

We know about the curvature of the earth because we are three dimensional creatures; however, a two dimensional creature living in a two dimensional surface would have a hard time discovering the third dimension. One way to imagine the existence of such a creature is to construct, in your mind, a very large, thin membrane such as a soap bubble. The bubble itself may be made of atoms, but the atoms are restricted to move in the film because they define the film. If the atoms collect into molecules, and the molecules join into more complex structures, these structures will also be restricted to exist in the two dimensions of the film. We can imagine organisms (perhaps even intelligent ones) being constructed out of the fabric of this film (which, of course, is no longer made of soap molecules because our imagination has been stretched a little). The creatures would be able to detect vibrations of the film because their bodies are made from the film material; hence, they would 'see' waves propagating along the film's surface, but they would not be able to look up or down out of the surface. Their motion would be influenced by the curvature of the film, and they would detect such curvatures as forces; however, they would not be able to see the curvatures directly

because their senses detect information travelling along the sheet and originating in the sheet.



Can you imagine this two-dimensional creature? You, being a three dimensional creature, can observe this flatlander, but it cannot observe you as long as you keep your fingers away from the film. You probably have the power to pop the 'soap bubble', but you will have a hard time removing the two-dimensional creature from its universe. You cannot peal it off because it is made from the film material. Even if you did manage to remove a portion of the film without bursting the bubble, the portion removed would probably curl in on itself to form a tiny bubble, and the flatlander would curl up along with the film. The creature could never leave its two-dimensional universe and travel into the third dimension even though the third dimension completely surrounded it.

In a similar way, you are a three dimensional creature composed of the fabric of three dimensional space. The fourth spacial dimension surrounds you completely, yet you cannot see it or enter it for the same reason that the flatlander cannot leave it's two dimensional bubble. If a fourth dimensional being tried to pry you from your three-dimensional universe, it would have to remove a piece of the three-dimensional bubble. This piece would instantly curl in on itself and crunch your body in the process. Even if you survived the separation, you could not look out of the bubble any more than you could look into the fourth dimension before your removal. You would simply be trapped in a tiny, wierd looking universe all by yourself.

Einstein explained gravity as a curvature of four dimensional space-time. That is, the force of gravity is a purely geometric effect due to the curvature of three space and one time-like dimension. His theory of general relativity is one of the most successful theories in physics. Many physicists believe that the other forces of nature can be explained in a similar fashion by introducing more dimensions. Curvatures of five dimensions can, apparently, simultaneously explain the force of gravity and the electromagnetic force. According to the latest theory 10 dimensions are needed to include the strong and the weak nuclear forces.

To get a glimpse of how this unification may work, take another look at the flatlanders on your two-dimensional bubble. Localized curvatures of the film could be interpreted by the flatlanders as gravitational forces, while areas where the membrane is stretched or relaxed in the same direction as the film could be interpreted as electrical forces. Vibrations which alternately stretch and relax the membrane may be interpreted as electric vibrations (or light). Transverse waves travelling along the film (and oscillating into the third dimension) would represent gravitational waves.

If beings do exist in a higher dimension, remember that they can see everything you do. You cannot hide from them, just as the flatlanders cannot hide from you by building a two dimensional wall around themselves. Worst of all, they may be able to burst our bubble. O.A.

Recent Comet Brightness Estimates

(excerpts from ICQ web page)

Selected recent magnitude estimates as reported to the IAU Circulars and International Comet Quarterly for currently-observable comets are given below. (Definitions of the "magnitude" and other terms regarding comets are available.) Contributors of such observations for IAU Circulars should use the format below --- but send data in chronological order (not in reverse chronological order, as given below) and use carriage-returns for any data beyond column 80 -- which is the form used for potential IAUC-published data (we have a program to automatically convert observations from IAUC-format chronological order into reverse-chronological order for the postings below).

Send observations for IAUCs to icq@cfa.harvard.edu). In general, we include data below only by experienced observers who also contribute full details in ICQ format (magnitude method, comparison-star reference, coma diameter, DC, etc.). Data not contributed in the format below

[**UT to 0.01 day, total visual mag., coma diameter (observer, observing site, instrument);]**

will not be posted here. Both below and on the IAU Circulars, 2-letter standard postal abbreviations are used for states in the USA and for provinces in Canada.

ICQ contributors need to supply more information; when reporting data, include magnitude method, comparison-star source, coma diameter (in arc minutes), instrument used for making the estimate, name, and address (while all this information is not included below, it is included in the published tabulated data in the ICQ).

Note that there are a few different acceptable methods for properly obtaining a total visual magnitude estimate of a comet, which is a much more difficult process than obtaining a visual magnitude estimate of a variable star (forexample), due to the extended size of the comet's coma and to the combination of diffuse coma plus central condensation. All of the acceptable methods compare a comet's brightness with that of comparison stars from acceptable catalogues of V (or visual) magnitudes, or from atlases/charts that have such data inscribed next to star images. [It is not acceptable to produce magnitude estimates of comets based on comparison with "deep-sky" objects (nebulae, galaxies, star clusters) or on "observer experience".]

The three most commonly used extrafocal methods for determining the brightness of a comet are known as the "In-Out", simple "Out-Out", and "Morris" methods:

The In-Out method is good for diffuse comets that do not have a strong central condensation; for this, you compare the memorized in-focus image of the comet to a de-focussed imaged of a comparison star (which is de-focussed to the same coma size as the in-focus comet).

The standard, easy-to-use extrafocal **"Out-Out"** method is only correct when the comet shows little coma (thus, mainly when comets are at small solar elongations and of mag 4 or brighter). With this method, which is sort of an "equal out" extrafocal procedure (in that the comet and star are defocussed by the same amount), the observer slightly de-focusses both the comet and comparison star(s)

the same amount (which makes this the easiest of the methods to use), until comet and star appear about the same size. However, the standard "Out-Out" method produces errant results for diffuse comets or comets with large coma sizes --- which is how comets usually appear! --- by giving magnitudes that are too faint, and should generally not be used.

Charles Morris' method is a "**Modified Out"** method that essentially combines the above "In-Out" and simple "Out-Out" methods into a single, better (though somewhat more difficult to use) extrafocal procedure --- in which the comet is defocused somewhat to smear out the nuclear condensation (and overall brightness gradient), making the defocused comet image as uniform as possible in surface brightness; the comparison stars are then (further) defocused to the same size as this defocused comet image, and one must make several observations of the memorized comet and star images for a good magnitude estimate. (In this method, the comet and star are usually defocussed by unequal amounts, yielding however a "more equally correct" surface brightness for the images of comet and star.)

Further Helpful Hints

Ideally, observers should strive to make total visual (or CCD) magnitude estimates of comets once every possible night (and only once per night, particular in the case of visual observations, unless the comet is observable all night long and very close to the earth, when a real brightness change may be noticeable in several hours' time). Observers should always use comparison stars with visual or V magnitudes from acceptable professional catalogues, and a minimum of 2-3 stars should be used for each estimate that are within 0.5 magnitude of the comet's brightness; use of deep-sky objects (galaxies, nebulae) are NOT acceptable for deriving comet brightnesses. Observers using V comparison-star magnitudes should be careful to avoid red stars (that is, those with B-V > +0.7 or so, especially K, M, and later-type stars, because they will appear 0.1-0.4 mag fainter to the human eye than their V values suggest). Observers of comets making total visual magnitude estimates should always use the smallest instrument needed to easily see the comet, due to large instrumental effects that can again cause values to be too faint. When comets are less than 20 or 25 degrees from the horizon, the observer should usually correct for atmospheric extinction.

An asterisk (*) below denotes that correction was made in the magnitude estimate for atmospheric extinction. A colon (:) after the magnitude estimate indicates that the estimate is approximate (uncertainty greater than +/- 0.3 mag). Below are given the Universal Time (UT) date, to 0.01 day, now in reverse chronological order ; the total magnitude estimate; the coma diameter (usually in minutes of arc), with a preceding plus (+) sign for 'artificial' coma diameters employed in CCD photometry; the observer and observing location; and the instrument USED FOR THE MAGNITUDE ESTIMATE (with the size of the instrument indicating the size of the aperture --- i.e., the primary lens or mirror ---

in centimeters or meters). In the listing below, if a comet is not seen and a limiting (stellar) magnitude given, a left bracket, [, appears before the magnitude value.

As comet C/1995 O1 nears and passes the 0-magnitude mark, it will be more difficult to find appropriate comparison stars. Jupiter may be usable in the morning sky during March, shining at mag -2.0 (Astronomical Almanac 1997), as may Mars at mag -1.2. Mercury may be briefly usable in the evening sky in early April, but its magnitude varies rapidly from day to day and must be computed using appropriate formulae; Mars may be usable in the evening sky in April and May, but will be difficult because it is rising in the east while the comet is setting in the west (opposition is in mid-March).

COMET C/1995 O1 (HALE-BOPP)

Total-visual-magnitude, coma-diameter (and tail-length, from 2/97 onwards; in case of two tails, first is ion and second is dust) estimates:

Mar. 15.45, -0.5*, --, 15 deg and 8 deg (B. Adams, near Farrar, IA, naked eye);

15.45, -0.4, --, 15 deg (G. W. Kronk, Troy, IL, naked eye);

15.05, -0.4*, --, 4 deg (G. W. Kronk, Troy, IL, naked eye);

14.80, -0.4*, 30', -- and 4 deg (P. Candy, Viterbo, Italy, naked eye);

14.15, -0.7*, --, 20 deg (T. Tanti, Naxxar, Malta, naked eye);

13.66, -0.3*, --, 20 deg (S. J. O'Meara, Volcano, HI, naked eye);

13.39, -0.4*, --, 23 and 8 deg (D. E. Green, Center Harbor, NH, naked eye);

13.39, -0.2*, 15', 17 & 9 deg (J. Bortle, Stormville, NY, naked eye)

13.23, -0.2*, --, 28 deg (A. Pereira, Cabo da Roca, Portugal, naked eye);

13.17, -0.3*, +32', > 6 deg (H. Mikuz, Crni Vrh Observatory, Slovenia, 90- mm-f.l. f/4 lens + V filter + ST-6 CCD);

13.15, -0.4*, 30', 18 deg (P. Candy, Viterbo, Italy, naked eye);

13.15, -0.4*, 37', 18 deg (T. Tanti, Naxxar, Malta, naked eye);

13.15, -0.4*, --, about 13 deg (F. Anzellini, Frasso Sabino, Italy, naked eye);

13.14, -0.4*, 40', 17 and 8 deg (K. Hornoch, Lelekovice, Czech Republic, 1x50 monocular);

13.09, -0.2*, --, -- (R. Keen, Mt. Thorodin, CO, naked eye);

13.05, -0.6*, --, 5 and 5 deg (O. Skilbrei, Hoenefoss, Norway, naked eye);

12.99, -0.3*, --, -- (D. W. E. Green, Cambridge, MA, naked eye);

12.77, -0.5*, 30', 10 and 8 deg (K. Hornoch, Lelekovice, Czech Republic, 1x50 monocular);

12.77, -0.5*, 40', 8 and 10 deg (M. Plsek, Lelekovice, Czech Republic, 1x30 monocular);

12.45, -0.3, --, 11 deg (G. W. Kronk, Troy, IL, naked eye);

12.41, -0.2*, --, 5 deg (D. W. E. Green, Middlesex County, MA, naked eye);

12.40, -0.2*, 18', 9 and 7 deg (J. Bortle, Stormville, NY, naked eye);

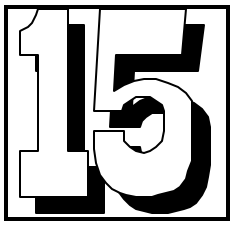
12.23, -0.1*, --, 16 deg (A. Pereira, Cabo da Roca, Portugal, naked eye);

12.22, -0.6, 15', 13 deg (J. J. Gonzalez, Asturias, Spain, naked eye).

12.19, -0.4, 15 deg (M. V. Zanotta, San Marco Pass, Italy, naked eye);

12.17, -0.2*, +32', > 6 deg (H. Mikuz, Crni Vrh Observatory, Slovenia, 90-mm-f.l.

PGAS CONTRIBUTORS



The PGAS would like to thank the following individuals, corporations and government agencies who, since 1991, have donated money, goods or services to the construction and operation of the Prince George Astronomical Observatory.

Ministry of Adv. Ed. Training and Tech	$25,000
BC Science Council	16,000
BC Lotteries	8,000
Helmar Kotsch (Acme Mas.)	1,932
Northwood Pulp and Timber	1,665
Electrical Services Ltd	1,583
Royal Bank of Canada	1,500
Canfor	1,214
Regional District of Fraser-Fort George	1,000
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The Pas Lumber Co	750
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Russelsteel	465
Lakeland Mills Ltd	460
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Carrier Lumber Ltd	160
Art Beaumont	150
Tom's Auto Repairs	150
Pine Drilling	150
Cloverdale Paint Inc	100
Claus Schlueter	100

The greatest contributors to the construction and operation of the observatory are from PGAS members who have generously contributed their time to this project. The value of their contribution surpasses all external contributions.

The PGAS is a non-profit organization dedicated to the advancement of astronomy and science in general in Prince George and the neighboring northern communities. Donations of money or materials to the society are greatly appreciated and tax deductible.

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