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# Journal

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CELEBRATING 100 YEARS OF PUBLICATION

April/avril 2007

Journal

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Cover:
David Lane captured this image of Centaurus A (NGC 5128) during the Florida Star Party using an Astro-Physics 130-mm f/6 APO refractor with an SBIG ST8XME CCD camera. Exposure times were 15 minutes through each of the R, G, and B filters.

# Editorial

## New Media and the RASC

*by Denis Grey, Toronto Centre (denis.grey@sympatico.ca)*

As Canada's national astronomy society, the RASC encounters the same fundamental issue that afflicts all national organizations in Canada regardless of their size or mandate — geography. Canada has a lot of it and most of our Centres, with the exception of parts of Southern Ontario and Quebec, are more than a two-hour drive from one another, making a visit to your fellow RASCals a difficult job. Our annual gatherings, such as the General Assembly, major star parties, and other conferences and special events, can help us to come together as a Society but what do we do for the other 11½ months of the year?

For 100 years, our primary means of bridging the gap between our members has been the *Journal* that you hold in your hand or are reading on-line now. The Society's key publication has always functioned as our "newspaper of record" and has continuously highlighted the life and work of the Society over the decades. The *Journal* has also acted as a bridge between the worlds of amateur and professional astronomy — bringing news of the Society to the world and highlighting the impact of Canadians on the increasingly international world of astronomy.

Over the past two years, the Society has been expanding its range of communication offerings. The National Web site at `www.rasc.ca` has been retooled and redesigned to make it more interactive, including an on-line news service (`www.rasc.ca/news`) that highlights events and happenings at Centres from across the country, The new on-line *Bulletin* is designed to pick up and highlight news of interest to all members of the Society and deliver it to your inbox in an attractive and easy-to-read format. The Membership and Promotion Committee has also recently launched a New Member Survey program to find out more about our new members — their interests, expectations, and reasons for joining — which will help us to get to know our new members better.

Reconciling old and new media is a challenge that every newspaper and magazine struggles with every day. We are no different. Carving out an appropriate role for our on-line information services while preserving the vitality and relevance of our print offerings (including the *Journal* and the *Observer's Handbook*) is going to be an issue with which we will wrestle for many years. The answer is the same one that the *Globe and Mail* has discovered — you have to do both on-line and print media equally well while taking advantage of the synergy that exists between them.

Our new media gives us more opportunities to share our


Journal

The *Journal* is a bi-monthly publication of the Royal Astronomical Society of Canada and is devoted to the advancement of astronomy and allied sciences. It contains articles on Canadian astronomers and current activities of the RASC and its Centres, research and review papers by professional and amateur astronomers, and articles of a historical, biographical, or educational nature of general interest to the astronomical community. All contributions are welcome, but the editors reserve the right to edit material prior to publication. Research papers are reviewed prior to publication, and professional astronomers with institutional affiliations are asked to pay publication charges of $100 per page. Such charges are waived for RASC members who do not have access to professional funds as well as for solicited articles. Manuscripts and other submitted material may be in English or French, and should be sent to the Editor-in-Chief.





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stories — both on-line and in the *Journal*. We also have the opportunity to highlight more information in greater depth than ever before. More publications with more room mean that we need more articles of all kinds. Have you thought about submitting a three-paragraph story about your upcoming Centre banquet to the *eNews* (`news@rasc.ca`)? Do you see something on the National Web site that could be better written or enhanced? Why don't you construct a better Web page and fire it off to the Web team? Do you have something of interest to the membership? Perhaps the editor of the *Bulletin* (`bulletin@rasc.ca`) can use your idea as part of his efforts to keep everyone in the Society in touch with one another.

Of course, the *Journal* is also very interested in your articles and stories and our editor (`editor@rasc.ca`) actively monitors the on-line side of the RASC looking for material for this publication, so don't be surprised if you do start to contribute to the *eNews* or the *Bulletin* that you get a friendly e-mail inviting you to come up to the "big leagues." After all, as fun and as interesting as the Web may be, if you want to have your work preserved for 100 years, the *Journal* is still the way to go.

# News Notes
# En Manchettes

*Compiled by Martin Beech (beechm@uregina.ca) and Russ Sampson (sampsonR@easternct.edu)*

## PRIMORDIAL ORGANIC MATTER IN THE TAGISH LAKE METEORITE

NASA researchers at Johnson Space Center, Houston have found organic materials that formed in the most distant reaches of the early Solar System preserved in a unique meteorite. The study was performed on the Tagish Lake carbonaceous chondrite, a rare type of meteorite that is rich in organic (carbon-bearing) compounds, which fell in northern British Columbia in January 2000.

Organic matter in meteorites is a subject of intense interest because this material formed at the dawn of the Solar System and may have seeded the early Earth with the building blocks of life. The Tagish Lake meteorite is especially valuable for this work because much of it was collected immediately after its fall and has been maintained in a frozen state since then, minimizing terrestrial contamination. The rapid collection and curation of the meteorite samples preserved its pristine state (see, for example, the Web link at `http://gsc.nrcan.gc.ca/meteor/tagish_e.php`).

In a paper published in the December 1, 2006 issue of the journal *Science*, the team, headed by NASA space scientist Keiko Nakamura-Messenger, reports that the Tagish Lake meteorite contains numerous submicrometre hollow organic globules.

"Similar objects have been reported from several meteorites since the '60s. Some scientists believed these were space organisms, but others thought they were just terrestrial contamination," said Nakamura-Messenger. The same bubble-like organic globules appeared in this freshest meteorite ever received from space. "But in the past, there was no way to determine for sure where these organic globules came from because they were simply too small. They are only 1/10,000 inch in size or less."

In 2005, two powerful new nano-technology instruments were installed in the scientists' laboratory at Johnson Space Center. The organic globules were first found in ultrathin slices of the meteorite with a new JEOL transmission electron microscope. It provided detailed structural and chemical information about the globules. The organic globules were then analyzed for their isotopic compositions with a new mass spectrometer, the Cameca NanoSIMS, the first instrument of its kind capable of making this key measurement on such small objects.

The organic globules in the Tagish Lake meteorites were found to have very unusual hydrogen and nitrogen isotopic compositions, proving that the globules did not come from Earth.

"The isotopic ratios in these globules show that they formed at temperatures of about minus 260° C, near absolute zero," said Scott Messenger, NASA space scientist and co-author of the paper. "The organic globules most likely originated in the cold molecular cloud that gave birth to our Solar System or at the outermost reaches of the early Solar System."

The type of meteorite in which the globules were found is also so fragile that it generally breaks up into dust during its entry into Earth's atmosphere, scattering its organic contents over a wide area. "If, as we suspect, this type of meteorite has been falling onto Earth throughout its entire history, then the Earth was seeded with these organic globules at the same time life was first forming here," said Mike Zolensky, NASA cosmic mineralogist and co-author of the paper. The origin of life is one of the fundamental unsolved problems in natural sciences. Some biologists think that making a bubble-shape is the first step on the path to biotic life. Indeed, Nakamura-Messenger comments, "We may be a step closer to knowing where our ancestors came from."

## COSMIC BUBBLE WINS PRIZE

A striking image of an enormous bubble blown into the dusty gas disk of our own Milky Way galaxy has won first place in the National Radio Astronomy Observatory's second annual Radio Astronomy Image Contest. Dr. Jayanne English of the University of Manitoba led the team that made the winning image using data from the National Science Foundation's Very Large Array (VLA) in New Mexico and Robert C. Byrd Green Bank Telescope (GBT) in West Virginia.

English and her collaborators Jeroen Stil and Russ Taylor, from the University of Calgary, will share the grand prize of $1000 from Associated Universities, Inc., the research corporation that operates the observatory for the NSF.

"We congratulate Dr. English for producing an outstanding image that beautifully illustrates the power of our radio telescopes," said NRAO Director Fred K.Y. Lo.

The image contest is part of a broader NRAO effort to make radio astronomical data and images easily accessible and widely available to scientists, students, teachers, the general public, news media, and science-education professionals. That effort includes an expanding image gallery on the observatory's Web site.

English's winning image shows a giant bubble in the Milky Way's dusty gas disk. The bubble has been sculpted by the wind and radiation force from a few dozen hot, massive stars, along with the explosive force of supernova explosions from dying stars.

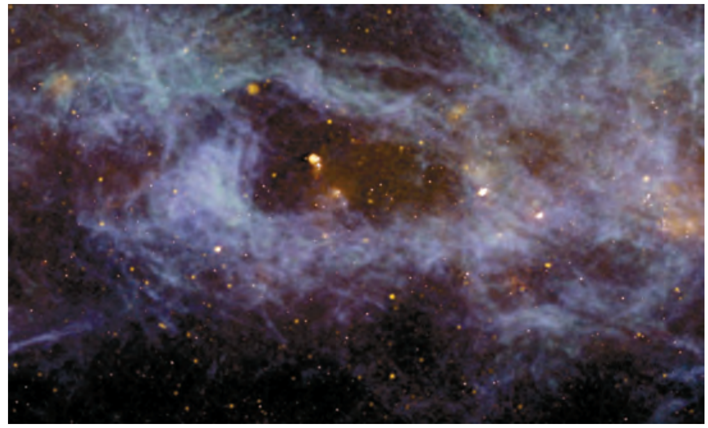

Figure 1 — What appears to be the hole of an elongated smoke ring in this National Radio Astronomy Observatory image really is an enormous, nearly empty, bubble blown into the dusty gas disk of our Milky Way galaxy. Such interstellar bubbles are sculpted by the force of the wind and radiation from typically a few dozen hot, massive stars along with the explosive impact of stars dying as supernovae. The force sweeps up the disk's gas that is in its path, creating a gas shell surrounding a bubble. The neighbourhood of our own Solar System resides in such a cavity. However, the shell in this image, catalogued (using its coordinates) as galactic shell GS 62.1+0.2-18, is located at a distance of 30,000 light-years from Earth, and measures 1100 by 520 light-years. Despite its distance, this "smoke ring" appears so large on the sky that the apparent width of the full Moon would fit eight times inside it. The bright yellowish-orange dots scattered across this image are clusters of young, massive stars surrounded by hot gas and are called nebulae. Astronomers from the International/VLA Galactic Plane Survey have determined that none of these clusters harbour the stars that blew the giant shell since none of the clusters are at the same distance as the shell — they all are located closer to the Earth. Probably, the stars that blew GS 62.1+0.2-18's hole perished as supernova explosions. This image shows only a small part of a survey that uses both the Very Large Array and the Green Bank Telescopes to trace, in detail, the cool gas in our galaxy. This gas has been coloured purple, blue, and green in this image. In order to show the locations of star clusters, the image of gas is overlain with two additional images. The image showing radio emission associated with regions of hot gas is coloured orange, while heated dust, imaged in infrared by the Midcourse Space Experiment satellite, is coloured red. Image courtesy of NRAO/AUI and Jayanne English (U. Manitoba), Jeroen Stil and Russ Taylor (U. Calgary), and MSX.

The bubble, seen in the faint radio glow of hydrogen gas, is some 30,000 light-years from Earth and measures 1100 by 520 light-years. If the bubble, in the constellation Vulpecula, were visible to human eyes, it would appear to be eight times the diameter of the full Moon in the sky.

The image was made using data collected as part of the VLA Galactic Plane Survey (VGPS), a set of systematic observations of the Milky Way. This survey, led by Taylor, required about 3000 separate VLA observations taking 260 hours, augmented by data from the GBT. Along with the Canadian Galactic Plane Survey and the Southern Galactic Plane Survey, the VGPS is part of an international effort to produce a detailed atlas of our home Galaxy as seen by radio telescopes.

## CITA DIRECTOR HONOURED

(CITA: Toronto) Dr. Norman W. Murray, Director of the Canadian Institute for Theoretical Astrophysics, has been appointed a Fellow of the American Physical Society in recognition of his research work, and particularly his "fundamental contributions to the theory of active galactic nuclei, black-hole and star formation in galactic disks, planet formation, and the dynamics of planetary systems."

The appointment of Murray as a Fellow marks the University of Toronto's 11th Fellowship, and the 2nd for the Canadian Institute for Theoretical Astrophysics. Previous director and university professor Richard Bond was recognized in 1998 for "contributions to astrophysics and cosmology; in particular for developing the understanding of fluctuations in the cosmic background radiation."

Annually, the physicists who comprise the membership of the American Physical Society elect at most one-half of one percent of their peers to the rank of Fellow to mark the members' "significant and innovative contributions in the application of physics to science and technology." This year 212 fellows were named from around the world. The Society, founded in 1899, began the fellowship program in 1995.

Murray received his Ph.D. in astrophysics in 1986 from the University of California at Berkeley and has been a professor at the institute since 1993. He became director of the institute on July 1, 2006. His recent work has centred on understanding the highly energetic outflows from massive black holes in the centre of some galaxies and the dynamics of planetary systems.

## TAU BOO'S MAGNETIC ATTRACTION

The catalogue of extrasolar planets is growing ever larger, and now contains more than 200 objects. Indeed, the detection of exoplanets has now almost become routine. But what are the characteristics of the stellar hosts, how can we explain the formation of these planetary systems, and why are some of these giant exoplanets migrating inward to form "hot Jupiters"? Astrophysicists suspect that magnetic fields play a crucial role in some of these issues, and although the indirect effects of magnetic fields have been detected on some stars hosting exoplanets, until recently no direct measurements of magnetic field strengths have been made. Now an international team of astronomers, using a spectropolarimeter mounted on the Canada-France-Hawaii telescope, have made the first measurements of the magnetic field of tau Boötis, a one-billion-year old star, having a mass of 1.5 solar masses located about 50 light-years from Earth. This cool and weakly active star, orbited by a giant planet with 4.4 Jupiter masses on a close-in orbit of 0.049 AU radius, possesses a magnetic field of a few gauss. This is just a little more than the Sun's, but shows a more complex structure.

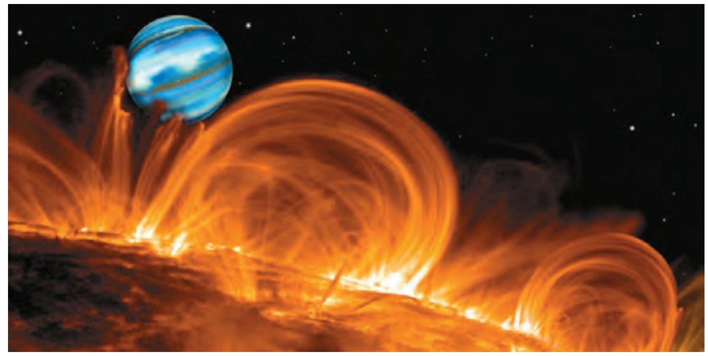

Figure 2 — Artist's view of the giant exoplanet orbiting tau Boötis, through the star's magnetic prominences (credit David Aguilar, CfA)

The team of astronomers has also measured the level of differential rotation of tau Boötis — a crucial parameter in the generation of magnetic fields. Accordingly, they have found that the material located at the equator rotates 18% faster than the material located at the poles, leading to a full turn advancement in approximately 15 days. By comparing the differential rotation of the star with the revolution of the giant extrasolar planet, astronomers have noticed that the planet is synchronized with stellar material located at about 45-degrees latitude. This observation suggests a very complex interaction between the magnetosphere of the star and the planet; a process perhaps similar to the interaction of the magnetosphere of Jupiter with its satellite Io that gives rise to the so-called "Io torus." (Article based upon the press release by Cyrille Baudouin).

**WEB ACCESS TO THE 2007 ISSUES OF THE *JRASC***

The 2007 issues of the *Journal* can be accessed from the RASC Web site at `www.rasc.ca/currentjrasc`. Issues are posted immediately after the final production version is complete. Username and password are sent by email to RASC members.

# Correspondence
# Correspondance

Dear Jay:

I am writing in response to your editorial of the latest *Journal*, questioning why the RASC is so invisible in the media and the public arena, noting that money is at the root of it.

There is an incredibly inexpensive way to remedy this situation.

I propose that we ask our members to write or email our Minister of Energy and Conservation, our MPs, our MLAs, and our city councillors, with copies to the editors of our local papers, about lessening the impact of greenhouse gases on our environment. Outdoor lights are enormous energy consumers, and not a mention is made by our politicians or the media of how easy it would be to turn off lights. This is not just lights in our homes, but parking-lot lights and neon lights advertising products that nobody could shop for at night, because the businesses are closed. Legislation to have businesses turn off their parking-lot lights and their advertising signs at night, except for energy-efficient security lights, would make a huge difference in energy consumption. As well, it would be of tremendous benefit to amateur and professional astronomers, making the stars visible again even in our cities.

We can do this, and become visible!

Yours truly,

Elizabeth van Akker

# The Lunar-X Files: A Fleeting Vision near the Crater Werner

*by David M.F. Chapman, Halifax Centre (dave.chapman@ns.sympatico.ca)*

## Introduction

Every month — or to be more precise, every 29.530589 days — the Moon cycles through its phases and alternately reveals and hides the features on its surface. As experienced lunar observers know, the appearance of a particular surface feature depends on the relief of the feature (that is, the height of the feature above or below the surrounding terrain) and the angle of the illumination of the Sun. The interplay of these two parameters leads to countless lunar landscape views, luring dedicated observers back time and time again to observe, sketch, and photograph the Moon. On any night, good lunar hunting is found at the terminator, that is, the line of demarcation between the dark and light portions of the lunar disk. The term "line" is used very loosely here, as the terminator can become quite convoluted, especially in rough areas. In extreme cases, one can see mountain peaks and crater walls that have been "caught in a noose of light" [1] and stand out brilliantly against the surrounding blackness. This high contrast is aided by the lack of an atmosphere on the Moon, as there is nothing to scatter sunlight into the shadows and soften the lighting. Are there any astronomers out there who have yet to watch sunrise on a prominent lunar feature?

A particularly striking phenomenon occurs at the terminator around First Quarter phase: an illuminated X shape that appears for an hour or so at lunar coordinates (25.5S, 1.1E) just northwest of the crater Werner (Figure 1). Although it must appear every month, the Werner X does not seem to be well known. There is evidence that the X has been observed (or at least photographed) in the past, but the author has been unable to find any written documentation of the X published before he noticed it in August 2004.[2] The author succeeded in observing the X for a second time in November 2005 and for a third time in January 2007, and just missed observing the X on several other occasions. Others have seen the X on those dates, some dates in between,

Figure 1 — The Moon showing the Werner X taken with a TeleVue 70-mm Pronto refractor, 2x Barlow, 13-mm Nagler eyepiece, and Canon Digital Rebel XT camera (Dave Lane, January 25, 2007, ~2345 UT).

[1] Edward FitzGerald's translation of the *Rubaiyat of Omar Khayyam* opens with: Awake! for Morning in the Bowl of Night / Has flung the Stone that puts the Stars to Flight: / And Lo! the Hunter of the East has caught / The Sultan's Turret in a Noose of Light.

[2] Note that the author is not claiming to have been the first to see it. He chose his words carefully!

and evidently beforehand. If one knows when and where to look, the Werner X can be observed by anyone with a modest telescope or even well-supported binoculars.

Since August 2004, there has been a flood of observations, sketches, photographs, discussions, and predictions of the Werner X posted on the Internet. (For one example, see `www.cloudynights.com`) The author published a letter on the Werner X in the Nov/Dec 2004 issue of *SkyNews,* along with a photograph by Tony Jones. The author also published an earlier version of this article in the February 2006 issue of *Nova Notes,* the newsletter of the RASC Halifax Centre. A selection of photographs and sketches (by others) is posted at `www.homepage.mac.com/chapmandave/WernerX`.

## How to Find the Werner X

Werner (28.1S, 3.3E; diameter 70 km) is a near-circular crater with high walls, easily seen on the daylit side of the terminator at First Quarter along with its near-twin Aliancis (30.6S, 5.2E; diameter 79 km). If one finds this prominent pair (about a third of the way up the terminator from the south limb) and follows the direction to which they "point" (A to W), one has a very good chance of seeing the X as a dazzling sunlit feature suspended in inky shadow, completely independent of the terminator boundary (Figure 2). If Werner and Aliancis were 2/3rds of a triplet, the X would be the third member! That is where to *find* the X; however, to o*bserve* the X, timing is critical, as we shall see.

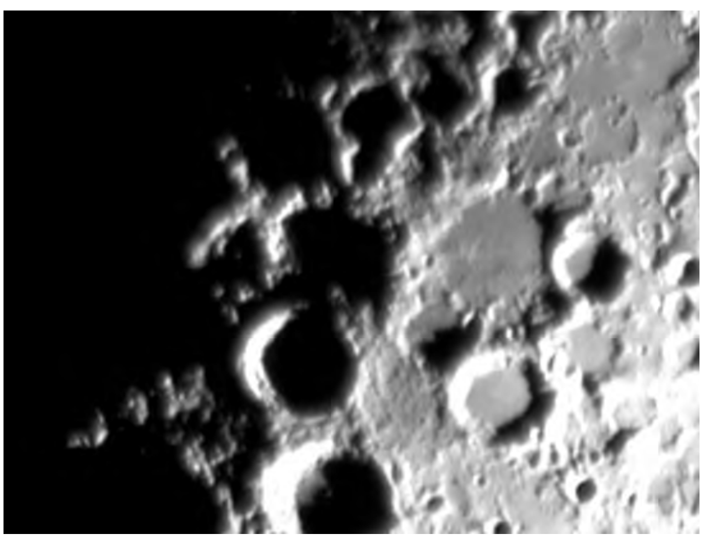

Figure 2 — A close-up of the Werner X taken with a Celestron C11 and Philips ToUcam PRO II Webcam (Randy Attwood, January 26, 2007, 0138 UT).

## Nomenclature

Regarding nomenclature, the author proposes "Werner X." This name aptly describes the approximate location and appearance of the apparition. It has also been called "The Purbach Cross" and other casual names in Internet newsgroups. Indeed, walls of the crater Purbach form two arms of the X! The author prefers "Werner X" for the simple reason that the crater Purbach is almost entirely invisible when the X appears, while Werner is the closest well-lit crater to the feature, an obvious beacon to observers. The lack of a standard name is testimony to poor prior awareness of the phenomenon.

In this article, "X" refers strictly to the visual phenomenon described above (fully illuminated X surrounded completely by shadow), not simply to the topography that teams with the Sun to create the X. As the Sun continues to rise, the surrounding shadowed lowlands fill in with light, and the X apparition vanishes. Of course, the topography is there, plain to see, and remains visible for the next half-month, but the topography alone is not the X. For the mathematically minded, X = topography + illumination.

## The Gradual Appearance of the Werner X

The Werner X does not leap out all at once but gradually appears over an interval of 2 hours and 20 minutes as the Sun rises on the spot. Watching this is either excruciatingly slow (if you are in a hurry) or exceedingly quick (if you are attempting to sketch the scene). Remember, the Sun rises about 30 times more slowly on the Moon than on Earth! It may be helpful to refer to Figure 3 (or a good lunar atlas) for what follows. Out of the blackness, the Sun's rays first catch the tallest point: this turns out to be

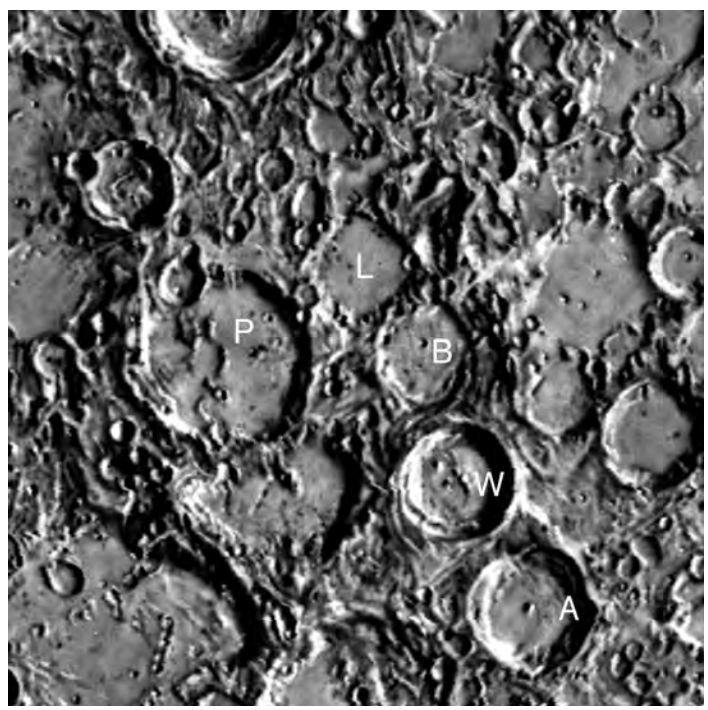


Figure 3 — The lunar region centred on the topography that forms the Werner X: Purbach (P), La Caille (L), Blanchinus (B), Werner (W), and Aliancis (A). The area shown is roughly 16-degrees square. (Image courtesy of NASA Planetary Data System Imaging Node, U.S. Geological Survey, Flagstaff, AZ)

a peak on the SE wall of Purbach. This point lengthens into an arm in the NNE direction towards the common area between Purbach, La Caille, and Blanchinus. Meanwhile, the NE wall of Purbach becomes illuminated and the two growing features join to form a corner. Next, the SW wall of Blanchinus catches the light and we see a "T." Finally, the common wall between Blanchinus and La Caille form a NE arm that joins the rest to form the X. There is a little hollow where the three craters join that takes a while to fill in, but it apparently has no designation. All the while, the X's arms are immersed in inky shadow and they are completely detached from the terminator. On the rims of the large craters, there are small craters that interfere with the joining-up process, leading to a fractured appearance. All this can be seen at high magnification; however, for the best "X" effect, lower magnification is preferred. For about an hour, the appearance of the Werner X becomes more defined, and then over the next hour and ten minutes, the surroundings gradually fill with light, and the effect is lost.

**The Significance of the Werner X**

Observing the Werner X has little or no scientific value. It is a curiosity, a trick of the light. The effect is striking, and it is exciting to rediscover. The phenomenon has some educational value, as it compels the observer to think about lunar cycles, daily cycles, selenographic coordinates, illumination of lunar features, and the general motion of the Sun-Earth-Moon system. Much of this is somewhat beyond the elementary level. It is a mildly challenging observation, but not difficult to see. Nevertheless, there seems to be continued interest in the phenomenon and there has been a steady stream of observations, images, and enquiries. Reports from first-time X observers are especially gratifying, as they recall the author's original experience.[3] If there is any science in the Werner X, it may lie more in the realm of psychology: what factors contribute to an obscure phenomenon that presumably has been taking place every month for some time, to suddenly becoming well known? We will return to this later.

**A Summary of Collective Observations of the Werner X**

***August 22, 2004: Seeing the Werner X for the First Time***

On August 22, 2004, at the Nova East star party at Smileys Provincial Park near Windsor, Nova Scotia, the author trained his TeleVue Ranger 70-mm telescope on the Moon just as dusk was gathering at about 9 p.m. Other amateur astronomers were making their own preparations for an evening under the dark sky, but it was a little too soon for "serious" deep-sky observing. Having a glance at the nearly First Quarter Moon seemed like a good way to start the night. The author focussed his telescope on the terminator and immediately noticed a bright X shape on the dark side of the terminator. Unlike many other astronomical views through a telescope, this observation took no imagination whatsoever, and the surrounding group of astronomers soon joined in the observation. Tony Jones took a picture of the Moon at this time. The discovery of the X was exciting and its appearance was striking. As the Moon was at First Quarter, it was roughly due south at sunset, and proceeded to set throughout the remainder of the evening, eventually becoming too low in the sky to observe comfortably.

***Previous Reports and Images of the Werner X***

Following the X observation on August 22, 2004, research on the Internet and in astronomy books turned up only a little information. An email enquiry to veteran lunar observer and *Sky & Telescope* columnist Chuck Wood elicited the reply, "I know what you observed. A couple of people have recently seen this cross, but strangely, almost no one mentioned it before. Visit my Web site *Lunar Photo of the Day* — `www.lpod.org` — on Sunday for the answer!" Sure enough, the August 29 *LPOD* turned out to be "X Marks the Spot," a photograph by accomplished lunar observer Carol Lakomiak taken in Wisconsin on June 24, almost exactly 59 days (two lunar months) before the August 22 observation. Word of the X spread, and the author was contacted by Dana Thompson in Hebron, Ohio, who reported seeing an X (in Newark, Ohio) in 1978, but had not seen it (or looked for it) since. Dana recalls that — with the unaided eye — he first saw a point of light on the dark side of the terminator, which turned out to be an X in the telescope. (Dana does not have observing records from that date, but he has correspondence indicating that the event probably took place 324 lunations before the Nova East sighting, on June 12, 1978.) Mike Boschat found a photo of the X in *Dinsmore Alter's Lunar Atlas,* plate 111, page 247. Pat Kelly wondered why the X had not been mentioned before, as observers often concentrate on the terminator because of the interesting detail to be seen. Since August 2004, prior photographs of the Werner X — without commentary — have been slowly drifting in, as intrepid Internet surfers find more examples. Paul Gray pointed out a nice Werner X on the Moon photo on page 98 of The Nature Company's *Advanced Skywatching*. The author recently found a pretty good Werner X in a Lick Observatory photo of the 7-day Moon, between pages 102 and 103 of the well-known 1962 Dover Publications of Webb's C*elestial Objects for Common Telescopes, Volume One: The Solar System* (revised edition).

***A Digression on Lunar Months and Solar Days***

At first thought, one would expect that the Werner X would appear every month, at about the same lunar time just before

[3] It must be said that some experienced lunar observers seem unimpressed by the Werner X. They dismiss it as yet another commonplace geometrical illusion, of which they have seen many, and may no longer feel the thrill that the first-time observer experiences.

first quarter. Why would it not be very well known? The answer is primarily a combination of two effects: (1) the peak X effect only lasts for about an hour, and (2) the lunar month is not an exact number of 24-hour days. (Then there is the weather!) If an observer saw the X one evening in a given month, then it would appear again 29.5 days later, but the half day would mean that the First Quarter Moon would have already set at the original observer's location and thus be unobservable from there; however, an observer on the other side of the world would be in a good position to see the X on that occasion.

On the other hand, an interval of 2 lunar months works out to 59 days and 88 minutes. From the first observations, the author reasoned that if the X had been seen 59 days earlier from Eastern North America, then there was a good chance it could be seen again slightly later on the evenings of October 20/21, December 18/19, and perhaps February 15/16. However, at first quarter, there is only a short interval of time — perhaps 4-5 hours between sunset and moonset — during which the Moon can be observed. The residual 88 minutes means that the Moon would be that much closer to setting at the observer's location each successive time the X appears. Eventually, the X would appear so late in the evening that the Moon would have already set. Because the Moon sets later (in Universal Time) as the observer moves west, this implies that the optimum longitude for seeing the X would gradually move westward by three time zones every four months. A persistent observer may see the X every other month for several appearances, but then there would be a long hiatus of a year or so during which the X would not be seen.

In reality, the motion of the Moon is much more complicated, but it is hoped that this explanation captures the essence.

### *Spreading the word*

A letter by the author featuring the Tony Jones photo appeared in the Nov/Dec 2004 *SkyNews* magazine, alerting observers to the events. The author also posted the relevant information to the RASC national discussion list. The Werner X was discussed in several astronomy newsgroups, but to document these discussions would be a Herculean task! The remaining history is admittedly selective, concentrating on observations by RASC members and a few other personal contacts of the author (listed at the end of the article).

### *Fall 2004 and Winter 2005*

On the night of October 20/21, 2004, it was cloudy in Halifax, but at around 0200 UT Ted Dunphy of Fredericton independently observed the X and took a photograph. Only afterwards did he learn about the author's observation and the *SkyNews* letter. Curt Nason of Saint John also saw the X. These sightings were reported in the Autumn 2004 issue of *Horizon,* the newsletter of the RASC Moncton Centre.

On December 18/19, it was again cloudy in Halifax, but Joe Carr and Bill Weir from the RASC Centre in Victoria both observed the X. Note that they observe far to the west of Nova Scotia and New Brunswick.

On February 15/16, 2005, Bill Weir of Victoria made a lengthy and detailed observation of the X: the centre became visible at 0430 UT, and the X was fully illuminated from 0515 UT until at least 0700 UT. These times were well past moonset in the Maritimes. Bill's observations, and the absence of any observations from the East, confirmed that the optimum longitude for observing the X gradually moves westward from one appearance to the next.

### *Attempts in July and September 2005*

Following the sequence of observations above, there were observations and photos of the X from "down under" in Australia, during odd-numbered months. No details are available. Due to the westward drift of optimum observing longitude, it was only a matter of time before this sequence made its way to North America. On July 12/13, Bill Weir observed the First Quarter Moon in B.C. until midnight, but concluded it was "too soon" for the X. On September 10, the author and others observed in the East, and it was also deemed to be "too soon." These unsuccessful observations are not surprising.

### *November 8, 2005: The Author's Second View*

On the evening of November 8/9, 2005, the author was able to observe the Werner X at sunset. The Moon was visible earlier, but the poor contrast in daylight made detailed observation of the Moon difficult. Many observers from eastern Canada supplied reports, drawings, and pictures of the X. These are documented in the RASC Halifax *Nova Notes* newsletter article of February 2006 (available on-line at `halifax.rasc.ca/archive.html`), and will not be repeated here. The observation time ranged from 2030 UT to 0215 UT. The X was fully formed at the start of this series of observations, but had "filled in" before 2330 UT. These observations helped define the temporal extent of the phenomenon, but were not definitive, as the commencement was uncertain.

### *Observations in 2006 and 2007*

Since November 2005, there have been two significant observations of the Werner X from North America[4]: March 6/7, 2006 and January 25/26, 2007. The group of observers contributing to the collective has grown, and all the names are included at the end of the article.

[4] There should have been an opportunity to observe the Werner X on the evening of January 6, 2006, but it was cloudy in Halifax and no other reports were received.

On March 6/7, 2006, observers in the East saw the X begin to form from a tiny point of light on the terminator's dark side, but the Moon set before the feature fully developed, and they could not see the full expression of the X. In the West, observers missed the very beginning, but saw the full X and the aftermath, when the surroundings fill in with light. Observations spanned the time interval 0345 UT to 0810 UT, representing the coordinated reports of about a dozen observers across the continent. These observations further refined limits on the duration of the phenomenon, which is about 4.5 hours, and on the "peak X" appearance, which is about 1 hour.

With these observations, the team was well prepared for the January 25/26, 2007 event. The first pinprick of light was seen at 2130 UT in the east, but it was not too late to see the X itself. By 2305 UT the pinprick had grown to a "T" shape and by about 2345 UT the X was forming nicely. The X was "more or less perfect" by 0120 UT but the scene started to fill in by 0200 UT, according to central- and western-Canadian observers.

### *Summarizing Event Timings*

It has been a challenge to capture Werner X observations with sufficient precision to aid in prediction. Lunar phase (percent of disk illuminated) is only a rough indicator, and counting forward from past events in units of synodic month only points to the right day. It has been suggested that selenographic colongitude (*i.e.* the lunar longitude of the terminator) and/or the elevation of the Sun at the site are appropriate indicators. Indeed, they are better, but there still appears to be some unexplained variation. Table I is a summary of these circumstances for the "peak X" stage of five Werner X occurrences, based on the most reliable observations, images, and timings. The selenographic colongitude and Sun elevation were calculated from observed timings using the *Excel* spreadsheet *Circumstances of the Moon* written by Keith Burnett and available at `www.bodmas.org/kepler/mooneph.html`.

Table I: Circumstances of the Moon at the time of "peak X"

| Date | Time (UT) | Selenographic Colongitude (degrees) | Sun's Elevation at Werner (degrees) | Lunar Phase (%) |
|---|---|---|---|---|
| Aug. 23, 2004 | 0130 | 359.6 | 1.9 | 46 |
| Feb. 15, 2005 | 0450 | 356.3 | 0.3 | 52 |
| Nov. 08, 2005 | 2115 | 358.1 | 1.7 | 48 |
| Mar. 07, 2006 | 0520 | 357.4 | 0.9 | 54 |
| Jan. 26, 2007 | 0122 | 358.4 | 2.0 | 51 |
| | | 358.0 ± 1.2 | 1.4 ± 0.7 | 50 ± 3 |

Lunar phase is correlated with colongitude, but includes a component due to libration that should not affect illumination of the X. The variation in phase is equivalent to a time uncertainty of ±15 hours, making it unsuitable as an indicator. Considering the angular variables, the variation in Sun elevation may be due to simple experimental error deriving from the combination of several observers' time estimates of an intrinsically imprecise event. The variation in colongitude is larger, perhaps because the Moon's axial tilt is not included in this calculation, than it is for the elevation. For reference, one hour of time is equivalent to about 0.5 degree of colongitude.

Table II shows the statistics of the circumstances for several stages of the entire Werner X event, based on all the reliable observations over five instances. It is important to remember that no individual has seen all these stages on a single night! This summary only covers the illumination of the X; it is also essential that the observer can see the Moon when the event takes place.

Table II: Statistical Summary of Circumstances of the Moon at Successive Werner X Stages

| X stage | Selenographic Colongitude (degrees) | Sun's Elevation at Werner (degrees) | Estimated Relative Time (hours:min) |
|---|---|---|---|
| First pinprick of light | 356.5 ± 0.1 | 0.2 ± 0.1 | -2:55 |
| "T" or partial X | 357.0 ± 0.6 | 0.7 ± 0.5 | -2:00 |
| earliest X | 357.7 ± 0.2 | 1.2 ± 0.3 | -0:35 |
| peak X | 358.0 ± 1.2 | 1.4 ± 0.7 | 0:00 |
| latest X | 358.2 ± 0.4 | 1.6 ± 0.6 | 0:25 |
| surroundings filled in | 358.8 ± 0.1 | 2.3 ± 0.1 | 1:35 |

## Predicting the Werner X

Using what we have gathered so far, predicting *when* Werner X events take place is somewhat straightforward, but being able to *see* them is dependent on observer location. For each instance, two questions are posed: When is the X illuminated? And, can the observer see the Moon at that date and time? For the purposes of illustration, we use the generic "peak X" values of 358.0 ± 1.2 for colongitude and 1.4 ± 0.7 for Sun's elevation at Werner.

### *Handbook Method*

Roy Bishop, a former editor of the RASC *Observer's Handbook* — and famous for crying out "It's in the *Handbook!*" at Halifax Centre meetings — demonstrated in an email how to estimate the date and time of Werner X appearances: In "The Sky Month by Month" section, on the left-hand page for every month, the selenographic colongitude is given for the date 1.0 UT for the month. One can use the fact that the colongitude advances 12.2 degrees per day to estimate the date and time of any event indicated by a colongitude. For January 2007, we get an estimate of "peak X" of (358.0-53.67)/12.2 +1.0 = 25.94, or January 25 at 2300 UT ± 2h 20m.

### *Spreadsheet Method*

Keith Burnett's *Excel* spreadsheet, already mentioned, must be used in a manual search mode, but it does not take long. Using the colongitude, the peak X is estimated to occur on January 26, 0040 UT ± 2h 10m. A similar calculation based on Sun's elevation gives the time January 26, 0005 UT ± 1h 35m.

### *Software Method*

Larry Phillips suggests the freeware program *LTVT (Lunar Terminator Visualization Tool)* by Jim Mosher and Henrik Bondo (`http://inet.uni2.dk/~d120588/henrik/index.html`). The program can be set to automatically search for events. Using a Sun elevation of 1.5 degrees at Werner, he finds a peak-X time of January 26, 0014 UT.

Ed Kotapish has a home-grown program based on algorithms from Jean Meeus' *Astronomical Algorithms, 2nd Edition,* written in the language *QBASIC*. He also searches automatically, but prefers to use a range of solar elevations to define an observing window. Before the event, he predicted January 26, 0110 UT ± 1h 10m.

All these calculations are in general agreement with observations on the night of January 25/26, 2007. As always, observers should err on the conservative side and be prepared to look earlier than expected, so as not to miss the event.

### *Upcoming Opportunities*

Table III shows the Werner X events in 2007 as calculated by Larry Phillips with *LTVT* based on the elevation of the Sun at Werner. Note the variation in selenographic colongitude. It is up to the individual to determine whether the Moon will be visible from the observing location at these times. Roughly speaking, as it is near First Quarter, if the local time of the event is in the evening before midnight, there is a good chance to see it. *LTVT* actually has a helpful function that computes viewability based on the observer's coordinates. Ed Kotapish uses an interesting technique enabled by some desktop planetarium programs whereby he transports the observer to the Moon at the appropriate time and looks back at the Earth. Any observer located on the portion of the Earth that is visible would see the X. This visualization indicates that southern latitudes in North America are most favoured.

Table III: Werner X Appearances in 2007

| Date | Time (UT) | Colongitude (degrees) |
|---|---|---|
| Jan. 26, 2007 | 00:14 | 357.8 |
| Mar. 26, 2007 | 05:35 | 358.7 |
| May 24, 2007 | 06:51 | 359.2 |
| Jul. 22, 2007 | 04:20 | 358.9 |
| Sep. 19, 2007 | 01:39 | 358.1 |
| Nov. 17, 2007 | 02:50 | 357.6 |

## Why is the Lunar X Not Better Known?

It is evident that alerted observers have no difficulty finding and observing the Lunar X. However, there seems to be no published evidence of X observations previous to recent times. Perhaps it was observed, but because an observer in a given location may have difficulty repeating the observation, it was not reported. For a start, the X does not appear at every lunation if observed from a given location. In addition, from a given location there is a long interval of time during which the illumination of the X and the appearance of the Moon in the observer's sky do not coincide. The combination of the lunar month and the solar day results in a quasi-periodic, almost random, sequence of opportunities. A possible hypothesis is that an irregularly appearing periodic event is less noticeable or less memorable than one that appears on a regular schedule. Another interesting hypothesis is that the almost instantaneous communication between widely separated observers made possible by the Internet has boosted awareness of such phenomena. Perhaps we experienced a tipping point.[5] Have we entered an era of network-enabled astronomy?

## Contributors

This project would not have been possible without the contributions of Gilles Arsenault (NS), Randy Attwood (ON), Chris Beckett (NS), Roy Bishop (NS), Mike Boschat (NS), Keith Burnett (UK), Paul Campbell (AB), Joe Carr (BC), Simon d'Entremont (NS), Ted Dunphy (NB), Matthew Emmanuele (ON), Paul Evans (NS), Kevin Fetter (ON), Dave Gallant (ON), Mike Gatto (NS), Paul Gray (NB), Paul Heath (NS), Clarence Hemeon (NS), Wes Howie (NS), Roger Hill (ON), Tony Jones (NS), Ken Kingdon (ON), Ed Kotapish (TX), Carol Lakomiak (WI), Dave Lane (NS), Blair MacDonald (NS), Tony MacDonald (ON), Dean McIntyre (AB), Curt Nason (NB), Larry Phillips (SK), Dana Thomson (OH), Tenho Tuomi (SK), Bill Weir (BC), Alan Whitman (BC), and Charles Wood (USA).

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5 Tipping point is a sociological term that refers to that dramatic moment when something unique becomes common. See Malcolm Gladwell, *The Tipping Point: How Little Things Can Make a Big Difference* (Little Brown, 2000).

# MODELLING METEOR CLUSTERS

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**ABSTRACT**
Anecdotal evidence suggests that meteors often appear in clusters during shower events. Most previous research has strongly suggested that these observations appear to be consistent with a uniform random distribution and further imply that the cluster meteoroids may not be physically associated. This investigation compares numerical and analytical models of the expected number of clusters observed in a meteor shower with temporal behaviour described by a uniform random distribution. Results of this study suggest that the accepted analytical model (a Poisson distribution) significantly underestimates the number of expected clusters.

**RÉSUMÉ**. Selon des observations anecdotales, des météores en groupes semblent apparaître fréquemment durant un évènement de pluie météorique. Jusqu'à présent, la recherche indique que ces observations apparaissent consistantes avec une distribution aléatoire uniforme. Aussi, cette recherche fait croire que ces météores en groupes pourraient ne pas être associés physiquement. Notre étude compare les modèles numériques et analytiques du nombre anticipé de groupes de météores observés durant une pluie météorique avec le comportement temporel décrit par une distribution aléatoire uniforme. Les résultats de cette analyse suggèrent que le modèle analytique habituel (une distribution Poisson) sous-estime considérablement le nombre de groupes anticipés.

## Introduction

Visual meteor observers often remark that meteor showers appear to produce temporally spaced clusters or clumps. These qualitative observations suggest that meteors may be physically related, possibly originating from the recent fragmentation of a larger parent body (Watanabe *et al* 2003). If meteor clusters are physically related, then their frequency must exceed that expected from a uniform random distribution of meteor timings. Previous investigations (*e.g.* Porubčan, Toth, and Yano 2003, Gural and Jenniskens 2000, and Ofek 1999) have strongly suggested that observed meteor clusters are statistical rather than physical in nature and follow the expected distribution produced by a uniform random distribution. However, these investigations may not fully address the issue of meteor clusters and appear to underestimate the number of clusters an observer should expect to witness.

This investigation presents both numerical and analytical models of the expected number of meteor clusters seen in a shower with a temporal spacing that follows a uniform random distribution. For the purposes of this investigation, a cluster is defined as three or more meteors seen within a given interval of time.

## Analytical and Numerical Models

It was assumed in the following numerical model that the time the meteor enters the atmosphere is random and uniformly distributed. This is not strictly true since the number of meteors seen is also a function of the altitude of the radiant and hence the time of night. As well, the number of meteors is a function of the time from the expected peak. However, for the purposes of the following model, these two variables were ignored.

Using a pseudo-random number generator contained in Microsoft *Excel*, a time series of simulated meteor timings was produced. This kind of model is often referred to as a Monte Carlo simulation. To simulate a meteor shower of an approximate zenithal hourly rate of 800, the model produces 800 random numbers between 0 and 1 and then multiplies these by 3600 to convert the random numbers into seconds. The *Excel* "Sort ascending" function is then used to order the timings from earliest to latest, producing the time series ($t_1$, $t_2$, ... $t_i$) where $i = 800$. The model generates 10 samples of 1-hour periods producing a total of 8000 virtual meteor timings.

To extract clusters of three, a floating interval is applied to the time series through the conditional statement:

$$\text{if}(t_{n+3} - t_n) < T, \text{ then } 1,0 \qquad (1)$$

where $n$ is the number of the meteor and $T$ is the interval (*e.g.* 1 second); the output is 1 if true and 0 if false. The true output is simply added afterwards to produce the total number of clusters in a sample. The process is repeated for each one-hour sample and the mean and standard deviation is then calculated.

The analytical model that has been suggested from a number of sources (Porubčan, Toth, and Yano 2003, Gural and Jenniskens 2000, and Ofek 1999) is the Poisson distribution, which determines the number of expected clusters $N$ from the equation:

$$N = n\frac{\mu^x e^{-\mu}}{x!}, \qquad (2)$$

where $n$ is the number of intervals (for example, if using a 1-second interval in a 1-hour time span, $n = 3600$), $\mu$ is the mean rate of meteors per interval (for an 800 meteor-per-hour shower, $\mu$ =.222 meteors per 1-second interval) and $x$ is the number of meteors in a given interval that constitutes a cluster (in this example $x = 3$).

Using the above values, equation (2) produces 5.3 clusters per hour. Taking each 1-hour period as a sample, the numerical model produced 16.0 ±4.9 clusters per hour. To help determine whether the difference between the Poisson and the numerical model was an artifact of the *Excel* pseudo-random algorithm, random numbers from the Web site `www.random.org` were imported into the model and the same analysis was performed. This produced a value of 17.9 ±3.0 clusters per hour.

The significant discrepancy between the Poisson and numerical model appears to originate from the fundamental definition of the Poisson distribution. The Poisson distribution is the probability of finding a given number of points or events "*within a fixed interval of specified length*" (Feller 1968). However, this typically is not how visual meteor observers would notice clusters of meteors. As observers count meteors, they essentially use a moving interval rather than fixed intervals of specified duration to judge whether a group of successive meteors constitutes a cluster. If a cluster of meteors straddles the boundary between two adjacent "Poisson" intervals, then it will not be counted in the Poisson model (Figure 1). However, in a model with a moving or floating interval these clusters would be included. Therefore, the Poisson distribution should underestimate the number of expected clusters reported by an observer using the more intuitive floating or moving interval.

The analysis of the numerical meteor timings was redone using a fixed time-interval characteristic of the above Poisson distribution. The result of this analysis found 5.9 ±1.7 clusters per hour. This is a close match to the above solution to equation (2) and appearing to verify the source of the discrepancy between the two models.

Bruce McCurdy (private communications 2001) observed two clusters of five meteors while observing outside Edmonton, Alberta during the peak of the 2001 Leonids. He estimated that the interval between the first and last meteor was in the order of a second. The model was adjusted to look for clusters of five within an interval of 1 second (between first and last meteor in the cluster). There were 2 clusters of 5 during the 1-hour period at a count rate of 800 meteors per hour and 4 clusters of 5 at a count rate of 1600 meteors per hour.

It may be many years before we see another meteor shower like the 2001 Leonids. However, the much more consistent Perseids and Geminid meteor showers may provide future observational tests for clustering behaviour. Using the numerical model described above, a meteor shower producing 60 meteors per hour (*i.e.* the typical Perseids) should produce 0.74 ±0.34 clusters per hour where the clusters are defined as 3 meteors within a 10-second interval. Therefore, an observer should expect to see about two such clusters within a three-hour observing window. The author has spent numerous hours observing the Perseids, and this does not appear to be an unreasonable expectation.

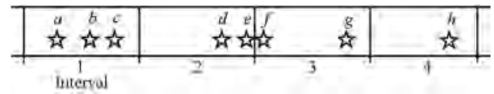


**Figure 1** — In this diagram eight meteors (labeled *a* to *h*) occurred during four concurrent and equal time intervals (labeled 1 to 4). From a visual examination, it is apparent that an observer would notice two clusters of three meteors that occurred within a period of less than one time interval. However, according to the Poisson distribution model, only clusters of three contained within the boundaries of the fixed time intervals represented by the boxes would be counted as clusters. Therefore, the meteor trio *a, b,* and *c* would be classified as a cluster according to the criteria stipulated by the Poisson distribution. However, according to the Poisson distribution criteria, the meteor trio *d, e,* and *f* would not be a cluster, even though the time between meteor *d* and *f* is less than between meteors *a* and *c*. This discrepancy is due to the fact that meteors *d* and *e* are in the second time interval and meteor *f* is in the third and therefore, the Poisson model would not count it as a cluster. The numerical model outlined in this paper uses a floating or moving interval and would count both clusters.

Using the Poisson distribution with input values of $n = 360$, $\mu = 0.167$, and $x = 3$, equation (2) produces 0.24 clusters per hour, This is about a third of those produced by the numerical model and, therefore, an observer would expect to see less than one cluster in a three-hour observing window.

## Conclusion

Observers have frequently reported clustering during meteor shower events. However, meteor shower members appear to occur in a uniform random distribution. This suggests that the meteoroids are not physically associated with each other. From a comparison between a numerical model and a Poisson distribution, it appears that the Poisson model is not appropriate for estimating the number of observed meteor clusters. The numerically determined number of clusters appears to be about three times the number estimated by the Poisson distribution model.

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# DSLR Astrophotography, Part III

by Doug George, Ottawa Centre (george@cyanogen.com)

When starting out in astrophotography, it is best to start simply. That means putting the camera on a tripod, pointing it at the sky, and opening the shutter. It is never quite that simple, unfortunately.

The first problem you will encounter is focus. Older SLR lenses almost always stopped at infinity; you just had to dial them to the end. Modern autofocus lenses (a) won't autofocus on the sky, and (b) can focus past infinity. There are a few solutions for this.

The Canon EOS 20Da is unique in that it was designed for astrophotography. In addition to improved red sensitivity, it has a built-in astronomy focus mode; you can switch into a continuous "live video" mode, and zoom in on the centre of the chip. Get a star in the field, and focusing is easy. Unfortunately, Canon has discontinued the camera and will not replace it with an equivalent model. It seems the 20Da was an anomaly. Someone at Canon Japan was an astronomer and pushed for the release of this model. It was extremely successful by the standards of astronomy products, but that is a drop in the bucket to a company like Canon.

If you don't own a 20Da, the next-best solution is to use a focus magnifier. Most camera companies supply this as an option. I have only tried the Canon unit and find that it barely has enough magnification for the job, so you do have to focus very carefully.

The third method is to use a computer: take a picture, download it to the PC, and then inspect it closely for focus, adjusting carefully until you like the results. Various astrophotography software programs are available to help you with this process.

Most DSLRs are limited to 30-second exposures "out of the box," but you need much more than that for good results. There are two solutions: stack many 30-second exposures, or use an accessory to extend the exposure time. I strongly recommend using *both* techniques simultaneously. Most DSLRs are capable of exposures of at least three or four minutes. If you go much longer, the "dark current" (an inherent defect suffered by all electronic sensors) will fill the pixels and wipe out your picture. To take pictures as long as four minutes in duration you will need an external "bulb" cable. Depending on the camera brand, you may be able to buy a basic manual-release cable or an external timer than can digitally control a sequence of exposures. Another alternative is to buy a custom computer-control cable and use astronomy imaging software to program the camera.

Once you can take four-minute exposures, start taking a bunch of them. If you wish, the exposures can be stacked up on a computer to create hours-long exposures. A single exposure on your electronic camera will be on a par with a very long film exposure; stacking many such shots will let you produce an absolutely stunning result. Special software is required for best results — typically, images need to be perfectly aligned with each other before they are stacked. While you can do this in *Photoshop,* it is most easily done with software intended for astrophotography.

Once you have decent results with tripod photography you will want to try piggyback guiding or perhaps prime-focus astrophotography. This is all pretty much the same as for film photography — except, of course, that you have a much better camera!

Next installment - overcoming the limitations of the technology.

*Doug George is President of Diffraction Limited, an Ottawa-based company that produces astronomical imaging products including MaxIm DL and MaxDSLR. In addition to engaging in astrophotography and observing occultations, he enjoys participating in patrol programs. He has co-discovered one comet visually and co-discovered 12 supernovae as a member of the Puckett Observatory Supernova Search team. Doug is also a Past President of the RASC.*

# Seeing Dark Matter

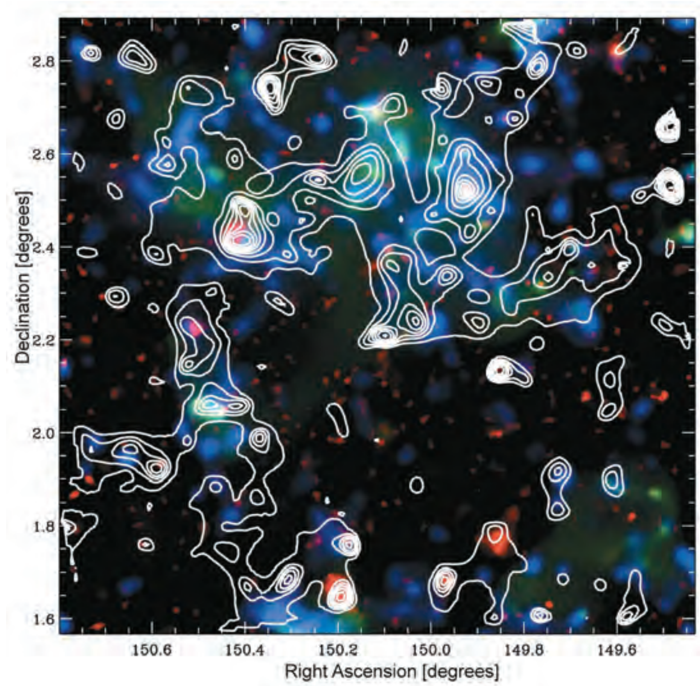
*by Leslie J. Sage (l.sage@naturedc.com)*

Dark matter makes up about 80 percent of the matter in the Universe, yet we have no idea what it is. It doesn't interact electromagnetically, so we can't see it. However, it does interact gravitationally — that's how it was first found — so in principle it's possible to figure out how it is distributed in the Universe. Many theorists have been numerically simulating the distribution of dark matter through cosmic time, as structures grow from the seeds of tiny fluctuations in the Big Bang. Now Richard Massey of Caltech and his colleagues from around the world have mapped the distribution of dark matter from a redshift of 1 (a bit more than halfway back to the Big Bang) to the present (see the January 18 issue of *Nature*).

How do you map something you can't see? As the light from a background galaxy travels past the dark matter lying between the galaxy and us, it is bent a little via a phenomenon known as "weak gravitational lensing." The photons follow paths that are curved slightly due to the presence of mass. (Remember that, according to the general theory of relativity, mass curves spacetime.) The curved paths subtly change the apparent shape of that galaxy. The shapes of half a million distant galaxies were observed with the *Hubble Space Telescope,* and the pattern of their distortions tracks the invisible presence of intervening dark matter.

Most simulations of the formation of "large-scale structure" focus on dark matter because such matter exceeds regular (baryonic) matter by about a factor of six. "Large-scale structure" is simply a fancy way of saying clusters of galaxies and clusters of clusters. As I mentioned earlier, structure got started with small inhomogeneities in the Big Bang — the same "ripples" that were first seen by the *COBE* satellite and for which the discoverers were awarded the 2006 Nobel Prize in physics. The ripples start as areas where there is a little excess of matter next to areas where there is a slight deficit. Over time, through the relentless pull of gravity, regions with extra matter gradually gain mass. The rich get richer, the poor get poorer, and matter accumulates in a network of dense filaments and sheets that surround vast, empty voids.

The Cosmos project (headed by Nick Scoville of Caltech) involved about 1000 hours of observing time on the *Hubble Space Telescope,* looking at 575 slightly overlapping fields to build up an image that is about 1.25 degrees on a side. For comparison, the full Moon has a diameter of about a half-degree. The motivation for choosing that particular image size is that the largest coherent structures observable should be no more than about a degree across. The project is supported by many ground-based observations, and the dark-matter mapping is just one of its results.




The total projected mass, which is dominated by the dark matter, is shown in the contours. Blue traces the stars in galaxies, yellow traces where the number density of galaxies peaks (*i.e.* dense clusters), and red indicates where the X-rays peak.

Massey and his colleagues used ground-based images in 15 wavelength bands, allowing them to estimate the redshift of each galaxy in the survey area. With the images supplemented by this distance information, they were able to reconstruct not only just how dark matter is distributed, but also how that distribution has evolved over time. In agreement with theoretical predictions, they found a filamentary distribution of dark matter that has become increasingly clumpy as it collapsed under the influence of gravity.

Theory also predicts that dark matter has played a vital role in the formation of galaxies. Galaxies should grow inside a gravitational "scaffolding" of dark-matter filaments, and giant clusters of galaxies should accumulate in the most massive concentrations of dark matter where those filaments intersect. This elegant theoretical picture, however, had little observational support. The new map indeed shows very good correspondence between the distribution of visible clusters of galaxies and the dark matter. Areas that are bright in X-rays — where the X-rays come from gas heated in clusters of galaxies — almost always correspond to the biggest concentrations of dark matter. Overall, there is a comforting level of consistency with theory and vindication that, on large scales, the coupled evolution of dark matter and baryons is well understood. Curiously, though, there are some concentrations of dark matter that appear to have no bright matter associated with them. There is lots of work left to do in more detailed comparisons but, if proved real, such localized discrepancies present an interesting puzzle to the physics of small-scale evolution and might even provide clues to the nature of dark matter.

So, even though we still do not yet know what the dark matter is, we can know where it is through its effects on the light of background galaxies.

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# Feature Articles

## Articles de Fond

# So, What's Your SQM?

*by Dan Taylor, Windsor Centre (dctaylor@xplornet.com)*

This odd phrase is a question that you might just be hearing at an astro-gathering in your future. To avoid that embarrassing counter question — "What IS an SQM?" — perhaps the following may be helpful.

SQM is short for Sky Quality Meter. It measures night sky brightness — one function, simply that. The Sky Quality Meter is manufactured in Canada by Unihedron (`www.unihedron.com/projects/darksky`). It is essentially a sensitive light meter that is pointed upward, generally toward the zenith, and that, at the press of a button and with a few seconds processing time, measures and calculates the sky brightness in units of magnitudes per square arcsecond.

- Magnitudes per square arcsecond is defined on Unihedron's Web site:
- Magnitudes are a measurement of an object's brightness, for example, a star that is 6th magnitude is brighter than a star that is 11th magnitude.
- The term arcsecond comes from an arc being divided up into seconds. There are 360 degrees in a circle, and each degree is divided into 60 minutes, and each minute is divided into 60 seconds. A square arcsecond has an angular area of one second by one second.
- The term magnitudes per square arcsecond means that the brightness in magnitude is spread out over a square arcsecond of the sky. If the SQM provides a reading of 20.00, it would be the same as saying that the light of a 20th-magnitude star was spread over one square arcsecond of the sky.

Some ballpark magnitude-per-arcsecond readings under various conditions follow:

- 17.0 poor urban skies
- 18.0 good urban skies, poor suburban skies, Full Moon
- 19.0 fairly good suburban skies
- 20.0 very good suburban skies
- 21.0 typical rural skies
- 22.0 ideal dark-sky site

There is one feature that makes this instrument especially valuable to astronomy and Light-Pollution Abatement (LPA) — its repeatable quantitative measurement of sky brightness. Before the SQM, such measurements were largely subjective and qualitative. Now we have quantitative measurements that permit day-by-day and point-by-point comparisons.

Today, on some astronomy lists, participants routinely trade SQM readings in a good-natured but spirited search for regional dark skies.

The implications and potential for this little meter are far-reaching. It is an especially useful tool in the battle for sensible lighting. In the future, light pollution arguments may be based largely on such measurements.

Robert Dick, RASC Light-Pollution Abatement Committee chair provides some history and highlights the light-pollution abatement potential of sky brightness measurements:

> About thirty years ago, Robert Pike and friends in the Toronto Centre applied an observing test to rate the quality of the night sky. During their summer holidays and trips, they recorded their observations. The result (to my knowledge) was the first light-pollution map for a large region. He reported his results in the *JRASC* in June 1976. That was exactly 30 years ago! It is time to update his map and test his predictions.
>
> 1. The Sky Quality Meter (SQM) allows us to easily update Pike's map — aim and press a button. The results are also more sensitive and qualitative than those of Mr. Pike's original program.
>
> 2. We have bragging rights over our favourite observing sites. However, how good is the site or a specific night? The SQM gives you an immediate calibrated number.
>
> 3. We are concerned about how light pollution is degrading our night skies. It is more effective to give specifics during a public meeting or a meeting of City Council. Say, "The wasted light from the city increases the brightness of the night sky by 50×." instead of "The city sky is much brighter than that in the country." The SQM lets you back up statements with facts.
>
> 4. An important path to a solution is to know the problem. Without quantitative data, there can be only general solutions and these may miss the mark. Without facts, a qualitative argument can be undermined by others who present their own data.

So there you have it — a concise description of the SQM. It is quickly becoming indispensable as a tool in our hobby.

Oh yeah — it would be good to have your SQM reading ready for the next star party (for those bragging rights)!

# High-Flying Auroras

*by Rick Stankiewicz, Peterborough Astronomical Association (stankiewiczr@nexicom.net)*

If you are lucky enough to be flying and it happens to be in the evening hours, here is a tip that has paid off for me over the years. If you get to the airline counter early enough to have a choice of seats, take a moment and consider the direction of your intended flight in relation to the North Star (Polaris). Try to get a window seat on the north side of the aircraft and avoid the wing and engine obstructions if you can. I have done this over the years and on several occasions been rewarded by a unique display of *Aurora Borealis* (Northern Lights). Auroras are a treat at any time or place, but those observed at tens of thousands of feet above the Earth and while you're traveling at 800 kmh can be extra memorable.

The first time that I had the pleasure of such a display, I was flying from Hamilton to Winnipeg in March 2001. On a late flight aboard WestJet, I happened to have a north-side seat. West of Thunder Bay around 9:45 p.m., I looked out over the wing tip and noticed a strangely familiar glow in the distant line of the horizon. We were at 35,000 feet and traveling at 800 kmh and the dance of the auroras had started. I was fortunate enough to have my 35-mm camera and a tripod with me on this flight, so I started taking pictures as I would on *terra firma*. With the camera pressed against the window (to stabilize movement and reduce reflections) and the shutter locked open for 20- to 40-second time exposures on 200 ASA film, I was able to register images that are quite unique. Considering that the jet was floating up and down a bit during the exposures, I was very pleased with the results.

Figure 1 — A wide-angle view out the right-side window to the distant aurora.

Figure 1 shows the wing tip of the jet (for perspective) and the initial auroral glow in the distance. The aurora slowly moved and danced in different shapes of homogeneous arcs as the minutes rolled by. The movement of the jet is obvious in the distorted images of stars in the photo.

The second shot (Figure 2) was taken about 15 minutes later as the display intensified significantly and we passed over the community of Dryden, Ontario (approximately 50 degrees latitude). Lights on the ground show up as golden streaks during time exposures, and the movement of the plane becomes even more evident. The display was magnificent! The arcing was still prominent, but now hints of colour changes from green to red

Figure 2 — A narrow-angle photo taken near Dryden, Ontario shortly after Figure 1.

became evident. From an aerial perspective, auroras are nothing like those you are used to seeing from the ground. You can get a sense of what the Earth-orbiting astronauts must feel like when they see such things from space. The night sky, framed by ground lights that poke out of the dark, is black to the horizon except for a few stars in the heavens. I am amazed that, even at 35,000 feet, it appears you are above the distant auroras, and that there is a hint of the Earth's curvature evident in the shape of the auroral bases. I have since seen images of the auroras taken from space, and they had nothing on this display!

I have been fortunate enough to have a few other occasions where auroras were visible while in the air, but none as amazing as the experience described above. I never give up trying for another opportunity to witness these free light shows. They are always unique and worth the effort. On your next evening trip by air, keep in mind the possibilities that await an astute observer. You may be rewarded and, if you are prepared to record the memory, it will be an added bonus.

Bon Voyage!

*Rick Stankiewicz has been an avid amateur astronomer since 1997 and has been the Vice President of the Peterborough Astronomical Association since 2003. He has been published in SkyNews and Sky & Telescope magazines and on numerous Web sites over the years. Rick has an enthusiasm for photography and the wonders of the Universe and enjoys sharing this passion with others.*

# John A. Brashear and SL Phoebe: The Kingston Connection

*by Leo Enright, Kingston Centre (tcorbor@frontenac.net)*

**Abstract:** John A. Brashear (1840-1920), the most eminent lens crafter and telescope builder of his era, a man whose name is usually associated with Allegheny Observatory and other sites in Pittsburgh, had a little-known connection with Canada. In fact, he owned an island on a beautiful lake in southern Ontario, and in the summertime enjoyed boating, along with his wife and friends, on that lake in a steamboat built in Ontario. Over the past eight years, a group of dedicated volunteers from Kingston, Ontario has repatriated that boat from New York State, has had her declared a "historic property of Canada," and has lovingly restored her to the lustrous beauty she once was — an amazingly ambitious project.

**Résumé:** John A. Brashear, (1840-1920), le plus éminent fabricant de lentilles et de téléscopes de son ère, un homme dont le nom est le plus souvent associé à l'Observatoire d'Allegheny et autres sites à Pittsburgh, a un lien peu connu avec le Canada. De fait, il était propriétaire d'une île dans un très joli lac dans le sud de l'Ontario. Durant l'été, en compagnie de sa femme et de ses amis, il aimait naviguer sur ce lac dans un bateau à vapeur construit en Ontario. Durant les dernières huit années, un groupe de bénévoles dévoués de Kingston, Ontario ont rapatrié ce vaisseau de l'État de New York, ont réussi à le faire déclaré "propriété historique du Canada", et avec grand effort, l'ont restauré à la condition neuve de sa construction — un travail extrèmement ambitieux.

## 1. The Man Called "Uncle John"

In a recent astronomy magazine article about the differences between the telescopes of today and those of about a century ago, the author stated that "Many modern commercial scopes pale by comparison in side-by-side optical tests with refractors made by Alvan Clark & Sons or John Brashear. The Clarks and Brashears of telescopes are the Stradivariuses and the Guarneriuses of violins, ... the Packards and Duesenbergs of luxury cars."[1] Indeed, just as was the case with the Alvan Clark instruments of the mid-19th century, so in the late 19th and early 20th centuries, the lenses, mirrors, and telescopes

[1] Bell, Trudy E.: *Rape of the Observatory:* Focal Point article: Sky and Telescope, June 2006, p. 110

Figure 1 — A drawing of John A. Brashear, showing his appearance in later life.

that John A. Brashear (Figure 1) designed and built were among the most respected, the most used, and the most sought after in the world. In that era, and for a long time thereafter, John Alfred Brashear was known throughout the world as an engineer and designer of precision astronomical instruments, and a self-taught astronomer and astronomy educator. Less widely known, but still deeply felt by those who knew him well, was the fact that Brashear was a kindly and gentle man, a true humanitarian, a husband very deeply devoted to his loving wife, and a person who treasured the precious time he spent on vacation with his wife and friends. What very few people in the astronomical community realize is that much of the treasured recreation time of his later years was spent at a considerable distance from the city of Pittsburgh and its Allegheny Observatory, with which he has long been associated. In fact, his dearly loved "home away from home" was the island he owned on a lake in southern Ontario and the very special boat that he used on that lake. It was a boat he lovingly called "Phoebe" after his dear wife and soul mate of many years. The life of its owner and the history of the boat are fascinating, even edifying, stories.

John Alfred Brashear was born of Scottish immigrant parents on November 24, 1840, in Brownsville, Fayette County, Pennsylvania, USA, a town about 80 kilometres southeast of Pittsburgh. He received only a common-school education, but by his own very persistent efforts he valiantly struggled from the obscurity to which he might have seemed destined, to a great and glowing success in his chosen field. He was, in fact, largely self-educated.

At a time when John was still an infant, the Great March Comet of 1843 was attracting worldwide attention. One of the people who took advantage of this interest in astronomy was Squire Wampler of McKeesport, Pennsylvania, who built a telescope and for several years travelled about with it, offering customers a view of celestial objects. The story is often told that, with five cents from his grandfather, nine-year old John had his first look through a telescope, Wampler's instrument, and it was a view of the planet Saturn. He said he was "smitten for life."

Growing up in Brownsville, John was influenced by his maternal grandfather, Nathaniel Smith, who was skilled in many trades, and who was also an amateur astronomer and lecturer. John watched him carefully and learned — both astronomy and various mechanical pursuits. He also learned from his mother Julia, a devout Methodist, to be humble, kind, and caring.

At the age of 20, he left Brownsville in search of a trade. For a time, in Louisville, Kentucky, he built caskets and then steam engines. Later he moved to Pittsburgh, and for 20 years (1861 - 1881) worked as a millwright in a plant owned by "Zug and Painter." Beginning in 1881, John worked for McKnight Duncan Co. as their master millwright, responsible for the entire mill's machinery. Meanwhile, he had married Phoebe Stewart, in spite of the objections of her parents. It proved a wonderful union: their interests were very similar, and their bond grew ever stronger. They were a great team, with Phoebe always supporting John's various projects.

In 1870, John and Phoebe built their own house at 3 Holt Street in a working-class district high on a cliff overlooking Pittsburgh. Since buying a telescope was out of the question for their meagre income, they bought an old coal shed and converted it to a backyard workshop to build a telescope; in it, John installed a lathe connected to a boiler and engine. There, every night after a 12-hour day in the mill, he worked at shaping a 5-inch piece of glass into a lens. Phoebe became very skilled at fine polishing — "fining" as it was called in those days.

They looked forward to completing the lens for their first telescope. It had taken 700 nights' work. Then a terrible accident happened — it fell and broke into two pieces. After recovering from the shocking setback and renewing their determination to build a telescope and share the heavens with their neighbours, they soon began work on a new piece of glass donated by a friend. The task took three years' work and was finally ready in 1875. Fitted into a nine-foot tube, it was part of a telescope that poked through the second-floor window of their house. John was thrilled to be able to renew an acquaintance with the Saturn he had first seen 25 years before. To John's delight, all his neighbours could enjoy the views. Eventually the telescope looked through a hole in the roof of the house, making it accessible to many more celestial wonders. Everyone in the city who was interested was invited to share the view — something that was not so for the other "telescope society" that existed in Pittsburgh at that time.

John soon met Samuel P. Langley, who was an astronomy professor at Western University of Pennsylvania. They became close friends and associates for 30 years, working together on flight research, and almost succeeding in beating the Wright brothers into the air.

Perhaps John Brashear's greatest achievement was the development of a formula for silvering telescope mirrors, one that has been used ever since. The discovery was part of a trial-and-error process. After the couple had spent a year grinding and polishing one particular mirror, the glass broke as they were applying the silver. John was crushed, but Phoebe did not allow him to despair. He experimented with several silvering methods, eventually developing one of his own. Later he would use it on the 100-inch mirror for Mount Wilson.

In 1881, the year John's day job advanced to that of a master millwright, he placed an ad in *Scientific American*. He would make lenses for amateur astronomers. He was absolutely flooded with requests from both amateurs and professionals. Little wonder that, before long, John simply collapsed from exhaustion and had to spend three weeks in bed to recover.

Fortunately at the right time, a well-to-do individual, William Thaw, came to the rescue and offered to subsidize John's operation. Along with his son-in-law, James McDowell, John formed The John A. Brashear Co. Ltd., and for many years they were able to produce lenses and mirrors that became renowned throughout the world. Prominent on the very long list of their optical achievements was the 72-inch mirror for the Dominion Observatory near Victoria, B.C., for a short while the largest mirror in the world, and later, for a much longer time, the second-largest. In addition, they polished and corrected the plates for the Rowland Diffraction Gratings that were used by spectroscopists worldwide, and that enormously advanced the science of spectroscopy.

A list of some of the other major instruments for which Brashear was responsible would have to include the following (note that these items may appear as multiple productions on the list; in fact, most such items were made years apart from each other):

1. Eleven large spectroscopes, including those at Yerkes, Lowell, and US Naval Observatory
2. Seven 12-inch lenses for major refractors in different parts of the world
3. Eight 12- to 18-inch lenses for major observatories throughout North America, including the 15-inch at the Dominion Observatory in Ottawa
4. Thirty-inch mirrors for both Allegheny Observatory's Keeler Telescope and Yale University Observatory
5. a 37-inch Cassegrain mirror for an expedition to Chile
6. a 37-inch mirror for University of Michigan Observatory
7. a 19-inch mirror for the Dominion Observatory, Victoria, B.C.
8. a 20-inch lens for the Chabot Observatory, Oakland, CA
9. a 24-inch lens for Swarthmore College Observatory
10. a 30-inch lens for the Thaw Memorial Telescope in Allegheny Observatory

Brashear's smaller lenses and mirrors are far too numerous to list, or even categorize. One was a high-quality 4.2-inch Brashear refractor purchased in 1910 by a doctor in Regina, an event that shortly thereafter provided the impetus for the founding of the first RASC Centre west of Toronto. The Regina Astronomical Society used the instrument until the 1980s. Still owned by the Regina Centre, it is now part of an astronomy display at Moose Jaw's Western Development Museum, which has undertaken to restore this fine refractor (Figure 2).

Figure 2 — The 1910-vintage 4.2″ Brashear refractor owned by the RASC Regina Centre and currently displayed at Moose Jaw's Western Development Museum. (Photo credit: Vance Petriew, Regina Centre)

Allegheny Observatory occupied a very special place in the life of John A. Brashear. The "Old Allegheny" with its 13-inch refractor had stood on Northside Hill in Pittsburgh since the 1850s. The "new" one, designed and built between 1900 and 1912, was a cooperative effort among Thorston Billquist, James Keeler, and John A. Brashear. It was built in the grand classical design, and under its three domes it housed three major telescopes: (1) the 13-inch Fitz-Clark refractor (primarily for public viewing), (2) the Brashear 30-inch Thaw refractor (used for photography), and (3) the Brashear 30-inch Keeler reflector (used for spectra and the study of double stars). The 30-inch Brashear lens, placed in a 47-foot-long tube weighing over 3600 kg, has been used for astronomy ever since. Since completion, astronomers have produced over 110,000 parallax plates using the instrument! This historic observatory was intimately associated with the careers of three great astronomers: Samuel P. Langley (known for discoveries in solar physics), James Edward Keeler (recognized for discoveries relating to Saturn's rings), and John A. Brashear (who was made director of the institution). Eventually Keeler and his wife and Brashear and his wife would be buried there.

With his always-generous nature, John never believed in trade secrets or patent profits. His discoveries and inventions were for the benefit of mankind; throughout his life, he always shared his knowledge and experience freely, continuing the tradition from the days when he shared that first telescope he had installed in his own home. He never turned down a request from an amateur. Moreover, he always found time to spread joy among those with whom he associated. John often played with the children at a nearby home for the blind, and frequently went to visit, and speak at, a penitentiary. He wrote astronomy articles for four newspapers. Many hundreds of people came to his home to use his telescope. Throughout all of Pittsburgh, John Brashear was known simply as "Uncle John."

**2. John A. Brashear and his Three Boats**

The year 1895 was an *"annus horribilis"* for John and Phoebe Brashear. They had more than a fair share of misfortune. Their only son died from typhoid fever. In caring for the boy, Phoebe became overworked. She fell, broke her leg in several places, and was crippled for life. Little wonder that they decided to do as many of their friends had done — "holiday in Muskoka," which was "up in Canada." As their friends kept telling them, Muskoka had unpolluted air, clear water, and dark skies. Who could resist? For three years the couple went each summer to a rented cottage on Lake Muskoka, 140 kilometres north of Toronto. Then, in 1898, they bought an island in the lake near the village of Beaumaris, and immediately named it *Urania.* They loved the setting. They had two sailboats and three rowboats. John adapted one of the rowboats for Phoebe.

In 1901, with money that they had saved for a trip, they bought a steam launch (later called The Allegheny) built by the Davis Dry Dock Company of Kingston, Ontario. The DDDC was already a long-established company in Kingston, having been founded there in 1867 and later expanded when Davis' three sons joined with the founder to establish the R. Davis and Sons Company, one of the several successful boat-building companies that grew up in the area. The Davis yachts were graceful and distinctive and enjoyed a solid reputation far and wide. After she had carried them for many excursions on Lake Muskoka (the log tallied 2700 miles), the SL Allegheny was heavily damaged by fire one night. Before long, John's good friend, the wealthy industrialist Andrew Carnegie, presented him with a new and larger steam launch, again built by the DDDC. John surprised his loving wife and named it after her; calling it the "SL Phoebe." Together they enjoyed it every year on their summer vacations until Phoebe's death in 1910. John was heartbroken. He temporarily lost interest in boating, and almost in life itself, but eventually recovered from the shock. Then in November 1913, John was shaken again by the news that his boat had again been destroyed in a fire.

John's many friends in Muskoka thought, now that he was 73 years of age, he should "really retire." They raised $5000 (the equivalent of $89,000 in today's dollars) for the purchase of a new boat and boathouse. The new SL Phoebe II was, once again, built at the DDDC in Kingston in 1914, with Matthew Davis as the chief builder. She was 48 feet long and (like all the other Davis-built "Muskoka launches" that had to travel by railcar from Kingston to Gravenhurst and were thus limited in width by what the rail companies would allow) 9 feet wide, and equipped with a Davis-built wood-fired water-tube boiler and a 65-horsepower Davis two-cylinder steam engine (with a 14-inch and an 8-inch cylinder). Typical of the Muskoka launches of the period, she had fine bow lines and what was called a "canoe stern." The enclosed forward cabin/pilot house had curved

Figure 3 — SL Phoebe II, at age three months, in a photo taken on August 10, 1914, is moored at Muskoka Wharf in Gravenhurst awaiting Brashear and his family and guests for a cruise on Lake Muskoka. (Photo credit: Ken Robinson/Friends of the Phoebe)

Figure 4 — The repatriated SL Phoebe II decked out for a "sail past" in Kingston Harbour. The date is July 2, 1983, at the beginning of SL Phoebe's final cruise. In the background is historic Kingston City Hall, once the legislative building for the newly united provinces of Upper and Lower Canada in the 1841-1842 period, following the Union Act when Kingston was the national capital. On the far left in the background, the larger of the two domes is that of another historic Kingston landmark, St. George's Anglican Cathedral. (Photo credit: Roger Compton/Friends of the Phoebe.)

windows; the centre-section's boiler room had roll-up side curtains; the enclosed aft-cabin had washing facilities on the port side; generous fore- and aft-decks allowed passengers plenty of room outside the cabins. Mahogany panelling in both cabins reflected the taste of an age of elegance. Nickel-plated deck fittings gave a pleasing effect and a touch of elegance (Figure 3).

Dr. Brashear, as he was now known, did indeed "really retire" and came to Lake Muskoka for longer periods of time. His new mahogany-clad launch was a gem of the Edwardian era; it could accommodate 10 to 15 day-travellers, and its owner was always welcoming and generous to all the neighbours, and to everyone else who paid a visit to Isle Urania. Friends called him "the Good Samaritan." At his house, he always had a telescope on the veranda for the people of the neighbourhood. He loved to spend evenings stargazing under the pristine Muskoka skies, and was especially delighted when the *aurora borealis* put on a spectacular show for his many friends.

John A. Brashear died on April 8, 1920. In Pittsburgh, church and school bells rang to mark the sad occasion. An immense funeral showed how many people had been touched by his life. His body was laid to rest beside that of his beloved wife in a crypt below the Keeler Telescope at Allegheny Observatory. On the plaque marking the crypt are words from a poem that John and Phoebe had long cherished: "We have loved the stars too fondly to be fearful of the night."[2]

Over the years, a lunar crater, a Martian crater, and a Minor Planet (Asteroid 5502) have all come to bear the Brashear name. A museum in honour of his achievements stands in Pittsburgh near the spot where he ground the glass for his first telescope. The most enduring tribute of all has been the many advances in the science of astronomy made at observatories using the lenses, mirrors, and spectroscopes produced by "Uncle John" and later by the company he started.

The Isle Urania has passed into the hands of Jim Grand of Gravenhurst. The Brashear cottage and Phoebe's boathouse have been lovingly restored.

### 3. SL Phoebe II's Long Life and Current Status

Between 1920 and 1979, SL Phoebe II had a series of five owners. She was moved to Ohio in 1949, and in 1959 began a 20-year period of operation on Skaneateles Lake in upper New York state. When she went up for sale in 1979, members of Kingston's Frontenac Society of Model Engineers moved quickly to guarantee a down payment for the historic craft and to insure a Canadian buyer. With the help of a Canadian National Museum Fund grant, Mr. Jack Telgmann, the curator, and the other directors of Kingston's Pump House Steam Museum (PHSM) made arrangements to buy SL Phoebe. She was declared a "National Treasure" under the Cultural Properties and Heritage Act of Canada and in 1979 was repatriated, taking up residence in a boathouse beside the PHSM. In 1982, she was featured prominently in Ottawa as the lead boat in a flotilla marking the Rideau Canal's 150th anniversary, and, in July 1983, she joined a 322-day excursion for a 17-steamboat flotilla between Kingston and Clayton, New York, one in which the Phoebe was both the "lead boat and baggage carrier for the crews of the flotilla."[3] That was her last venture on water; the gracious lady was now elderly and showing her age.

In the 1990s, several assessments showed that her keel and keelson were rotting and her hull had suffered displacement. With the City of Kingston as her new owner, a huge restoration project was undertaken. Beginning in 1998, a group of 19 highly skilled volunteers from the Kingston area, coordinated by Henk Wevers, a retired Queen's University mechanical engineering professor, invested over 17,000 hours of free labour and over $60,000 in private donations and gifts in kind. By the end of the six-year restoration project, Phoebe's transformation was complete — to a stately, dignified Edwardian steam launch, and her market value was given as $500,000. On August 22, 2003, a gala ceremony held at the Pump House Steam Museum marked the completion of this remarkable project. In the post-restoration period, a strategic plan for the SL Phoebe was put forward, calling for the raising of an additional $70,000 to build a new boathouse and exhibit area.

A group called "Friends of the Phoebe" was formed and its enthusiastic members have joined in a partnership with the City of Kingston in caring for the Phoebe on a daily basis.

Over the next two years, Kingston's proposed waterfront renewal will include a new boathouse and exhibit area for the SL Phoebe, which continues to be heralded as not only a tourist attraction for the City of Kingston, but as an example of an elegant boating style that was enjoyed in a bygone era by gentlemen like John A. Brashear and his guests. Present plans call for the Phoebe to be displayed on a custom trailer at the Pump House Steam Museum in the summer of 2007, and inside the newly completed structure in the year 2008. At that time,

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[2] Williams, Sarah: The Old Astronomer To His Pupil, from *Best Loved Poems of the American People,* Hazel Fellerman, ed., Garden City Publishing Co., Garden City, N.J., 1936, pp 613-614. (The poem, a rhythmic sixteen-liner, composed of four stanzas, each having two rhyming trochaic octometric couplets, is told from the point of view of an aging astronomer asking his young student to carry on, and accept criticism willingly, for his master is soon going to join Tycho Brahe. The line on the crypt was slightly paraphrased; the poem's final couplet reads

*Though my soul may set in darkness, it will rise in perfect light;*
*I have loved the stars too fondly to be fearful of the night.*

[3] Wanklyn, David, *The Last Cruise of the SL Phoebe,* an article appearing on the Friends of the Phoebe Web site. Mr. Wanklyn was himself involved in that 17-boat flotilla; he was the skipper of the boat that immediately followed Phoebe, and, using what was then called a "walkie-talkie," kept in contact with her crew during the cruise.

the SL Phoebe will have safely returned to a suitable exhibition site quite near to the place where she was built for the enjoyment of "Uncle John" in 1914.

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1. Kingston Whig-Standard, feature front-page article, Thursday, August 7, 2003: *A Labour of Love: Phoebe Restored To Former Glory.*
2. Pittsburgh Post-Gazette (Web site): Brashear Obituary, April 8, 1920.
3. Personal conversations with staff/volunteers of Pump House Steam Museum, Kingston, Ontario.
4. Pump House Steam Museum (Kingston) two-page visitor brochure: The Phoebe Restoration Project.
5. Conversations and correspondence with Henk Wevers, coordinator of the Phoebe Restoration Project.
6. Several parts of the helpful Web site: `http://db.library.queensu.ca/phoebe`. This web site is recommended to readers both for additional background information, and for ongoing updates regarding the future status of, and exhibition times and places for, SL Phoebe.

*Leo Enright is editor of our Society's* Beginner's Observing Guide. *He would like to assure readers that in the moments when he finds time to go boating on Sharbot Lake, it is never in a lovingly restored, mahogany-clad steam launch from the Edwardian era, but in a fibreglass craft of 1971 vintage, one in serious need of some restoration.*

## Deep-Sky Contemplations

# The Great Rift and the Coal Sack

*by Doug Hube (jdhube@telus.net) and Warren Finlay (warren.finlay@interbaun.com), Edmonton Centre*

The subject of the previous column in this series was NGC 2261, a reflection nebula or a cloud of interstellar dust with a source of illumination on "our side." Light from the stellar source is reflected or scattered out of its original direction of travel, meaning an observer on the "other side" will receive less light than she would otherwise: she would observe a *dark nebula*.

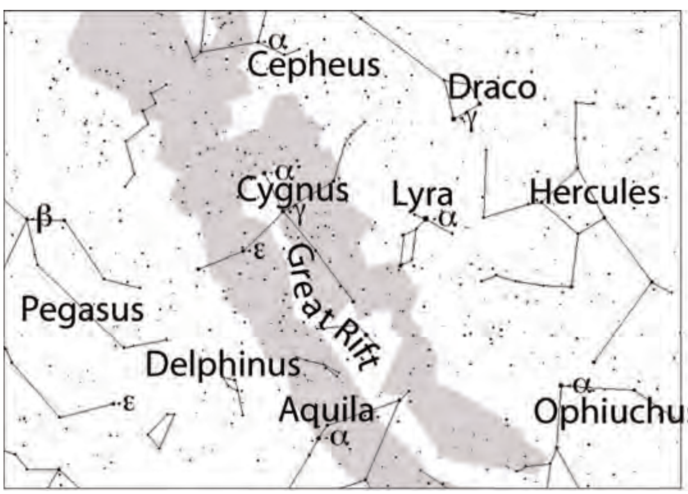



Figure 1 — Location of the "Great Rift" in Cygnus.

William Herschel may have been the first astronomer to note the presence of "holes" within the star fields of the Milky Way. E.E. Barnard, a pioneer in astrophotography, detected many such "holes." On page 541 of *Problems in Astrophysics* published in 1903, Agnes Clerke states, "They are...what they appear to be, namely, intervals of star-less space...." That those "holes" are *not* due to the absence of stars but, rather, to the presence of obscuring matter was not appreciated fully until well into the 20th century. The more general distribution of low-particle-density obscuring matter, diffuse interstellar dust, was not accepted generally until the late 1930s. The detection of the latter was made possible by the dust's differential effect on incident light: Short wavelength (blue) light is more efficiently reflected and scattered by dust particles than is the longer wavelength (red) light. Thus, stars observed through intervening interstellar dust not only appear fainter than they otherwise

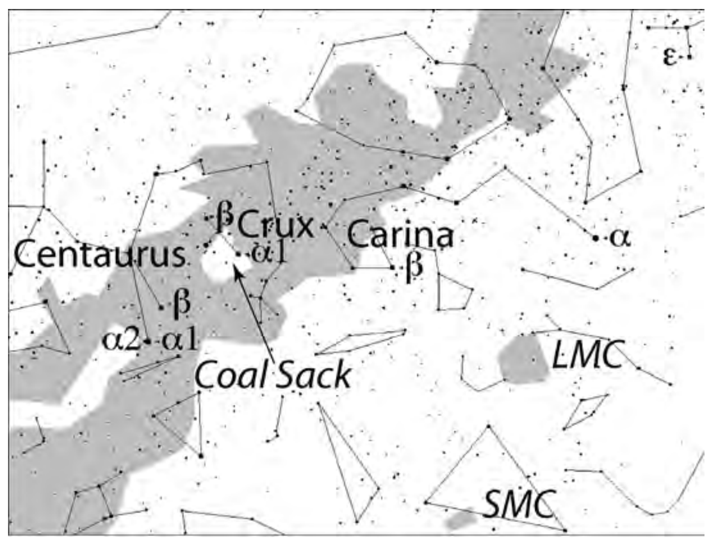



Figure 2 — Location of the "Coal Sack" in Crux.

would, they also appear redder. (The practical, or observational, effect is that such a star is redder than its spectral classification would imply.)

Figure 3 — Image obtained by Doug Hube of the Milky Way from Cepheus through Cygnus and Scutum to Sagittarius. (Nikon D70 with 10-mm lens, August 6, 2005). The Great Rift is the dark band left of center.

Those who are not familiar with the night sky would, no doubt, be surprised at being told that objects that do not emit light can be observed with the unaided eye. In contrast, those who are reading this column know that two of the most impressive features of the night sky are examples of those dark "holes" in the Milky Way. Fortunately, Nature has played fair and placed one of the best of them in the northern hemisphere, and another in the south. Following the band of the Milky Way from Cassiopeia through Cygnus and on into Aquila, one is struck by the separation of that band of diffuse light into two distinct streams beginning just south of Gamma Cygni, running parallel to the long neck of the Swan, and continuing into Scutum. The "Great Rift" in

Figure 4 — Image obtained by Alan Dyer of the Milky Way including portions of Centaurus, Crux, and Carina. (Canon EOS 5D with 35-mm lens, June 27, 2006). The Coal Sack is just left of centre.

Cygnus is due to the presence of foreground interstellar dust — probably several overlapping clouds of dust. While you might regret your inability to observe some of the distant nebulae and star clusters that must exist in that direction, the intervening cloud of dust seems to us to be suitable compensation. From a dark site on a clear summer evening, to look up and see that dark cloud "hanging" over one's head can leave a sense of foreboding...especially if you have read Fred Hoyle's novel *The Black Cloud!*

Southern-hemisphere observers have their own favourite dark cloud — the "Coal Sack" in Crux. While not as large (in apparent size) as the Great Rift, the Coal Sack is much darker and its boundaries better defined. On the southeast side of the Southern Cross, the Coal Sack is as dark and distinct as to have an almost three-dimensional character when observed from a dark site. With an apparent diameter of 5 to 6 degrees and a distance of order 500 light-years, the Coal Sack has a true diameter on the order of 50 light-years.

While these dark clouds hide more distant objects from our view, they also hide from our optical vision internal features that are relevant to the formation of stars and, perhaps, of life. More about interstellar dust will appear in later columns.

**Acknowledgement:** The authors thank Alan Dyer for providing, and giving permission to publish here, one of his outstanding images of the Coal Sack (Figure 4).

*Doug Hube is a professional astronomer actively retired from the University of Alberta and Associate Editor of this* Journal. *Warren Finlay is the author of* Concise Catalog of Deep-Sky Objects: Astrophysical Information for 500 Galaxies, Clusters and Nebulae *(Springer 2003), and is a professor of engineering at the University of Alberta.*

# Observing Passion

*by Paul Heath, Halifax Centre (pheath@eastlink.ca)*

The sand was still warm as my father and I climbed up the back of the dune. We settled a short way down the dune facing out towards the lake. As we lay back on our blanket, the Milky Way stretched out overhead and stars filled the sky. My Dad pointed out the Big Dipper, then said to look up and watch. Shortly a meteor swept across the sky.

"WOW!"

"There are more — just lie back and watch," my father told me. As we settled back, I began to feel a breeze off the lake. I could smell the beach debris and hear the waves washing onto the shore. As we waited and watched, more meteors shot across the sky; and as the shower intensified, the meteors began to shoot out over the lake. A loon called in the marsh behind the dunes and curlews piped from down the beach. Then the sky lit up as a double meteor shot down the sky diving deep into the lake. We watched for two or three hours until the breeze grew to a chilling wind. Climbing back up the dune I fell many times, trying to walk up that sandy hill and watch the sky at the same time.

What is it that keeps one observing the night sky?

A passion begins, often with a pivotal event that affects one's psyche - a moment of awe and amazement that drives one to explore further into the wonder that he or she has seen. Yet this event may not overcome the many changes in one's life. Often it is a series of "awe events" that help to continue that passion to explore; events that capture again that mix of sight, sound, smell, and touch that first amazed and filled our minds with wonder.

We continue to observe, with search programs or new toys, but our real hope is for that moment of awe and wonder that will refresh our first moment of amazement - the moment that our passion began. To become again that seven-year-old lying on warm sand and watching the stars fall into a summer lake.

No matter what your "AWE" moment was, may your zeal keep you under the stars so you will discover the next moment of wonder that will keep your infatuation strong, and perhaps help pass the passion along.

# Take Care of Your Valuable Telescope Equipment and Accessories

*by Ray Khan, Khan Scope Centre*

In the course of doing telescope repairs and maintenance, we see a lot of circumstances where some preventative measures might have saved a trip to the shop.

Over the years, we have encountered a hornet's nest in the base of a customer's Schmidt-Cassegrain telescope drive base, grasshoppers crawling inside a SCT corrector plate leaving a "wonderful" residue, dog and cat hair inside a Dobsonian telescope, and cobwebs in telescope tubes, complete with a dead spider! So here are a few tips on taking care of your telescope and other optical equipment:

1) Store your equipment in a dry area. Try to avoid musty or damp areas as it is possible for fungus to damage your optics over a period of time. Cover your equipment with a breathable cloth material if possible or at the very least a tarp — even a garbage bag is better than nothing.

2) Keep dust out of your optical system. Put a plastic plug in any focuser, or star diagonal. Cover the front of your instrument. Most telescopes today come with some sort of dust cover for the front objective. For Dobsonians and Newtonians you may be able to find some inexpensive plastic covers in the plumbing section (used to cap the ends of pipes).

3) Store your eyepieces and accessories in cases. Avoid putting them in coat pockets as they will often pick up small pieces of lint that are difficult to remove. That extra Jovian satellite you see may be just another piece of pocket fluff. Cases come with another benefit: when you are finished observing, you will be able to account for everything by making sure all of the slots are filled.

4) Before storing your equipment, ensure that all surfaces are dry. If necessary, let the equipment air dry completely before putting it away. You may use a dry, soft cloth on the tube, but be careful not touch the optics as tempting as it may be. The same goes for your eyepieces and other telescope accessories.

5) Carry a product called a "Lenspen," available at telescope and photo stores — it allows you to remove fingerprints from eyepieces, and from Maksutov and Schmidt-Cassegrain corrector plates. If fingerprints remain for a while, they will etch into the coatings (a great way of identifying a telescope if it is stolen, but not much else!).

6) Store binoculars in the case in which they came. Do not leave them in your car as changes in temperature over time can damage the cement in the objectives. If you want to keep a pair for handy use, you are better to buy an inexpensive "back up" pair. Knocking binoculars around in a car trunk or anywhere else can affect their collimation and bring a very unwelcome double image.

Protect your optical investments with these few simple suggestions and they will reward you with years of trouble-free observing pleasure!

*Ray Khan, is an active amateur astronomer who enjoys testing out new equipment, and who also owns and manages Khan Scope Centre, a telescope retail & specialty store located in Toronto. Ray is also a member of the Toronto, Mississauga, and Niagara Centres.*

# The "Live Session" Web page

*by Walter Macdonald (walter.macdonald@sympatico.ca)*

One night as I sat in the control room at Winchester Observatory, the thought occurred to me that it would be neat to be able to let people watch the observatory in action. There are technologies such as Webcams or PC remote-control software that do something along these lines. The automation software I use to run the observatory, called ACP, actually has an Internet-enabled version that lets one person at a time take control of the observatory and acquire images (as David Levy demonstrated at the 2006 Ottawa GA), but that was not what I had in mind. Besides, because I am using 100% of the available imaging time, there is never any left over for anyone else anyway!

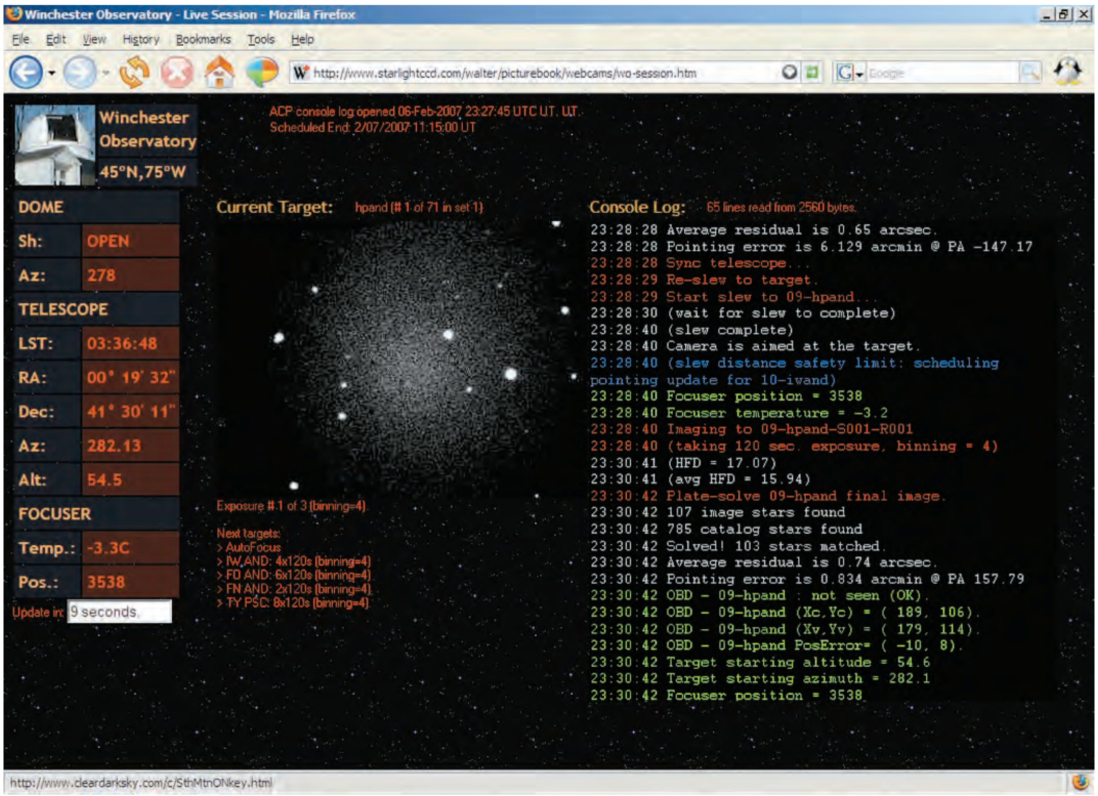



Figure 1 — The Live Session Web page - a jpeg preview of the latest image at centre, with information about the dome, telescope, focuser, and output from the ACP log file. Exposures are typically 120 seconds, so the image does not update more often that this; other textual information updates every 20 seconds.

What I finally came up with was a hybrid solution. I modified ACP's AcquireSupport module so that it would also produce a jpeg version of each image as it was taken. Then I wrote some JScript code to build a Web page using the contents of the ACP log file as well as information queried from some of the ASCOM objects being used during a session (*i.e.* focuser, telescope, and dome). After some testing and refinement, I had a pretty good-looking solution! The JScript reads the information it needs and writes out HTML code every 20 seconds. The Web page is designed to automatically refresh itself so that viewers only have to sit back and enjoy the show. Since the Web page and JPG image size only total about 15k, even dial-up surfers can watch with ease. A sample screen is shown in Figure 1.

I've been very pleased with how this little project has turned out and, based on the feedback received, a number of RASC and AAVSO members have enjoyed it as well. I look forward to the day when more robotic observatories will have such (hopefully free!) Web pages so we can all "peek over their shoulder" as they peer about the sky!

Live Session can be accessed at `www.starlightccd.com/walter/picturebook/webcams/session/wosession.htm`

*Walter MacDonald runs Winchester Electronics, a company that sells astronomical imaging products and observatories. He is a long-time astrophotographer, deep-sky, and variable-star observer. These interests have culminated in his robotic house-top domed observatory that images the heavens on every clear night. In addition to submitting observations to the AAVSO, Walter also hunts for supernovae with the Puckett team.*

Through My Eyepiece

# Comets Seen and Unseen

by Geoff Gaherty, Toronto Centre (geoff@foxmead.ca)

First of all, to get this off my chest, I did not manage to see Comet McNaught, though not through want of trying. Between clouds and ice crystals, I was foiled at every attempt. The closest I came was on the morning of January 10: I scanned the dawn sky for an hour without any success, took a brief break, and then came out at 8 a.m. to see this:

Figure 1 — A sun pillar. Photo by the author.

For a brief moment, I thought the comet had flared up overnight. Then a few seconds later the Sun appeared in the trees directly under my "comet" and I knew I was looking at a sun pillar, one of the largest and most beautiful I have ever seen. I also knew that the ice crystals that were causing the pillar were also the reason why I hadn't seen the real comet.

This was not the first comet I have missed. That distinction goes to Comet Arend-Roland. That comet had a path opposite that of Comet McNaught. It started out as a modest object in the southern hemisphere in the early months of 1957, rounded the Sun in mid-April, and first became visible to observers in the northern hemisphere on April 20. One of the first people to spot it, on April 21, was a young lad in Edmonton named Franklin Loehde, whose report appears in the June 1957 issue of *Sky and Telescope*. A comet that big and bright naturally made it into the newspapers, which is where I learned about it in the last few days of April. To a 16-year-old geek in Montreal, it sounded like something exciting to look at, so, on the night of May 1, I went out on my back porch with my brother's copy of *New Handbook of the Heavens* in hand to see if I could spot this comet.

Unfortunately, I was a bit late. The comet had faded significantly by then, and had moved into Camelopardalis, that most unpromising of constellations. Trees and houses blocked that part of my sky anyway, but if I had been luckier, this is what I might have seen:

Figure 2 — 30-minute exposure of Comet Arend-Roland on May 1-2, 1957, taken with a 3-inch Ross patrol camera by students at Mount Holyoke College.

What I did see was a very bright object about half way up the sky to my south. Even though this was my first night as an amateur astronomer, I was pretty sure this was not the comet. Then what was it? With the help of the star chart in my book, I identified the stars immediately above it as the triangle and sickle of Leo. Using Leo as a guide, I identified Arcturus in Boötes. But there was certainly no bright star just south of Leo, so I knew my bright object had to be a planet! The next day I did some further detective work with the limited resources available to me (where was the Internet when I needed it?) and decided that this must be Jupiter, a deduction that later proved to be correct. The next clear night I was out again, identifying five more stars and two more constellations. Arend-Roland forgotten, I became totally obsessed with my new-found starry friends!

Later that summer at my family's cottage in the Laurentians, when I was out under a really dark sky for one of the first times, I spotted a comet! At first I thought I'd finally found Arend-Roland, though I wondered how I'd overlooked it for so long. A few days later, I learned in the newspaper that this was the *second* bright comet of 1957, Comet Mrkos.

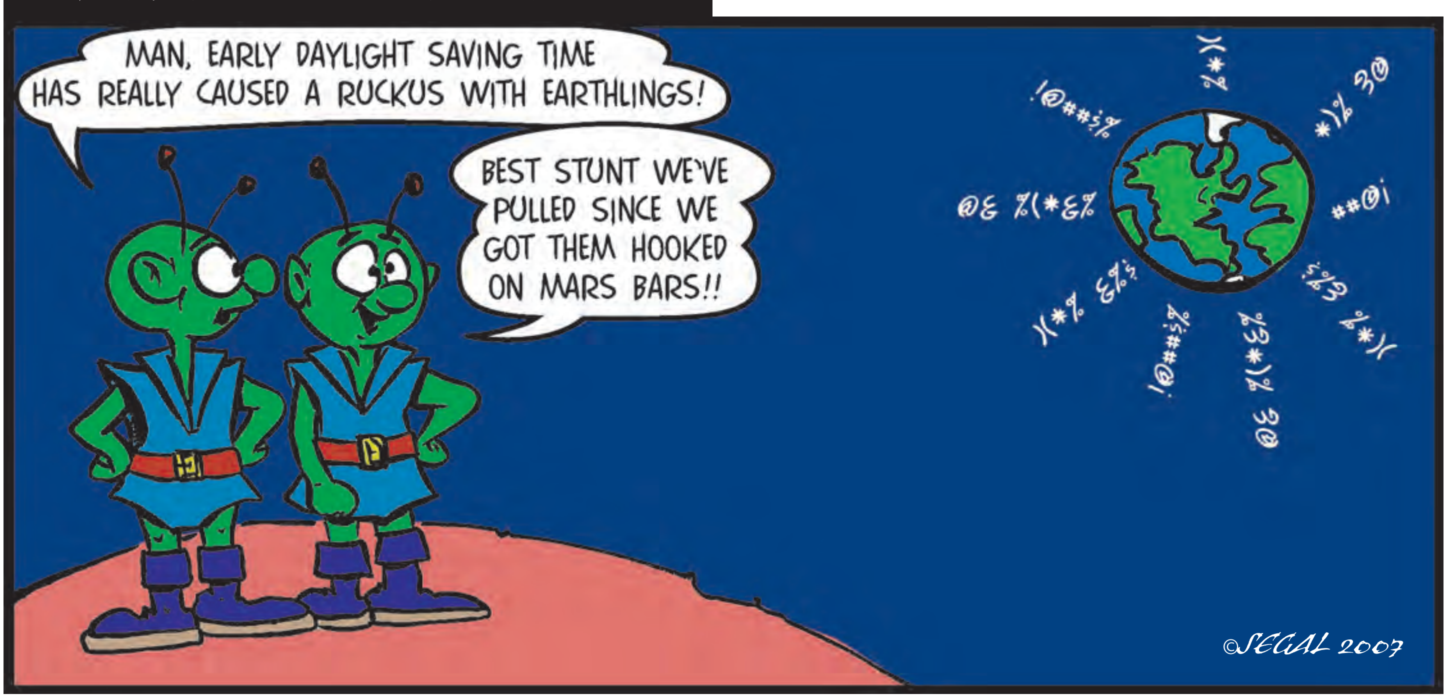
Figure 3 — Comet Mrkos during its passage in 1957 showing its smooth dust tail, and its turbulent gas/ion tail. Photo courtesy NASA.

I joined the Montreal Centre a couple of months later and astronomy assumed an even larger portion of my life for the next seven years. Then graduate school, teaching, marriage, divorce, *etc.* took over my life, and I didn't look through a telescope for decades, though I did continue to enjoy the night sky with my unaided eyes whenever the opportunity arose. Then in 1996, Comet Hyakutake caught my attention. I plotted its position on my star atlas and located it one night from my cottage, then followed it from downtown Toronto as it raced across the sky. In March 1997, I was with my family on vacation in New York City when, early one morning, I chanced to glance out the window of my hotel room and saw this humungous comet hanging in the sky, framed by a couple of skyscrapers. This was Comet Hale-Bopp, by far the best comet I had ever seen, and it started the astronomy neurons in my brain humming. *Were these comets trying to tell me something?*

For the previous 16 years, I had been using a Meade 8-inch Schmidt-Cassegrain telescope, one of the first ones made. It was the most expensive telescope I had ever owned, but the views were always disappointing compared to those I had seen as a teenager. Since this was a state-of-the-art telescope, I concluded that my eyes were shot, and so my astronomical prospects were limited. Then one day, in a spurious moment, I bought one of the cute little Meade ETX 90 Maksutov-Cassegrains that had just come on the market. My first views through it were a revelation! I was seeing the Moon and planets with the same detail I remembered from my youth. There was nothing wrong with my eyes: my expensive Meade SCT must be an optical lemon. Careful testing confirmed this, and suddenly I was propelled back into amateur astronomy with a vengeance.

To this day, I have mixed feelings about Meade telescopes. Their awful 8-inch SCT kept me away from the hobby for over 15 years, yet their excellent little ETX propelled me back into it. It was those comets, seen and unseen, that got me into astronomy, not once but twice.

## ANOTHER SIDE OF RELATIVITY



# Sorting Out Suspected Variables in AAVSO Fields

*by Rick Huziak, Saskatoon Centre (huziak@sedsystems.ca)*

I have taken a break from writing this column for the last two issues since two other projects — light-pollution abatement and data collection for some suspected variable-star projects — were taking all my time. But a comment by someone on the RASClist recently, that he hadn't looked though his telescope for a long time and was in need of an observing project, gave me the impetus to describe the project to which I migrated when I decided to stop observing deep-sky objects from the standard lists.

At the end of my last article (Introducing CCD Photometry, *JRASC,* October 2006), I alluded to my "suspects star program" — the project on which I am currently working. Many years ago, while I was still doing visual estimates and observing known variable stars, I noticed that some of the AAVSO star charts contained references to stars marked *"var?"*. These were interesting because they represented a mystery! Someone, somewhere along the way had suspected that these stars might be variable. I reasoned that if I observed these stars every clear night I might unravel each mystery and add brand new variable stars to the lists of known ones. Within a few years, I had added over 100 suspected variable stars to my observing program, and about one-third of my estimates were dedicated to these objects.

Suspected variable stars would have been cleared up long ago if they had regular periods or large amplitudes. However, it was clear from my visual observations that most did not do very much in the eyepiece of my 10-inch telescope. Indeed, in the first ten years of observing, I had unequivocally confirmed that only two suspects were certainly variable — AAVSO 2003+57B 107 COMP S of S Cygni, and AAVSO 1918+02B var W of V1370 Aquilae.

One other way to see if suspects are variable is to data-mine literature to see if anyone else has observed these stars under different names or designations and has identified them as variable. The *General Catalogue of Variable Stars (GCVS)* lists all known variables and the *New Catalogue of Suspected Variable Stars (NSV)* does the same for "suspects" mentioned in research literature. Some of the AAVSO-suspected stars turned out to be *NSV* stars, but that only added more weight to the suspicions that those little *var?* stars were indeed changeable. I also tried the *SIMBAD* and *NASA ADS* utilities without much more success. Other than tying the stars to a better catalogue name, I was not any further ahead.

In 1997, I bought the *Millennium Star Atlas t*o help expand my deep-sky observing program. I was immediately distracted by the multitude of new variable stars that had been found by the European Space Agency's *Hipparcos* satellite a few years earlier, and that were plotted in the *Atlas*. This caused me to check my 1200 or so AAVSO charts against the *Atlas* to see if *Hipparcos* had confirmed some of the suspected stars and indeed, this was so. Even then, only a few dozen more stars were taken off my suspected list. Soon after, two new large-area CCD-based sky surveys appeared; the *All Sky Automated Survey (ASAS)*, and *The Amateur Sky Survey (TASS).* Once again, I went through the AAVSO charts and found that these surveys had verified only a few dozen more stars. Undaunted, I decided to build a database of all of the suspected variables within the AAVSO program, and cross-identify these *var?* stars to more-recognized catalogue names, using mostly *Hubble Guide Star Catalog (GSC 1.2)* identifiers. That database became the *AAVSO Suspected Variable Star Database,* now hosted on the AAVSO Web site.

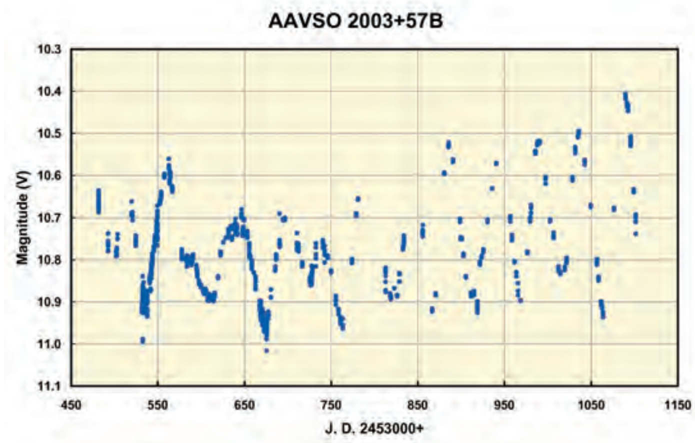



Figure 1 — The light curve of the new variable AAVSO 2003+57B near S Cygni. The star is a semi-regular star of about 0.5-magnitude amplitude and about a 119-day period. Until the star's confirmation as a variable, it was used as a comparison star for S Cyg.

It seemed at first glance that most of the suspected variable stars were not variable at all. Surely visual observers and researchers could not be wrong hundreds of times! Admittedly, the majority of questionable stars are likely *not* variable. They may well have been plotted on the charts after visual observers

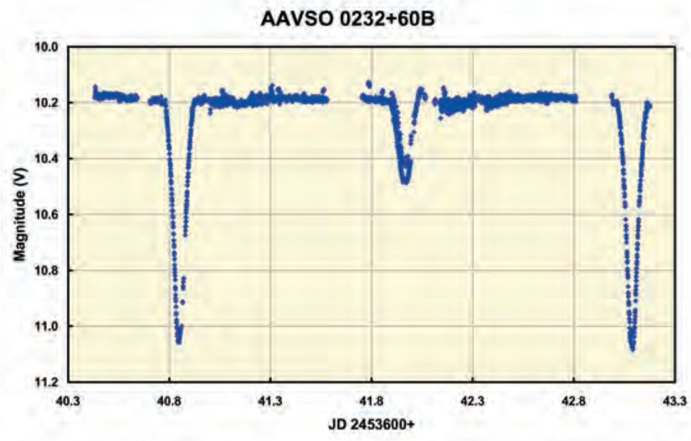



Figure 2 — The light curve of the new Algol-type eclipser AAVSO 0232+60B near V615 Cas. The star was likely marked *var?* on the chart because a professional paper stated that the star appeared to be a variable X-ray source. The primary eclipse is partial, with a range of 10.17V to 11.1V. The secondary eclipse falls to 10.4V and is total. The star eclipses every 2.237615182 days.

had been influenced by other factors such as poorer-quality chart sequences, sequence copy errors, misidentification, or because very red comparison stars play Purkinje tricks with observers' eyes.

However, it is also possible that these variables are of small range or have unusual periods. Why the automated surveys did not catch these might lie in an understanding of the limitations of such projects. All were limited to stars no fainter than 10th or 11th magnitude. The majority of AAVSO-suspected variables are between 9th and 14th magnitude, too faint for these surveys or at best within a range where measurement error is highest. Individually, each survey had its own unique shortcomings. *Hipparcos* sampled some areas of the sky only several dozen times within its 3-year mission time and petered out after 10.5 magnitudes. *ASAS* covered the entire southern sky but the northern sky to only +28 degrees. Although *TASS* did cover the northern sky, it has a fairly large scatter for stars dimmer than 10th magnitude. Both the *ASAS* and *TASS* surveys checked the sky only once every clear night. They were good at finding variables with ranges greater than 0.1 or 0.2 magnitudes and multi-day periods, but could easily miss other variables with periods of less than a few days, especially for the fainter stars.

Clearly, another strategy was required to confirm finally whether the suspects were variable. In early 2004, I jumped from being a visual observer to a CCD observer almost overnight after a trial run on the then-new transiting planet HD 209458b. On our first run, Gord Sarty and I clearly detected a transit immersion that was only a 0.025-magnitude drop in light! I was elated by the success and the realization of how powerful a scientific tool a CCD camera was for the amateur observer! I was hooked on the power of the CCD.

From April 2004 to the present, the shutters on the cameras I use have cycled over 61,700 times, and data reduction has produced nearly 100,000 high-accuracy measurements of variable stars and suspects. Seventy-seven fields containing 128 suspected stars have been repeatedly imaged and analyzed, confirming 14 suspects as being variable and producing good light curves for most of them. To complicate things, every third starfield on average contains an exciting new discovery that slows down the original task of studying the AAVSO variables. In the 77 fields, 33 new variables have been discovered. The new variables are of many different types: RR Lyrids, delta Scutids, semi-regulars, irregulars, a magnetic dwarf star, a few eclipsers, and a Mira star.

A confirmation rate of 11% may seem a little low if you are hoping for easy success, but no image is wasted, as every suspect field also contains an original AAVSO variable star. As a consolation, I can submit the measurements to the international database. But 77 fields over 3 years is pretty slow when 600 or 700 fields will have to be imaged dozens of times each to complete this project. To help with the task, I have managed to recruit Vance Petriew (Regina) and Mike Koppelman (Minneapolis) to help out with imaging and analysis, and our group recently expanded to include Walter Cooney (New Mexico). Vance, Mike, and Walter bring another three dozen new discoveries into the mix, all of which need more data. Other observers from across the globe hop in and out of the project to offer help in field coverage. Part of the attraction of this project is being able to work with talented variable-star observers from all over the world!

One new and exciting utility that has been developed at the request of AAVSO observers and researchers is the *International Variable Star Index (VSX),* written by ace AAVSO member Chris Watson. *VSX* came about because of concerns that the entry of new variable discoveries into the *GCVS* is very slow, with new discoveries often taking a year or more to be catalogued and named. More current and complete than the *GCVS, VSX* can accept data much more quickly and is an amazing tool for compiling lists of known variable stars from within any field in the sky — basically one-stop shopping that includes nearly all variable stars from all sources. *VSX* also allows us to enter our new variables immediately on discovery via an on-line graphical interface and after a very short review by *VSX* moderators, to see the data appear on-line. In this way, new discoveries do not have to be published before they get onto the list, as required by *GCVS*. Announcement of new variables in near-real time reduces the chance of redundant discovery that wastes everyone's time.

Eventually, though, all new discoveries must be published, and this work falls to the team. Currently Mike, Vance, Walter, and I, along with other collaborators have two papers in the works destined for the *Journal of the AAVSO (JAAVSO):* the first is on a batch of about ten new RR Lyrae stars, and the other on an exciting new fast-spinning magnetic dwarf star. With 40 or more new discoveries remaining, we have ample material for future papers; in the meantime, the *Suspects Project* continues to produce many new discoveries.

So, getting back to that comment on the RASClist: if you are in need of a project, there are about 1400 AAVSO-suspected variables that need more measurement by camera and eye, and more research by data mining. The *NSV* catalogue contains thousands more stars that need work. As a matter of fact, a large number of *NSV* stars are known to be variable, but there is simply not enough data to classify them and give them permanent *GCVS* names.

Nevertheless, in spite of the new successes of CCD astronomy, the need continues for visual observers to do long-term monitoring of all the variables, old or new. Visual observing will remain the mainstay of amateur variable-star monitoring for years to come.

*Richard Huziak is a member of the Saskatoon Centre and the AAVSO. He hopes to give a paper on the* Suspects Program, *describing progress to date in far greater detail, at the 2007 Calgary GA RASC/AAVSO/ALPO joint session.*

**Internet Resources**

AAVSO *Suspected Variable Star Database* - The author's expanding database of all suspected variables, and variables that were hard to identify, that reside in the AAVSO Validation file. Find from the AAVSO main page under "Charts."
`www.aavso.org`

The Smithsonian/NASA *Astrophysics Data System (ADS)* - This is a searchable database of research papers and the first site to check to see what's been published about anything in the sky.
`www.adsabs.harvard.edu`

*VSX* - The AAVSO *Variable Star Index*
`www.aavso.org/vsx`

*General Catalogue of Variable Stars (GCVS)* and *New Catalogue of Suspected Variable Stars (NSV)*
`www.sai.msu.su/groups/cluster/gcvs/gcvs`

*The Amateur Sky Survey (TASS)*
`www.tass-survey.org`

*The All Sky Automated Survey (ASAS)*
`http://archive.princeton.edu/~asas`

## Gizmos

# Star-crossed

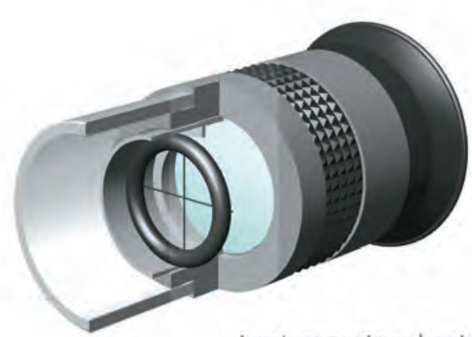
*by Don van Akker, Edmonton Centre (don@knappett.com)*

Shakespeare's star-crossed lovers did rather poorly at the end but with this star-crossed eyepiece you can do much better. It is a useful accessory to the copier-lens finder scope that has been described in the last few issues of the *Journal* but you might use it most often to set up your GOTO scope. Yes, you can set up just by centreing the guide stars by eye, but you'll get much better pointing if you set up with a crosshair eyepiece.

You need a 20- or 26-mm eyepiece that you can dedicate to this. You also need a rubber O-ring, a piece of automotive wire, some white glue, and a toothpick. If you buy an eyepiece, get a cheap one. It's for pointing, not observing, so optical quality is not an issue here.

Since all eyepieces are a little different you will need to adapt these instructions for the one you have but you should be able to use this technique in almost any kind. I used a Meade 20-mm series 4000 only because we happened to have two.

Hold the eyepiece to your eye and slowly move the toothpick into the lower end. When the tip comes into focus, hold it in place and take a look. Where the end of the toothpick is in focus is where the crosshairs need to be. In the Meade eyepiece this point comes about midway down the length of a piece of threaded tubing that serves both as a retainer for the lens element and as a field stop. I removed this to see how everything fits together but you don't need to take anything apart. Just take the entire eyepiece to a hardware store and find a rubber O-ring that slides into the end just snugly enough to keep from falling out but



A cut away view showing the o-ring and cross hairs as they should be located inside the lens element retaining tube.

not so tightly as to compress or distort it. O-rings are typically sold individually from a boxed assortment so you can try a few different ones to get the best fit.

Pick up the wire while you are there. You need stranded automotive wire, 14- or 16-gauge, but because you only require a few inches, try to avoid buying the whole roll.

Strip the vinyl insulation from the wire when you get it home. You can slit it with a sharp knife and then peel it back. Automotive wire consists of a number of thin strands wound together in a long spiral. Cut two strands about an inch long and straighten them out as best you can with your fingers. Then take two flat blocks of wood (I used breadboards), lay a strand on one block, put the other block on top, and move the top block back and forth so the wire rolls between the two. Bingo — straight as an arrow.

Lay the O-ring on a flat surface and squeeze out a dollop of the white glue. Dip the toothpick in the glue and put four tiny dabs on the quarter points of the O-ring. Use tweezers to place the two copper strands in the glue and gently shift them around until they look square to each other and centred on the ring. Don't bother measuring anything. You can do this by eye much more accurately than you could with a ruler or a tape.

Give the glue about 20 minutes to dry (it turns clear). Use nail clippers to trim the ends of the strands — the copper is soft and won't hurt them. Angle your cuts back so that the ends of the strands are inside the perimeter of the O-ring. You don't want the wires to contact the edges of the eyepiece assembly as you insert it into its final position.

Handle the next assembly with care: it's delicate. Push the cross-haired O-ring down the end of the eyepiece with some kind of a cylindrical follower (I used the flat end of a Jiffy Marker). The wire side goes first. Go slowly and check often as this is a one-way trip. When the crosshairs come into crisp focus, stop. Use the toothpick to put a few drops of glue into the angle between the O-ring and the inside of the tube and you're done.

And if you change your mind, remember — your star-crossed eyepiece, unlike the sad fate of the star-crossed lovers, is reversible.

*Don Van Akker and his wife Elizabeth observe together from the Victoria area. As of this writing they are waiting under clouds so Don has lots of time to help you with this or any other Gizmos project. As well, he would love to hear your ideas. Reach him at don@knappett.com.*

# Astrocryptic

*by Curt Nason, Moncton Centre*

The solution to last issue's puzzle

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H | U | Y | G | E | N | S | ■ | P | O | L | A | R |
| A | ■ | A | ■ | J | ■ | H | ■ | E | ■ | O | ■ | E |
| L | Y | R | A | E | ■ | O | P | T | I | C | A | L |
| L | ■ | K | ■ | C | ■ | O | ■ | R | ■ | A | ■ | A |
| E | V | E | N | T | ■ | T | R | I | P | L | E | T |
| Y | ■ | R | ■ | ■ | ■ | I | ■ | E | ■ | ■ | ■ | E |
| ■ | I | S | A | A | C | N | E | W | T | O | N | ■ |
| P | ■ | ■ | ■ | U | ■ | G | ■ | ■ | ■ | R | ■ | S |
| A | N | T | A | R | E | S | ■ | D | R | I | F | T |
| R | ■ | A | ■ | O | ■ | T | ■ | I | ■ | O | ■ | A |
| S | I | B | E | R | I | A | ■ | J | A | N | E | T |
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## A Moment With…

# Dr. John Spray

*by Philip Mozel, Mississauga Centre (phil.mozel@sympatico.ca)*

Do you remember the photos of *Apollo* astronauts on the Moon's surface?

Often, their suits were filthy with moon dust. Well, no matter, they could simply brush each other off before re-entering the *Lunar Lander.* Or is it that simple? Beyond the cleanliness issue, lunar "dirt" is a great unknown and its properties will have a critical impact on the progress of lunar exploration. Dr. John Spray's research will have a direct bearing on how this exploration proceeds.

Dr. Spray is a classically trained geologist who obtained his Ph.D. from Cambridge University in England. Looking for work and ancient rocks to study, he came to Canada, finding the former at the University of New Brunswick and the latter in the Canadian Shield. He is currently Director of UNB's Planetary and Space Science Centre, the only NASA Regional Planetary Image Facility in Canada. Largely interested in terrestrial impacts, Dr. Spray and his group run the international Earth Impact Database (`www.unb.ca/passc/ImpactDatabase`). This archive occasionally attracts interest from unusual quarters as, for example, users of the *Google Earth* Web site who sometimes call to inquire about circular, putative impact structures they have "discovered."

Dr. Spray also hunts for craters, and is interested in how impacts are involved in planet building and modification. He also studies the geological results of impacts such as shock processes. With a U.K. colleague, he determined that the Rochechouart crater in France is about 214 million years old. Realization that this is the same age as the Manicouagan Crater in Quebec and the St. Martin impact crater in Manitoba led Dr. Spray to consider the idea of several asteroids or comets impacting Earth at about the same time with their attendant destruction and extensive modifications of the terrestrial surface.

The study of planetary surfaces and their evolution through time, and the geological context of Earth in relation to neighbouring worlds, also form important parts of Dr. Spray's research. The lunar surface, for example, is much as it was billions of years ago but has been ground up by a succession of meteoritic impacts. There is almost no exposed bedrock. Instead, astronauts walked on *regolith* — rock that has been "rubble-ized" by the incessant pounding from meteoroids and micrometeoroids. There is nothing like regolith on Earth and, quite frankly, we don't understand it. Yet we must, if lunar exploration is to continue.

We certainly do know that particles of regolith adhere quite nicely to spacesuits. Based on samples returned during *Apollo* missions, we know that regolith is angular, abrasive, stuff

Dr. John Spray

made of pulverized rock plus shards of glass formed from impact-melted surface material. However, there are many other questions for which Dr. Spray is seeking answers. How does regolith behave when you try digging in it? Or tunneling through it? These are important issues because any lunar base is likely to be buried purposely in regolith as protection against radiation and further impacts. Should the construction vehicles move around on wheels? Treads? Some other method? The Caterpillar Tractor Company has a contract with NASA to develop lunar digging techniques and so needs to know the kind of surface with which it will be dealing. There are also many *in-situ* resources that might be extracted from the lunar soil such as helium-3, oxygen, and possibly water, which will be critical for a base. How best to mine them? Knowledge of the characteristics of regolith will help point the way to answers.

To this end, Dr. Spray is working to create a lunar simulant — a physical analogue — of lunar regolith. Based on a sample of the real stuff supplied by NASA, Dr. Spray plans on turning some of those old rocks from the Canadian Shield, specifically the mineral anorthosite, into regolith. Two Sudbury, Ontario-based organizations also working with NASA are interested in the simulant in order to develop drilling and excavation technologies. Once Dr. Spray is ready, a giant "sand box" with up to a thousand tonnes of regolith will be created for practicing with heavy machinery.

Mars has also caught Dr. Spray's attention and he has become involved in the European Space Agency's *ExoMars* mission that aims to set a rover down on the surface of the red planet around 2012. It will carry the *Pasteur* science payload that is designed to seek out life. On the front of the rover will be a robotic arm carrying, among other items, what amounts to a geologist's loupe, or hand lens, for inspecting rocks. Images will be obtained with a digital camera and transmitted to Earth where Dr. Spray will perform a remote geological "triage," to determine if the sample warrants a closer look with other on-board instruments. He is the only Canadian on the team charged with performing this task. Until then, he is developing software to analyze rock texture as an aid to geological identification.

Much of what interests us about Mars, such as minerals and water, lies below ground. Getting our (robotic) hands on the subsurface structure calls for drilling. Easier said than done. For one thing, normal lubricants are useless at frigid Martian temperatures. Dr. Spray is using his drilling experience, honed on Earth, to develop a low-speed, lubricant-free drill with which *ExoMars* can penetrate to a depth of twenty metres at -120° C. He hopes to have it field-tested on the Moon. In essence, with *ExoMars,* Dr. Spray is helping to create a robotic field geologist that gives him an off-planet "out of body" experience.

Further into the future, Dr. Spray foresees ever-more sophisticated rovers exploring Mars. They will be nuclear powered for long-term surface operations and will analyze the regolith and what lies below. For this job, they may use drills, ground-penetrating radar, and seismometers triggered by carefully planted explosives.

Not long before our interview, the *Mars Reconnaissance Orbiter* transmitted a fascinating photograph earthward. The photo showed what seemed to be a gush of water that had flowed down the interior of a crater. A similar image made seven years earlier showed no evidence of any liquid. It seems that the Sun had warmed the ground to a depth sufficient to melt ice sequestered there, releasing water to the surface, and forming a miniature flash flood. This came as no surprise to Dr. Spray who had expected such phenomena. Nonetheless, he finds this observation exciting as it confirms that Mars is still a dynamic and appealing planet to study.

When Dr. Spray came to Canada, it was to be a temporary stay. Twenty years and four children later, he is still conducting research here. Part of the reason is the Canadian funding system, administered by the Natural Sciences and Engineering Research Council. While not possessed of the monetary resources of some other countries, the Canadian system generally allows scientists to complete their studies by giving them the latitude to explore and the time for their research to evolve. Canadian research is not as constrained as it may be elsewhere.

Dr. Spray's research has barely scratched the (simulated and otherwise) surfaces of several worlds. It is possible that, in the near future, his long reach will enable him to gain an in-depth understanding of some of these exotic places and help place the Earth in its proper planetary context.

*Philip Mozel is a past librarian of the Society and was the Producer/Educator at the former McLaughlin Planetarium. He is currently an educator at the Ontario Science Centre.*

## Carpe Umbram

# New Developments at IOTA

*by Guy Nason, Toronto Centre (asteroids@toronto.rasc.ca)*

*Takin' care of business (every day)*
*Takin' care of business (every way)*
— Bachman Turner Overdrive
(c) 1973 Randy Bachman

Because there have been a few developments and changes at the International Occultation Timing Association (IOTA) recently, it's time to take care of a bit of business.

### New Reporting Procedure

First of all, the asteroidal occultation reporting procedure for North America has been vastly improved, thanks to IOTA's Brad Timerson and his team. They developed an on-line form consisting of a set of fields to be filled in. This can be done either from a generic "blank report form" or from "archived report forms," for recent events that already have such information as the date, the asteroid's name and number, and the occulted star's catalogue number. So all you do is enter your personal data (telescope type and size, geographic coordinates, sky conditions, *etc.*) and timings. Also, you can make and save your own personal templates to be used for future events observed with the same equipment and/or from the same location.

Go to `www.asteroidoccultation.com/observations/NA`, where report forms are available as *Excel* spreadsheets. They also work with the latest version of the free program *OpenOffice* (`www.openoffice.org`) and operate on both *Windows* and *Mac* platforms. If you do not have *Excel* or *OpenOffice,* you can still use the old form, to which a link is provided on the IOTA Web page. The new report form has a "Directions" page to help first-time users. Please take the time to read through that page. Once you have used the new form a couple of times, it really does become easy to work with. Then email your reports to `reports@asteroidoccultation.com`.

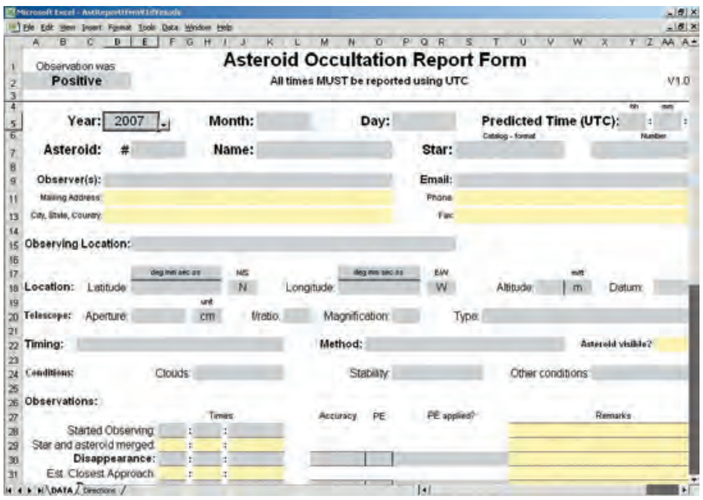


Figure 1 — A screenshot of the new reporting form available from the occultation Web page.

Reports will be analyzed in a timely fashion by one of three Regional Coordinators and posted to the results page: `www.asteroidoccultation.com/observations/Results`. Here you can: view a map of the occultation path; check the deduced asteroid profile (with *OCCULT*); check the list of observers, their locations, and timings; and even get a Google satellite map of the observers' locations. (For a description and directions for downloading *OCCULT* go to `www.lunar-occultations.com/iota/occult3.htm`.) This quick turn-around of data is one of the most important improvements in the new procedure. In the past, we might have waited several months to see the results. Sometimes the data were never reduced, but just sat in a file, ignored and unloved. Now we can see the effects of our contributions almost immediately.

The three coordinators and the Canadian components of their regions are: Tony George: Yukon, NWT, B.C., and Alberta; Richard Nugent: Nunavut, Saskatchewan, and Manitoba; and Brad Timerson: Ontario, Québec, and the Atlantic Provinces.

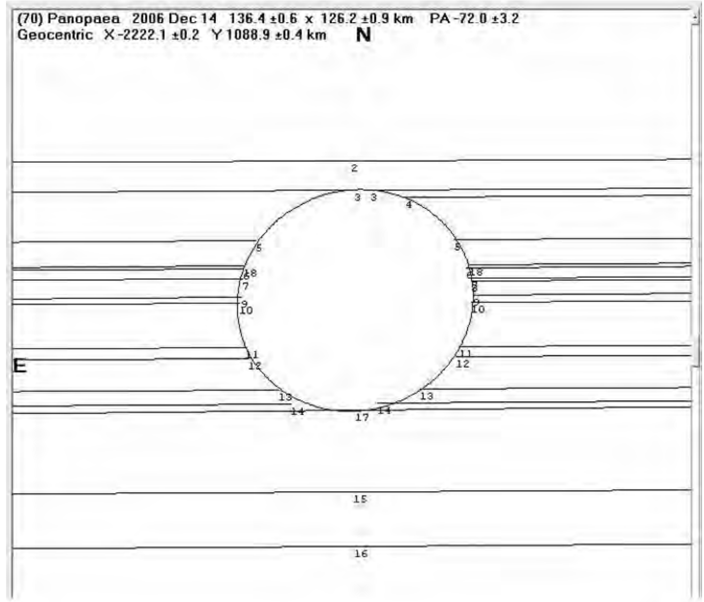


Figure 2 — This is the "sky plane plot" for an occultation by the asteroid (70) Panopaea, December 14, 2006, deduced from the reports of 18 observers.

The coordinators have access to an *Excel* macro that will take the individual report forms and create a file that can be read directly by *OCCULT,* David Herald's occultation prediction and processing program that is central to IOTA's operations. No more manual data entry is required, except for those few reports that use the old reporting system. That, in turn, means fewer chances of errors during data input.

"Many people have worked very hard to make this new process a success," said Timerson. "I would like to acknowledge David Dunham, Tony George, Richard Nugent, Dave Herald, Steve Preston, John Talbot, and a number of "beta" testers (including Geoffrey Gaherty and Guy Nason). Thank you!"

**Three New Planning Aids**

1. Derek Breit has added a neat little feature to help with the pre-pointing of non-driven telescopes. Scroll down his Home Page, `www.poyntsource.com/New/index.htm` to "Asteroid Occultation Station Sorts" and continue to the desired event. Click on the event and you will see a huge list of known observers and sites at various distances from the predicted path's centre line. Below that list is another chart listing stars that share, or nearly share, the same declination with the target star. Using the "time offset" RA and Dec for any of a number of "pre-point stars," one can centre that star in the field of view, then stop tracking at the indicated time and the target star will come into view in time for the occultation to be recorded. This aid is especially useful for those who video-record occultations from multiple, unattended stations.

2. Sander Pool has a new Web site `http://occult.tungstentech.com/Default.aspx` that is

extremely helpful in planning asteroidal occultation observations tailored to the needs, wishes, and tastes of individual observers. Here you can list only those occultations that meet your desires and capabilities. For instance, you can set the search engine to list only occultations that involve stars brighter than magnitude 10; asteroids larger than 20 km; or those within a specified distance of your home or observatory. But my favourite feature, by far, is that you can find all the Tim Hortons restaurants along the occultation path! Just click on the "Hosted KML" for the desired event: a Google map that includes time pointers along the path will open. Zoom into your desired area (or select the time closest to that predicted for your site). Click on the time pointer and then on "search nearby." Type in "Tim Hortons," *et voilà!* Sander (an American) has no idea what a great service he has provided to us Canucks!

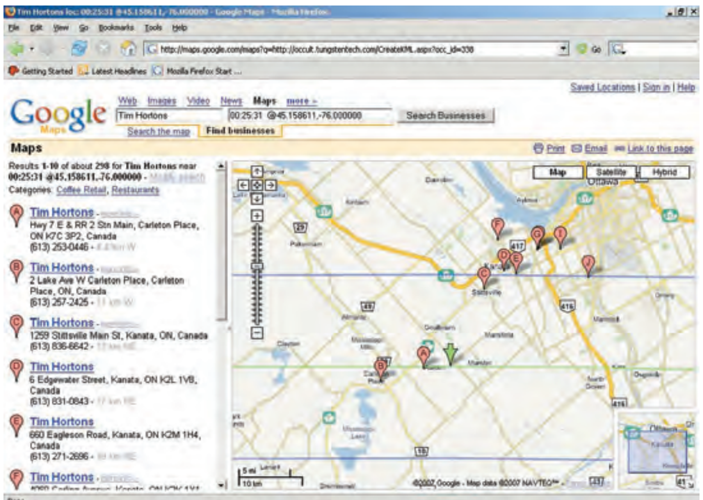


Figure 3 — Results of a Tim Hortons search. On the map, the green line is the predicted occultation centre line; the blue lines are the north and south limits, and the pointers indicate Tim Hortons locations.

3. Brad Timerson has a Web site `www.fingerlakessynthetics.com/AstOccult` that addresses low-probability asteroidal occultations. Ostensibly, the list is for eastern North America, but in reality, the event listings include maps and data for the whole continent. Many of these do not appear on the semi-official asteroidal occultation site, `www.asteroidoccultation.com`. The idea here is not to put out too much effort, since the probability of success is usually less than 1%. Rather, it's just a list of occultations that you might consider including in your normal observing session if you are planning to be at the telescope at those times anyway. Wherever you happen to be, just slew your telescope to the target star two or three minutes before the predicted occultation time and see what happens for the next five minutes or so. If you are extremely lucky and see an occultation, report it (see above) even if you don't get a good timing for the event. Of course, if you do have an accurate time source and recorder available, use them; but for these events, just being able to confirm that an occultation occurred at your site is a valuable thing.

As the days get longer and the nights shorter, we have fewer opportunities to observe asteroidal occultations. Nevertheless, here's a list of occultations for populated parts of Canada during April and May. As always, the columns are: Date in 2007; asteroid number; asteroid name; magnitude of the target star; change in magnitude of the combined light of the star and asteroid; maximum expected duration of the occultation; and provinces or regions affected.

*Guy Nason is a long-time member of the RASC Toronto Centre and IOTA (International Occultation Timing Association). He has served the Toronto Centre as Observational Activities Coordinator, Councillor, National Council Representative, Secretary, Vice-President, President, and was, until recently, Past President. He received the RASC Service Award in 2004. He has successfully timed several lunar grazes, total occultations, and eight asteroidal occultations*

| Date (2007) | Asteroid Number | Name | Star Mag | Δ-mag | Max Duration (s) | Path |
|---|---|---|---|---|---|---|
| | | | | | | |
| Apr. 03 | 214 | Aschera | 10.3 | 2.9 | 2.6 | seAB-nwBC |
| Apr. 06 | 777 | Gutemberga | 11.3 | 3.3 | 13.0 | NL |
| Apr. 08 | 563 | Suleika | 11.3 | 1.9 | 13.4 | Vancouver Is-nwMB |
| Apr. 10 | 976 | Benjamina | 11.8 | 3.2 | 5.8 | sBC |
| Apr. 13 | 19 | Fortuna | 11.0 | 0.9 | 22.2 | swMB-nBC |
| Apr. 13 | 1499 | Pori | 10.5 | 4.8 | 7.8 | QC |
| Apr. 21 | 888 | Parysatis | 9.9 | 4.6 | 1.3 | nBC-sSK |
| Apr. 25 | 3451 | Mentor | 11.8 | 3.4 | 7.2 | swON, sMB-cSK |
| Apr. 25 | 542 | Susanna | 11.4 | 3.0 | 5.0 | sON-cMB |
| Apr. 26 | 395 | Delia | 9.2 | 7.0 | 1.9 | NS |
| Apr. 27 | 708 | Raphaela | 6.9 | 8.6 | 1.3 | swON |
| May 4 | 568 | Cheruskia | 11.1 | 3.6 | 11.8 | NB-eQC |
| May 17 | 1268 | Libya | 9.1 | 6.4 | 7.9 | eON-wQC |
| May 24 | 471 | Papagena | 11.0 | 1.7 | 5.5 | ON |
| May 25 | 3256 | Daguerre | 9.7 | 7.3 | 2.5 | seON-cON |
| May 27 | 640 | Brambilla | 11.7 | 2.0 | 7.8 | swBC |
| May 29 | 835 | Olivia | 10.4 | 6.6 | 6.7 | cSK-cBC |

# Great Images

On January 11 at 5:45 p.m. AST, Dave Lane captured one of the better Northern Hemisphere images we've seen of Comet McNaught using a Canon Rebel and a 450-mm TeleVue Pronto. Exposure time was 3.2 seconds. The comet was quite "reddened" from the low altitude and cirrus cloud near the horizon.

This August 11, 1999 solar eclipse image shows the diamond ring prior to totality. The photo was taken by Roy Bishop on the North Atlantic, 350 km southeast of Halifax, Nova Scotia from the *Regal Empress* at 06:30 ADT using an Olympus OM-1 with a 200-mm, f/4 lens on Kodak Elite 100 film.

Blair MacDonald of the Halifax Centre provided this image of M81 and M82 (along with a few interlopers). The image is a stack of six, five-minute exposures taken at the Centre's St. Croix Observatory. Blair used an 8-inch f/4 Schmidt Newtonian and a Canon Rebel XT.

David Lane captured this image of Centaurus A (NGC 5128) during the Florida Star Party using an Astro-Physics 130-mm f/6 APO refractor with an SBIG ST8XME CCD camera. Exposure times were 15 minutes through each of the R, G, and B filters.

# Across the RASC
## du nouveau dans les Centres

### 2006 Society Donations Report

*by Denis Grey, Toronto Centre (denis.grey@sympatico.ca)*

On behalf of the Membership and Promotion Committee it is my pleasure to report on charitable giving to the Society in 2006. The following report outlines the total donations accepted by the Society for its four major fundraising programs: general donations, the Millman Endowment Fund, the Ruth Northcott Fund and the Sustaining Membership program.

| 2006 Donation Summary | | 2006 | 2005 | % Change |
|---|---|---|---|---|
| General Donations | | 4546 | $ 4,996 | - 5% |
| Millman Endowment Fund | | 1,882 | 1,060 | + 77% |
| Ruth Northcott Fund for Education | | 411 | 1,273 | - 68% |
| Sustaining Memberships | | | | |
| - Society Portion | $ 3,239 | | | |
| - Centre Projects Fund | 2,332 | 5,571 | 3,349 | + 66% |
| | | **$ 12,335** | **$10,678** | **+15%** |

Overall donations were up 15% in 2006 compared with 2005. In particular over 90 members responded to the Sustaining Membership program and helped to support both the Society and the Centre Projects Fund.

In addition to these individual donations the Society also received another major gift from the estate of Walter Feibelman in 2006 in the amount of $7,916. This amount, combined with the $27,951 given in 2005 brings Dr. Feibelman's total contribution to the Society to $35,867. A special fund has been set-up to receive this gift and its application to our mission and mandate will be considered as part of the strategic planning process for the Society.

### Centre Donations

The National Society also accepts many donations on behalf of our Centres. These donations are turned over to participating Centres where they are used for various Centre programs, initiatives, and services. In 2006, the Society accepted a total of $42,070 in donations. A significant portion of this year's donations to Centres were special donations to the Vancouver Centre in support of their remote observatory project. As noted below, this amount does not include donations accepted by Centres that issue their own charitable donation receipts — our thanks to these generous individuals as well.

### Donations to the Society

*Donations to the Society for its operations and activities.*

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Laurence Anderson
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Derek Watson
Amelia Wehlau
Louise Whalen
Gene Wilson
Ross Wilson
Robert Winder
Robin Woods

**Donations to Centres**

*Donations to Centres that were processed by the Society (Centres noted in brackets).*

*Note: This report does not include amounts reported by Centres who manage their own charitable donation receipts. The total amount of such donations will be given in the 2006 Annual Report. Recognition of such donations is made by the appropriate Centre.*

Brian Alexander (Mississauga)
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*Denis Grey is President of the Toronto Centre and Chair of the Membership and Promotion Committee.*

# Astronomy Roundup 2007

Registration for Astronomy Roundup 2007 has begun. We hope you are planning to join fellow RASCals and colleagues from the American Association of Variable Star Observers (AAVSO) and the Association of Lunar and Planetary Observers (ALPO) for a great meeting, from June 28 to July 1. The early-bird registration deadline is April 30 and after June 12, only on-site registrations will be accepted.

If you enjoy workshops, the Roundup will have four from which you can choose. These optional workshops take place on the morning of Friday, June 29. Full descriptions can be found on the Astronomy Roundup Web site but here are the highlights.

## Fireball Investigation Workshop

This three-hour operational session is intended for individuals who want to learn how to be a fireball investigator. The workshop will cover fireball characteristics, the various types of instrumental records, energy-mass relationships, dark flight, meteorite-strewn fields and recovery, and case histories. Participants will be able to run various software routines in a computer lab. Presenters are Alan Hildebrand (University of Calgary) and Martin Beech (University of Regina), both members of MIAC (Meteorites and Impacts Advisory Committee to the Canadian Space Agency).

## Light-Pollution Abatement Workshop

The Calgary Centre of the RASC has developed a highly successful strategy to battle light pollution. In this workshop, participants will acquire the knowledge and skills needed to negotiate effective solutions in their community. The workshop will emphasize diffusing the two biggest barriers to better lighting: commercial interests and fear of crime. The course will be led by Anna Brassard, Brassard Associates, an expert in urban planning and "Crime Prevention Through Environmental Design" (CPTED) training; Kevin Leitch, Calgary By-Law Services (retired Calgary Police Service); and Bob King, Chair, Light-Pollution Abatement Committee, RASC Calgary Centre.

## Imaging Workshop

It has been confirmed that Alan Dyer will be available to conduct a workshop on Digital SLR Astrophotography. Alan has been using digital single-lens-reflex cameras for three years and now shoots the sky with almost nothing but these amazing cameras. Alan will take you through the steps for getting great photos, from selecting a camera to processing the final image, with the emphasis on getting great deep-sky images. At the time of this writing, we are awaiting confirmation of a second imaging workshop presenter.

**Introduction to Scientific Observing Workshop**

This workshop will provide an introduction to a number of observing programs by which amateurs can contribute data useful to the scientific community. So far, the following speakers and topics have been confirmed:

Dr. Arne Henden (Director, AAVSO), "Variable-Star Observations: Past, Present, and Future."

Dr. Richard Schmude, Jr., "Photometry of Mars, Jupiter, and Saturn."

Dr. Sanjay Limaye, (Space Science and Engineering Center, University of Wisconsin-Madison), "Amateur Contributions to Planetary Space Missions."

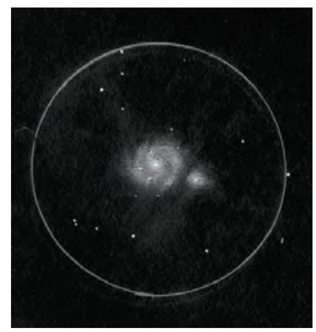
The most current information on all of the G.A. plans, including speakers and optional tours, can be viewed at the Web site: `http://Calgary.rasc.ca/ar2007`.

Contact email: `AR2007@shaw.ca`

Astronomy Roundup 2007 Organizing Committee

# Great Images

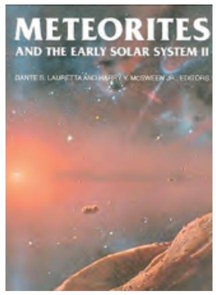
Kevin Black of the Winnipeg Centre captured this image of the Earthlit Moon and Venus setting in the evening sky on January 20, 2007 from Winnipeg. Kevin used a Canon 20Da to make the image.



RASC President Scott Young left his 2.6-inch Tasco and switched to a 10-inch Dob to make this drawing of M51 and its companion. Scott viewed through 26-mm and 17-mm eyepieces to make the drawing, then digitally inverted the image to give the sky a black background.

Klaus Brasch obtained this image of M45 on February 9, 2005 using a Canon 20D and a TeleVue 101 telescope. It is a combination of three images.

# Reviews of Publications
## Critiques d'ouvrages




**Meteorites and the Early Solar System II,** edited by Dante S. Lauretta and Harry Y. McSween Jr., pages 943 + xvii, 22 cm × 28 cm, University of Arizona Press, 2006. Price $90 US hardcover (ISBN 0-8165-2562-5).

Meteorites are a remarkable resource for understanding the origins and earliest history of our Solar System. Mostly formed in the first few million years of the Solar System's existence, these rocks and chunks of metal contain an exquisitely subtle record of the still largely mysterious events of that time. And they are delivered to Earth (and to its meteorite specialists) in large quantities, without any of the expense of space probes. But reading the record each one provides — discovering where and how each meteorite formed and what it tells us about the circumstances of its formation — is a complex and difficult art, involving expertise in computation, physics, chemistry, and mineralogy, and experimental techniques capable of exploring fantastically tiny structures.

Specialists dissect the chemical and isotopic composition of individual mineral grains, infer the fleeting presence of tiny amounts of short-lived radioactive species, use texture and crystal structure to deduce the history of heating and cooling, and try to reconstruct the sequence of events and the general setting when these objects formed. Out of such complex and difficult studies, the hope is to understand in detail the great events of the first few million years of our Solar System's existence. This book covers the full scope of that massive undertaking.

*Meteorites and the Early Solar System II* surveys the present state of the science in splendid and authoritative detail. It is an extremely impressive book by any measure, starting with the physical one: 81/2 by 11-inch pages, more than 2 inches thick — the size of the telephone book of a medium-size city. Weighing in at more than five pounds, it is simply too heavy to read in bed! And the contents are up to the imposing physical presence. Cover to cover, the book is overflowing with comprehensive and well-referenced articles.

The articles, each typically 20 pages or more in length, cover almost every aspect of the formation epoch of the Solar System, and the clues about the events 4.5 billion years ago that are carried by the meteorites, in a roughly chronological structure. Various sections of the book deal with the pre-solar epoch, the epoch of disk formation, the production and modification of Solar System materials, the formation and alteration of planetesimals, and the final arrival of meteorites to the Earth.

It is a book that should be in the collection of every meteorite and early-Solar-System specialist, and in the library of every university and institute with a serious planetary sciences programme. The book is doubly attractive because of its remarkably modest list price.

However, the book is probably not suitable for most non-specialists, and certainly not appropriate for amateur astronomers and beginning undergraduates. Many of the articles do start with general introductions to their topics, but most very quickly get down to the real business at hand, of reviewing progress in the field since the first version of *Meteorites and the Early Solar System* was published in 1988. A great deal of background is assumed of the reader. Since the techniques and theoretical ideas in the field are complex and diverse, the non-specialist reader is likely to be quickly left behind. (There are a few exceptions: *e.g.* the first three articles, which set the stage for the rest of the book, and the article on "Meteorites and the Chemical Evolution of the Milky Way." A good reference for people wanting a survey of the field at an introductory level is *Meteorites and their Parent Planets* by Harry McSween, published in 1999 by Cambridge University Press.)

The book has a number of very appealing features. In general, the articles are clearly written, and the standard of proofreading is very high. The figures uniformly have labels and symbols that are large enough to see easily. The quality of printing is excellent, and the type face chosen is easy to read. The index is a massive 25 pages, and is quite complete. There are a very useful glossary of terms and 14 pages of colour illustrations. Almost every one of the articles has an extensive list of references, with the extremely useful feature of listing titles of referenced articles as well as the usual bibliographic information.

I can only find a few features to criticize. There are not as many sketches and diagrams as I might have liked, which probably reflects the limited familiarity of most scientists with the tools of the graphic artist in our type-it-yourself age. In the text of the articles I find the choice of setting references in italic type somewhat irritating. And even with the glossary, the ubiquitous use of acronyms makes it pretty difficult to dip into an article in the middle.

However, these are minor quibbles. This is a really outstanding book that presents a definitive survey of its field. If you are an early-Solar-System or meteorite specialist, or the collections librarian for a major science library, buy it!

John Landstreet

*John Landstreet is a retired professor of physics and astronomy who has served as President of the Canadian Astronomical Society and is the author of an intermediate-level planetary physics textbook,* Physical Processes in the Solar System.

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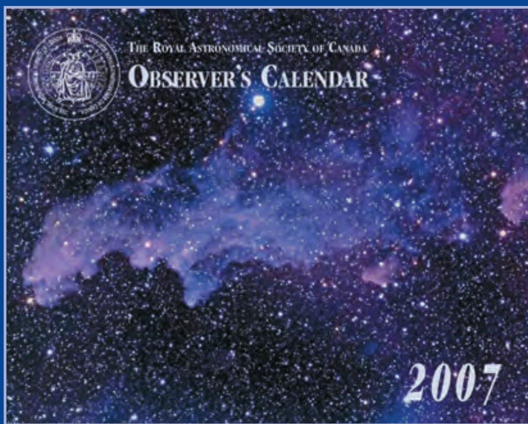


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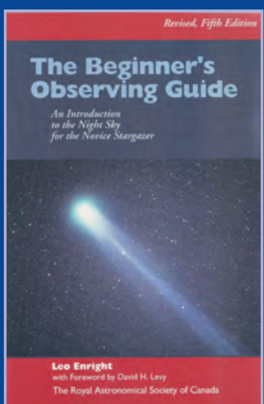


## The Beginner's Observing Guide

**Extensively revised and now in its fifth edition, The Beginner's Observing Guide is for a variety of observers, from the beginner with no experience to the intermediate who would appreciate the clear, helpful guidance here available on an expanded variety of topics: constellations, bright stars, the motions of the heavens, lunar features, the aurora, and the zodiacal light. New sections include: lunar and planetary data through 2010, variable-star observing, telescope information, beginning astrophotography, a non-technical glossary of astronomical terms, and directions for building a properly scaled model of the solar system.**

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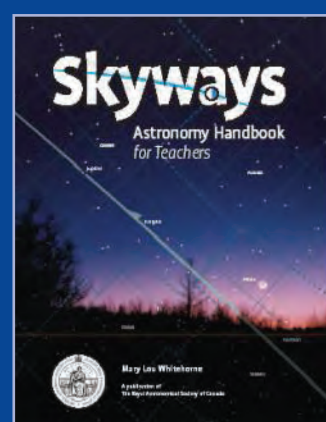


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