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Celebrating the International Year of Astronomy (IYA2009)

December / décembre 2009

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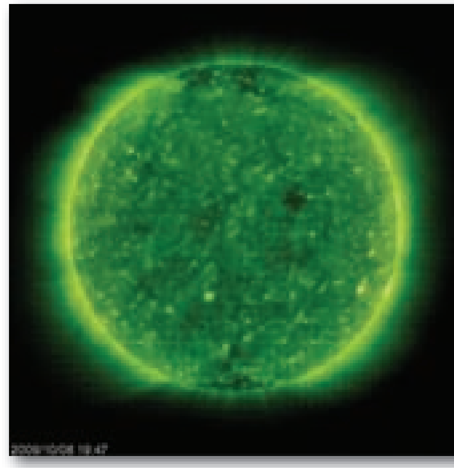

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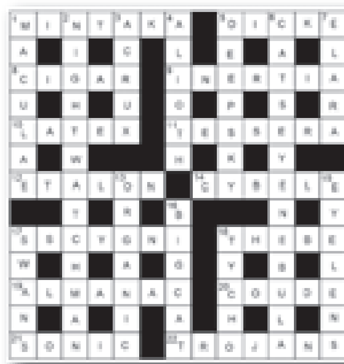

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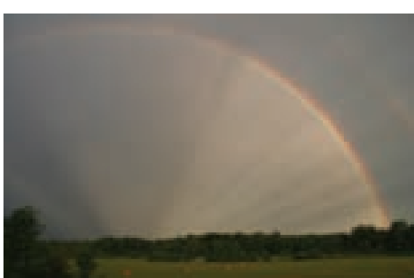

On the Front Cover:
Geoff Gaherty caught this rare image of crepuscular rays converging on the antisolar point at the centre of a rainbow. The photo was taken from just outside Coldwater, Ontario, using a Canon Rebel camera, a 17-mm lens setting, and an ISO of 400. Lucky indeed to have a camera at the right moment!

COLUMNS

News Notes/ *En manchettes*

compiled by Andrew I. Oakes, Unattached Member (copernicus1543@gmail.com)

Theoretical Physicist Leaves Lucasian Chair of Mathematics

Stephen Hawking, an internationally respected scientist known for his work in cosmology and quantum gravity, stepped down as the Lucasian Chair of Mathematics on September 30. Hawking spent 30 years in the prestigious post at Cambridge University.

Figure 1 — Stephen Hawking in Cambridge
Photo: Doug Wheller.

According to the University, the decision was prompted by Hawking reaching the maximum age limit attached to the post of 67 years in January 2010.

The Lucasian Chair of Mathematics is named after its founder and Cambridge politician Henry Lucas. The chair came into being in December 1663 as the "Professorship of Mathematick." There have been 17 incumbents since the Lucasian Chair's founding, one of whom was Sir Isaac Newton, who occupied the chair between 1669 and 1702. Astronomer Sir George Airy held the chair from 1826 to 1828.

Dr. Hawking is planning to work at Cambridge University. He will hold the title of Emeritus Lucasian Professor of Mathematics.

Earth Buffeted with Streams of Solar Energy During Sun's Quiet Phase

New research has found that the number of sunspots provides an incomplete measure of changes in the Sun's impact on Earth over the course of the 11-year solar cycle. The research has shown that Earth was bombarded in 2008 with high levels of solar energy at a time when the Sun was in an unusually quiet phase and sunspots had virtually disappeared.

"The Sun continues to surprise us," said lead author Sarah Gibson of NCAR's High Altitude Observatory in a press release. "The solar wind can hit Earth like a fire hose even when there are virtually no sunspots."

Scientists for centuries have used sunspots, which are areas of concentrated magnetic fields that appear as dark patches on the solar surface, to determine the approximately 11-year solar cycle. At solar maximum, the number of sunspots peaks. During this time, intense solar flares occur daily and geomagnetic storms frequently buffet Earth, knocking out satellites and disrupting communications networks.

"It is vitally important to realize that the 'quiet' Sun really isn't all that quiet," says Rich Behnke, program director in NSF's Division

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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The Royal Astronomical Society of Canada
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of Atmospheric Sciences. “These high-speed streams of wind can affect many of our communications and navigation systems. And they can come at any time, during any part of the solar cycle.”

For the new study, the scientists analyzed information gathered from an array of space- and ground-based instruments during two international scientific projects: the Whole Sun Month in the late summer of 1996 and the Whole Heliosphere Interval in the early spring of 2008. The solar cycle was at a minimal stage during both the study periods, with few sunspots in 1996 and even fewer in 2008.

According to a press release, the team found that strong, long, and recurring high-speed streams of charged particles buffeted Earth in 2008. In contrast, Earth encountered weaker and more sporadic streams in 1996. As a result, the planet was more affected by the Sun in 2008 than in 1996, as measured by such variables as the strength of electron fluxes in the outer radiation belt, the velocity of the solar wind in the vicinity of Earth, and the periodic behaviour of aurorae as they responded to the repeated high-speed streams.

The prevalence of high-speed streams during this solar minimum appears to be related to the current structure of the Sun. As sunspots became less common over the last few years, large coronal holes lingered in the surface of the Sun near its equator. The high-speed streams that blew out of those holes engulfed Earth during 55 percent of the study period in 2008, compared to 31 percent of the study period in 1996. A single stream of charged particles can last for as long as seven to ten days.

At their peak, the accumulated impact of the streams during one year can inject as much energy into Earth’s environment as massive eruptions from the Sun’s surface can during a year at the peak of a solar cycle, said co-author Janet Kozyra of the University of Michigan.

The study was published in the *Journal of Geophysical Research* in September 2009. NASA and the National Science Foundation, NCAR’s sponsor, funded the study.

New York Teen Discovers Junior-Sized Supernova

Caroline Moore, a 14-year-old student from upstate New York and a member of the Puckett Observatory Supernova Search Team, discovered a supernova in a nearby galaxy in November 2008. Since then, professional observations have determined that the object is a new type of stellar explosion. Moore discovered the object using a relatively small telescope, and has become the youngest person ever to discover a supernova.

Called SN 2008ha, the supernova’s explosion is 1000 times more powerful than a nova, but 1000 times less powerful than a “normal” supernova.

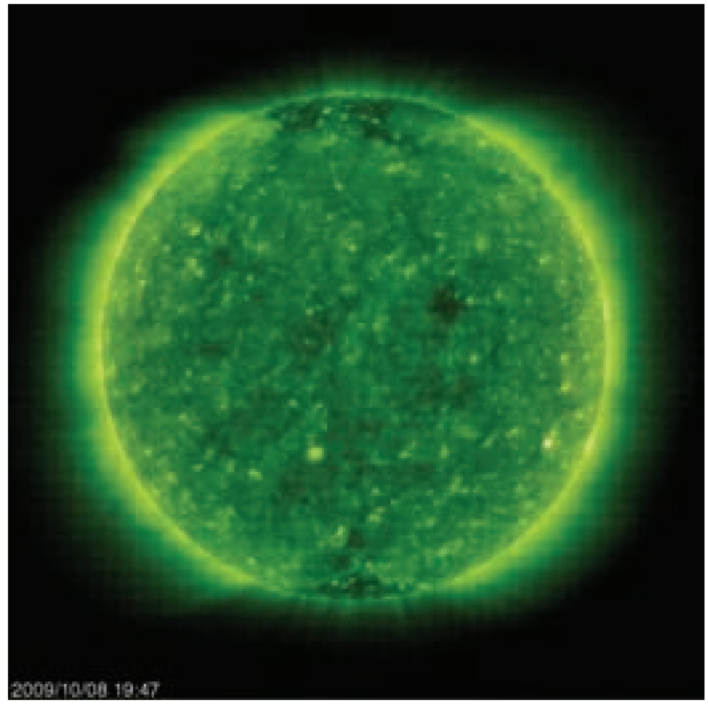

Figure 2 — The Sun in October this year, at 195 Angstrom units in the extreme ultra-violet. Image courtesy of *SOHO* (ESA and NASA).

According to the Harvard-Smithsonian Center for Astrophysics, astronomers note that it may be the weakest supernova ever seen. For a short time, SN 2008ha was 25 million times brighter than the Sun, but since it was 70 million light-years away, it appeared very faint when viewed from Earth.

“If a normal supernova is a nuclear bomb, then SN 2008ha is a bunker buster,” said team leader Ryan Foley, Clay Fellow at the Harvard-Smithsonian Center for Astrophysics and first author on a scientific paper reporting the findings.

“From one perspective, this supernova was an underachiever, however you still wouldn’t want to be anywhere near the star when it exploded.”

Following the discovery, some of the most advanced telescopes in the world were needed to determine the nature of the explosion. Data came from the Magellan telescopes in Chile, the MMT telescope in Arizona, the Gemini and Keck telescopes in Hawaii, and NASA’s *Swift* satellite. One reason astronomers have not seen

The Royal Astronomical Society of Canada is dedicated to the advancement of astronomy and its related sciences; the *Journal* espouses the scientific method, and supports dissemination of information, discoveries, and theories based on that well-tested method.

these types of explosion before might be because they are so faint.

"SN 2008ha was a really wimpy explosion," said Alex Filippenko, leader of the University of California, Berkeley, supernova group, which monitors thousands of relatively nearby galaxies with a robotic telescope at Lick Observatory in California.

Foley's team concludes that hundreds of this type of event may be spotted in the next few years, as a new generation of telescopes and instruments is beginning to search greater distances than ever before, effectively monitoring millions of galaxies.

"Coincidentally, the youngest person to ever discover a supernova found one of the most peculiar and interesting supernovae ever," remarked Filippenko. "This shows that no matter what your age, anyone can make a significant contribution to our understanding of the Universe."

The research paper was accepted for publication in the *Astronomical Journal*. Titled *SN 2008ha: An Extremely Low Luminosity and Extremely Low Energy Supernova,* a draft version is available online at `arxiv.org/abs/0902.2794`.

Early Planetary Radiation Shield — Prebiotic Ozone

Scientists have confirmed a key chemical reaction that forms the molecule triacetylene in the ultra-cold atmosphere of Saturn's moon Titan. At 5150 kilometres across, Titan is Saturn's largest moon and the second-largest moon in the Solar System.

A study by an international group of researchers suggests triacetylene may have been formed in Earth's early atmosphere, and the presence of the molecule at Titan may offer clues to the evolution of Earth's atmosphere before the development of life some 3.5 billion years ago. Titan's current atmosphere is thought to resemble Earth's early atmosphere.

Triacetylene is a member of the polyyne family of compounds. Polyynes are thought to serve as an ultraviolet-radiation shield in planetary environments, thus acting as prebiotic ozone and as important components of the orange-colored and aerosol-based haze shrouding Titan.

Triacetylene and diacetylene are molecules consisting of six and four carbon atoms, respectively, and two hydrogen atoms. Scientists have been studying the role of triacetylene, as well as the polyyne diacetylene, in the chemical evolution of Titan's atmosphere for the last four decades.

Triacetylene was detected in Titan's outermost atmosphere via a positively charged form of triacetylene with an additional hydrogen atom. The mission also revealed that the transformation of acetylene and diacetylene to polyacetylenes such as triacetylene likely presents one of the most fundamental steps in the evolution of planetary atmospheres.

The findings appeared in the 2009 September 14, advance online issue of the *Proceedings of the National Academy of Sciences.*

University of Toronto: Astronomy and Astrophysics Theses List for 2009

Four new Ph.D. theses, supervised by teaching staff at the Department of Astronomy and Astrophysics at the University of Toronto (U of T) and successfully defended in 2009, are available for download on the Department's Web site. Both abstracts and full-text PDF versions are available at `www.astro.utoronto.ca/theses/theses97--.html`. The titles of the theses are:

Numerical Experiments in Core-Collapse Supernova Hydrodynamics / Rodrigo A. Fernandez

Evolving Starburst Model of FIR/sub-mm/mm Line Emission and Its Applications to M82 and Nearby Luminous Infrared Galaxies / Lihong Yao

Weak Gravitational Lensing Uncertainties / Tingting Lu

The Morphology of Local Galaxies and the Basis of the Hubble Sequence / Preethi B. Nair

Andrew I. Oakes is a long-time Unattached Member of RASC who lives in Courtice, Ontario.

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Indices for Measurement of Seeing Quality by Low-Cost Camcorder Imaging

Arthur Pallone, Melissa Addessi, and Sara Evans,
Telescopes in Education and Research at Murray State;
Department of Engineering and Physics;
College of Science, Engineering & Technology;
Murray State University; Murray KY USA 42071
art.pallone@murraystate.edu

ABSTRACT: Before modified Webcams and inexpensive CCD (Charge Coupled Device) cameras existed for astronomical imaging, amateur astronomers converted camcorders to take guided, long-exposure images. Advances in image processing software now permit assembly of unguided, short-term exposures into one equivalent long-exposure image. Atmospheric conditions affect the ultimate quality of all images taken from the surface. The conditions cause the familiar twinkle of stars that degrade spatial resolution in and limit photometric measurements from an image. Observing conditions are quantified by time-variation analysis of a bright star captured in the VHS-C camcorder video in an urban environment. Results are presented in terms of the image quality and photometric indices.

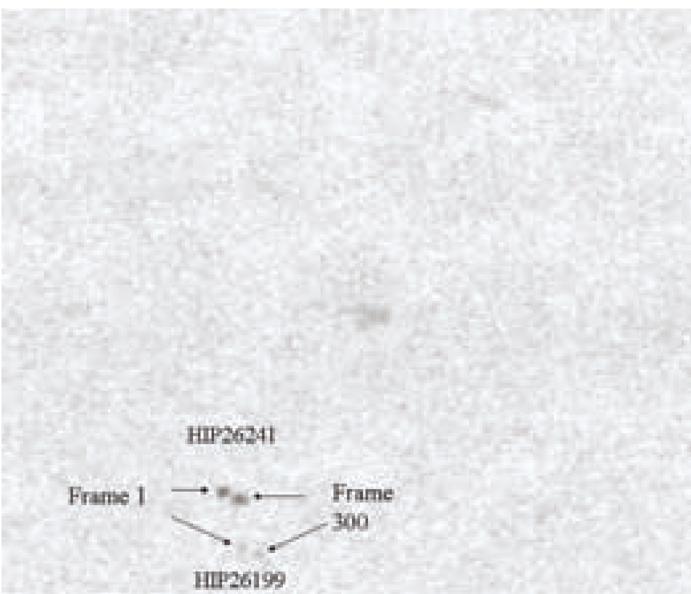

Figure 1 — Overlay of negatives of two unprocessed images separated by 10 seconds shows effects of Earth's rotation, camera mount vibrations, and atmospheric conditions.

Introduction

As an alternative to the more complex ways used at professional observatories and the well-established but observer-dependent visual inspection of stellar diffraction patterns through telescopes (Seneta & O'Donovan 2004; Caccia, Azouit, and Vernin 1987; Vernin & Muñoz-Tunon 1994; Avila, Vernin, and Masciadri 1997), a method that uses commercial off-the-shelf camcorders (in this study a VHS-C format) to gather data has been developed to objectively quantify the effects of seeing conditions on observations (McNish 2008; Ayton 2006; Beish 2008; Sherrod 2007; Peach 2003; MacRobert 2009; Menzel 1963; Zeilik & Gregory 1998). The method measures the position and brightness of one or more select stars in each video frame with *ImageJ:* a free, public-domain Java-based image-analysis program (Sbalzarini & Koumoustsakos 2005). Changes in star positions in the frames are caused by the rotation of the Earth (Scagell 2006), motions in the camera mount, and fluctuations in the optical density profile along the line of sight from the star to the camera (Menzel 1963). The rotation effect is removed and the remaining motion is quantified. Changes in brightness of the selected star between successive frames are caused by thermal variations in the camcorder, pixel-to-pixel variations in response to light within the camcorder (Richmond 2004), and fluctuations in the atmospheric absorption and scattering of light along the line of sight from the star to the camera. The variations due to camcorder performance are reduced by proper image post-processing and the remaining brightness variations are quantified. The test star (shown in Figure 1) for this method was HIP26241 from the *Hipparcos* star catalog (*Hipparcos* 1997), also known as iota Orionis in the sword of Orion (Dunlop 2005).

Methods

Image collection and preparation

A camcorder was mounted to a stationary tripod. The test star was located using the camcorder viewfinder (rather than the LCD display) to avoid affecting other observers' night vision and to minimize electronic contribution to noise. The camcorder was set to its lowest light setting, an optical zoom of 15×, and infinite focus. The observer then stepped away from the camcorder to avoid the effects of observer-generated thermals on the video. Post-processing and data reduction of the video began with selection of a 10-second section of the original video that showed no gross jumps in star position to avoid camcorder re-pointing, wind gust, and accidental tripod bumping effects. This section of the video was captured from

VHS-C tape to uncompressed AVI (Audio Video Interleave) files by a WinTV-HVR 950. Separate red, green, and blue FITS (Flexible Image Transport System) files were created for each frame of the AVI with the Astronomy plug-in to *ImageJ* (Hessman & Modrow 2008).

Electronics and thermal noise adversely affect charge-coupled-device (CCD) images such as those from camcorders. The noise depends on environmental and camcorder operational conditions, so it varies from session to session. It is approximated by an image formed with a covered-lens video taken just before or just after the video used to form the object image, so as to best match the object-imaging conditions. The covered-lens image, known as a dark frame, is time normalized to the duration of a single frame from the object-image video and then subtracted from each object-image video frame (Richmond 2004).

Camera optics imperfections and nonuniform pixel response produce pixel-to-pixel variations to the same light. An image of a uniformly lit surface, known as a flat field, measures these variations. The same dark-frame subtraction procedure is applied to the flat-field image using a dark-frame image taken at the time of the flat field to produce a corrected flat-field image. Division of the dark-frame subtracted images by a time-normalized, corrected flat field reduces these imperfections (Richmond 2004).

Image Quality (IQ) index

The Particle Tracker plug-in to *ImageJ* measured the location of the star centroid in each frame, and that location was exported to Microsoft *Excel* for analysis. Particle Tracker provided sub-pixel resolution in star position by an intensity-weighted-pixel centroid algorithm (Sbalzarini & Koumoustsakos 2005). The rotation of the Earth produced a steady movement of HIP26241 across the field of view of the camera (Dunlop 2005). This movement was removed by application of curve fits to the star positions along the image axes (x and y) as shown in Figure 2. The residual variations in star position between frames were then due to vibrations of the mount and atmospheric effects. Those variations affect image quality and were quantified as follows.

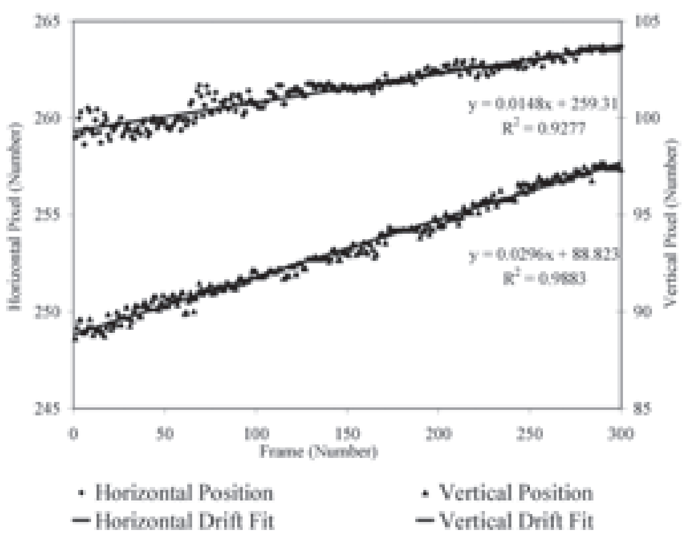

Figure 2 — Effect of the rotation of the Earth on star position is determined by curve fits to the change in that position (pixel number) over time (frame number) in the images. The subpixel resolution in position was provided by an intensity-weighted-pixel centroid location algorithm in the Particle Tracker plug-in to *ImageJ.*

The number of pixels that separates HIP26241 and HIP26199 (identified in Figure 1) was measured in the best single video frame. The angular separation between HIP26241 and HIP26199 was calculated from the reported right ascension and declination of each star (*Hipparcos* 1997; Richmond 2005). That separation, the position angle from HIP26241 to HIP26199 measured relative to the image axes, and the Pythagorean theorem for a right triangle were used to find the angular separation along each of the image axes. The ratio along each axis of that angular separation to the separation in number of pixels yielded the conversion factor of 15.2 arcseconds per pixel for each image axis. Measurement of the drift of HIP26241 across the CCD image confirmed the conversion values. Residual position information was transformed into the coordinate system shown in Figure 3 by

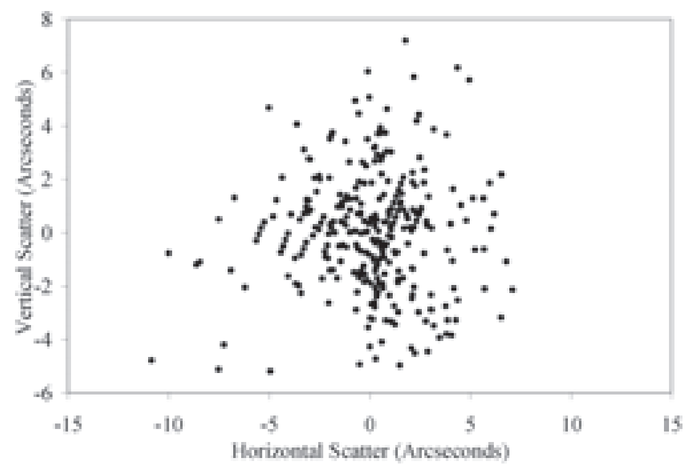

Figure 3 — The star motion due to seeing conditions is seen as the scatter in these residual positions after removal of the effect of the rotation of the Earth.

$$\Delta x_i = x_{curve,i} - x_i \text{ and } \Delta y_i = y_{curve,i} - y_i \quad (1)$$

where x_i, y_i are the data points and $x_{curve,i}, y_{curve,i}$ are the curve fit values in Figure 2.

The angular step size, S_i, defined as the change in residual star position, is given by

$$S_i = (S^2_{x,i} + S^2_{y,i})^{1/2} \quad (2)$$

where $S_{x,i} = \Delta x_i - \Delta x_{i-1}$ and $S_{y,i} = \Delta y_i - \Delta y_{i-1}$ with the values in Figure 4 expressed in arcseconds. Jitter, *J,* is an exercise in counting. It is measured by

$$J = n / (N\text{-}1) \quad (3)$$

where *n* is the number of times the step size, S_i, is greater than, or equal to two arcseconds and *N* is the number of frames extracted from the video. Unlike other methods that measure stellar diffraction pattern diameters, such as the Amateur Astronomer "Seeing" Scale (McNish 2008), jitter does not depend on telescope diameter. *J* varies between 0 (perfect seeing) and 1 as shown in Table 1.

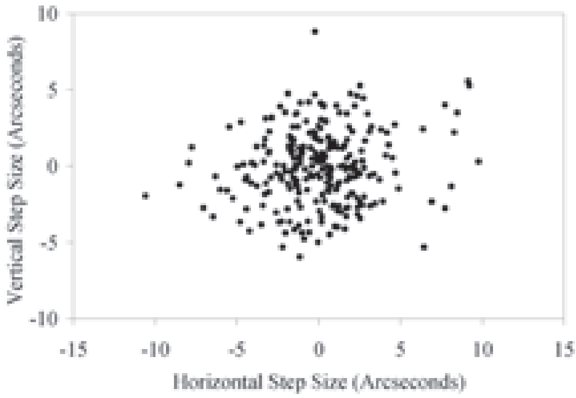

Figure 4 — Angular step size measures the change in the residual position between successive frames.

Photometric Index (PI)

The dark-subtracted, flat-field-corrected frames are used for photometry. Aperture photometry adds the intensities of the pixels that enclose an object of interest, such as a star, in an image. The pixel intensities for a region around the star are added and the value normalized to the same number of pixels that enclose the star to determine the background intensity of the sky. This background intensity is subtracted from the star intensity to provide the true star brightness, *B*, measured by the camera (Hessman & Modrow 2008). The difference between the maximum, B_{max}, and the minimum, B_{min}, of these measured values in the sampled frames is divided by the maximum to normalize the brightness variation

$$\Delta B = (B_{max} - B_{min})/B_{max} \quad (4)$$

in the star. For a star of constant brightness over the measurement time interval, ΔB varies between 0 (perfect seeing) and 1.

Results

Perfect sky conditions yield zero-valued residual positions and thus zero jitter. HIP26241 was observed under less than ideal urban skies. Residual positions were as large as 12 arcseconds with a maximum step size of 11 arcseconds between frames as shown in Figure 5. The resulting jitter of $J = 0.58$ corresponds to a poor rating on the image-quality index. The integrated pixel intensity (brightness) of HIP26241 measured with *ImageJ* varied from 2271 to 3502 ADU. This gives a relative brightness variation of $\Delta B = 0.35$, which corresponds to an average rating on the photometric index.

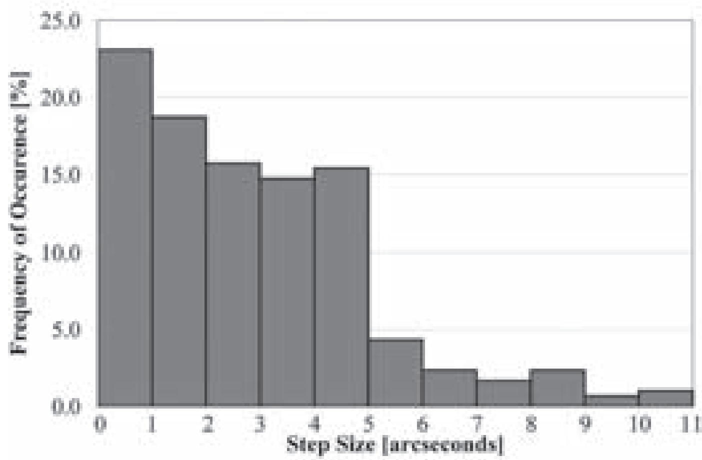

Figure 5 — The histogram of step sizes illustrates the relative steadiness in seeing conditions during observation of HIP26241. Jitter (a measure of image quality) is the fraction of step sizes greater than or equal to two arcseconds.

Rating	Jitter	Brightness
Very Poor	0.76 – 1.00	0.91 – 1.00
Poor	0.51 – 0.75	0.61 – 0.90
Average	0.26 – 0.50	0.31 – 0.60
Good	0.10 – 0.25	0.10 – 0.30
Excellent	0.01 – 0.09	0.01 – 0.09
Perfect	0	0

Table 1 — Seeing Quality Indices Determined from Stellar Videos

Conclusion and Recommendations

We demonstrated a method to quantify seeing conditions by analysis of night-sky video. Jitter is useful for astrometric and imaging purposes, such as planetary viewing. The brightness variation is useful to quantify conditions for photometric work where object details are not directly imaged. Jitter and brightness variations as quantified on the image quality and photometric indices offer a simple, low-cost alternative to methods used at professional observatories to quantify atmospheric seeing. The jitter can also account for mechanical disturbances such as vibrations in the camera mount. Thus these indices are suitable for astrovideographers, educators, and those with limited budgets to compare observation conditions between locations, between nights at the same location, and over the course of a single night.

Since the atmospheric conditions may vary over the field of view in an image, determination of these indices for multiple, widely separated stars in the image should be performed when possible. Also an indicator of the variations in relative positions between the multiple stars should be developed. These methods should then be compared with other accepted methods.

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Feature Articles

Astronomy Abstracts from the 2009 RASC General Assembly/Saskatchewan Summer Star Party

compiled by Gordon E. Sarty, Saskatoon Centre (gordon.sarty@usask.ca)

The 2009 Annual General Assembly of the RASC was hosted by the Saskatoon Centre in a novel location, and at a novel time. Instead of being held on the traditional Canada Day long weekend, this year's General Assembly was held from August 13 to 16, in conjunction with the Saskatchewan Summer Star Party (SSSP) at Cypress Hills Interprovincial Park. Some day we will be able to predict the weather a little better, but this year it was cloudy and rainy for the SSSP. I managed to get a little observing in by arriving a day early on August 12, but my telescope remained covered for the rest of the Star Party.

This year's General Assembly included the usual "scientific paper session." I propose that future General Assembly organizers call this collection of interesting talks the "astronomy paper session" because astronomy is much more than just science to most amateur astronomers. We had, for example, the *Starry, Starry Night Art, Quilt, and Poetry Exhibition* curated by Kathleen Houston. In the same room with the exhibition were the "scientific posters" associated with our paper session. The blend from art to science was smooth, natural, and a wonderful statement of what it means to be an amateur astronomer.

Presented here are the abstracts from the astronomy paper session of the 2009 General Assembly of the RASC. We begin with the Father Lucien Memorial Talk by our new honorary president, Dr. Jim Hesser. Following that are the abstracts from the paper sessions beginning with the keynote talk by Martin Beech. The talk abstracts are followed by the poster abstracts, where we take note of the poster by Kathleen that spilled over from the art exhibition. Wonderful! Finally, this year's General Assembly included a Light Abatement Forum, and the abstracts from those talks are given at the end of this report.

I know I speak for everyone who attended this year's GA/SSSP in expressing a big thanks to the dedicated bunch of people who organized this year's event. Thanks for a great party.

2009 Father Lucien Kemble Memorial Talk

International Year of Astronomy In Canada: A "Mid-Term" Report Card With An Eye On The Future

Jim Hesser (NRC-HIA), C. Bartlett (Cape Breton U.), K. Breland (Canadian IYA Project Manager), K. Hay (RASC), D. Lane (RASC), R. Lacasse (FAAQ), D. Lemay (FAAQ), P. Langill (U. Calgary), J. Percy (U. Toronto), D.L. Welch (McMaster U.), A. Woodsworth (Galaxy Consulting)

Our national IYA partnership is striving to secure education and public outreach legacies for Canadians, *e.g.* informal and formal educators, Aboriginal communities, the parks system, and so on.

These legacies will ensure that the efforts of the past three years of the three partner organizations and our hundreds of collaborators will extend far beyond 2009. The materials developed for education and public outreach by volunteers from the amateur communities are being exceptionally well received by the public and by educators. Thanks in large measure to Canada's amateur astronomers, by mid-IYA, 500,000 Canadians (representing every province and territory) had experienced a "Galileo Moment of personal astronomical discovery" through participation in an IYA activity from our diverse palette. We are thus nicely on track to our (modest) target of engaging 1,000,000 Canadians during 2009. This presentation had two goals. First, to review how creative participation in astronomy education and public outreach by traditional and non-traditional partners is resulting in remarkable IYA successes. Second, to outline the latest developments, including opportunities for fun, engaging events in the fall and winter of 2009, that will further secure the legacies of IYA in Canada.

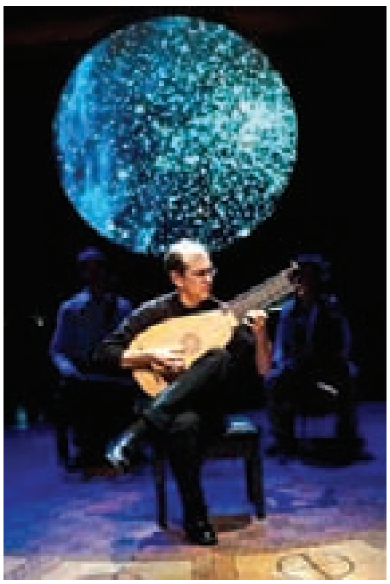

Figure 1 — Tafelmusik's *The Galileo Project: Music of the Spheres* is just one of many Canadian IYA events [courtesy Tafelmusik/Banff Centre from IYA Web site]

Traditional Astronomy Papers

Keynote Talk: Meteorites in the Land of Living Skies
Martin Beech (Campion College, University of Regina)

Saskatchewan, *The Land of Living Skies,* is one of the best locations within all of Canada for finding meteorites and large impact structures. At least 5 multi-kilometre-diameter impact craters are presently known in the province and a total of 15 distinct meteorite falls are currently recognized. The first meteorite find was made in 1916 at Annaheim, to the east of Saskatoon, while the most recent fall was that of the spectacular and high-yield Buzzard Coulee meteorite that landed to the southeast of Lloydminster. In this talk, I reviewed the rich history and circumstances behind the collection of meteorites within Saskatchewan, and I presented an overview of some of the research relating to these extraterrestrial interlopers.

Figure 2 — A small fragment of the Buzzard Coulee Meteorite is held aloft shortly after being found on 2008 November 29.

Amateur at Buzzard Coulee
Bruce McCurdy (Edmonton Centre)

Avid meteor observer Bruce McCurdy saw the fireball of his life through his picture window last November 20. The brilliant spectacle lured him into pursuing the proverbial pot of gold at the end of the rainbow, which had fallen to earth in a shower of meteorite fragments 300 km away. In an eventful 24 hours, Bruce attended the media scrum of the initial find by University of Calgary scientists, got a hands-on look at the largest recovered specimen in the Marsden

Figure 3 — One often gets the opportunity to view astronomical objects through a telescope, but a microscope also reveals plenty of interest and of beauty. Here Bruce McCurdy examines the largest of our recovered specimens. (Photograph: Murray Paulson)

Hotel pub, and found a couple of fragments himself on a frozen beaver pond. Bruce's presentation followed those specimens through their subsequent scientific analysis at the University of Alberta and the public outreach that followed. He also discussed the spring search that yielded the largest number of meteorite fragments from a single fall in Canadian history, and the important relationship between the amateur and professional science communities.

The Cypress Hills Observatory
Gerald Gartner (Friends of Cypress Hills Park Inc.)

In 2007, the "Friends of Cypress Hills Park" proposed the idea of an educational observatory to be built as part of the Dark-Sky Initiative at the Cypress Hills Interprovincial Park. This observatory, along with an outdoor (under-the-stars) planetarium, is planned to be co-located within the Park's Dark-Sky Campground. When built, the facility will sport a 16-inch telescope and a large classroom where schools, community groups, and astronomers can learn about the Universe under the very dark skies of Cypress Hills. Fundraising for the project has advanced though a "Buy-a-Star" program and through a request for corporate funds. This talk discussed the design of the observatory facility and goals of "The Friends and the Park" in this project.

Figure 4 — Artist's concept of the Cypress Observatory and Planetarium. Construction start proposed for 2009.

The Galilean Telescope
David M.F. Chapman (Halifax Centre)

The International Year of Astronomy 2009 celebrates the 400th anniversary of Galileo's use of the telescope to investigate the cosmos. But how many of us know how a Galilean telescope works? For instance, how do you get a magnified image using a negative eyepiece lens? This presentation used ray diagrams to compare the conventional Keplerian telescope to the Galilean telescope and explained magnification, image orientation, field of view, and both real and virtual exit pupils. Finally, we learned how to transform an ordinary refractor into a Galilean telescope simply by using a Barlow lens.

The ARP Atlas of Peculiar Galaxies
Rémi Lacasse (Montreal Centre)

In ten years of doing astrophotography, I went from imaging different objects to taking long exposures and was looking for a long-term challenge, which the *Arp Atlas of Peculiar Galaxies* provided me. Starting in the early '50s, Halton Arp conducted a photographic investigation of galaxies that did not fit into Edwin Hubble's "tuning fork" diagram. In November 1966, his *Atlas* was published. Arp's observations led him to believe that the redshift of certain peculiar galaxies was not due to the recessional velocity of the Big Bang Universe, but to properties inherent in the galaxy itself. This controversial hypothesis caused him a number of difficulties. In April 2007, I decided to image the 338 galaxies in colour over a period of five years. Although some are spectacular, many are extremely small and challenging. Two years into the project, the 210 completed photographs can be seen at `www.astromirabilis.com`

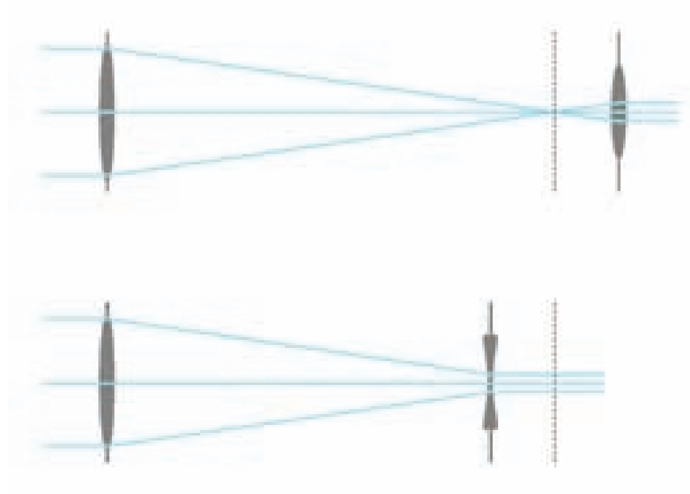

Figure 5 — Kepler's telescope is shown above, Galileo's telescope is below.

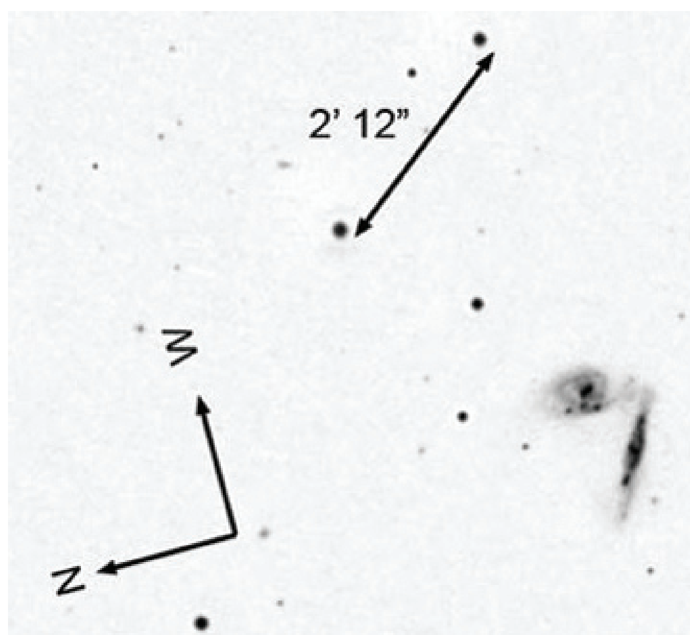

Figure 6 — ARP 301 from Rémi Lacasse's collection

Observing HMXBs with Professional and Space Telescopes
Gordon E. Sarty (Saskatoon Centre)

HMXBs are high-mass X-ray binary stars. They are massive stars orbited by a neutron star or a black hole. HMXBs have provided a way for me to change my professional research interests from imaging brain function to astronomy. This is a story about how I "expanded" from an amateur to a professional astronomer. A major part of that expansion was learning how to write successful observing proposals for professional telescopes. I started with photometry on the 40-inch telescope at Siding Spring Observatory in Australia. Then I moved on to spectroscopy with the 72-inch Plaskett telescope at Victoria, B.C. (Yes, a very bad case of aperture fever). The data I obtained from those ground observations allowed me to propose observing time on the Canadian *MOST* space telescope. Now I'm analyzing data from *MOST*. My latest success is the award of time on NASA's *Spitzer* space telescope. The talk featured an overview of my professional observations and a discussion of "what it takes" to go pro. I was especially interested to see teenagers in the audience who are now making critical career and life choices.

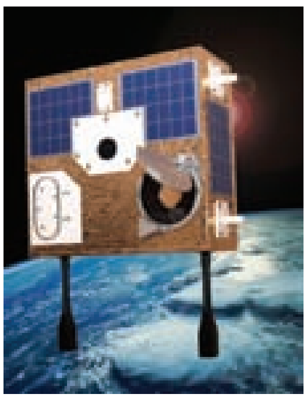

Figure 7 — An artist's conception of *MOST* – courtesy of the Canadian Space Agency

Posters

IYA 2009: A Pictorial Overview
Jim Hesser (NRC-HIA), C. Bartlett (Cape Breton U.), K. Breland (Canadian IYA Project Manager), K. Hay (RASC), D. Lane (RASC), R. Lacasse (FAAQ), D. Lemay (FAAQ), P. Langill (U. Calgary), J. Percy (U. Toronto), D.L. Welch (McMaster U.), A. Woodsworth (Galaxy Consulting)

Canada's IYA effort relies nearly 100 percent upon generous donations of time and effort by hundreds of people. Some of the striking accomplishments to date, illustrated in the poster, included new youth-oriented educational and outreach materials that are distributed freely at IYA events; a new planetarium show being presented at four major science centres; original works of music and performance that showcase astronomy in a captivating way for children and adults; an animated video narrated in English, French, or Mi'kmaq of an aboriginal story relating the seasons with circumpolar motions of stars; theatre events; image exhibits; improved science education materials linked closely to curriculum requirements; and many more.

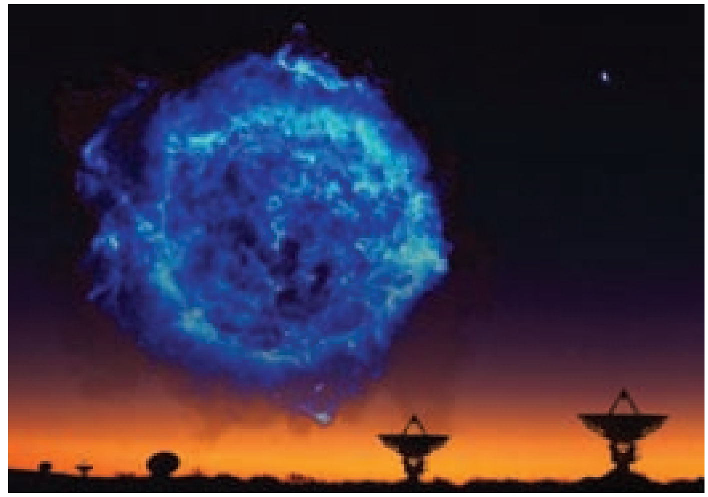

Figure 8 — This cool image is a collage, showing a radio image of the supernova remnant Cassiopeia A in the sky, with a foreground showing the NRAO Very Large Array Telescope that made the radio image. [original image data courtesy of NRAO and R. Perley, image assembled by Michael Bietenholz and used as per the terms on the Canadian IYA Web site]

Solar Observing from 1999-2009
Kim Hay (Kingston Centre)

It takes approximately 11 years, plus or minus several months, to complete one solar cycle that follows the activity of the Sun. The 11-year period also encapsulates the much shorter Carrington Rotations, which average 27 days, plus or minus 2 days. Our poster showed observations of sunspots by an amateur observer in white light and how they compare with the NASA/NOAA sunspot counts over the same period, showing that amateurs can do solar science with modest equipment. As we enter the newest cycle 24, we find the Sun very nearly at its quietest time in many centuries — so quiet that NOAA has just revised its predictions of the scale and timing of the beginning cycle.

Figure 9 — White-light telescope used for solar observations

Galileo Observing Challenge: Interim Report
The RASC Astrosketchers: Kim D. Hay, Clark Muir, Dorothy Paul, and Randall A. Rosenfeld

To mark IYA 2009 and the 400th anniversary of the beginning of telescopic astronomy, the RASC Astrosketchers Group launched the "Galileo Observing Challenge." This experiment encourages modern observers to re-create something of early 17th-century observing conditions by 1) using accessible equipment constrained in some features to match that available four centuries ago (*e.g.* magnification from 3× to 30×); 2) observing the objects Galileo studied (as reported in *Sidereus nuncius* and elsewhere); 3) making a hand-drawn record of their observation(s); 4) producing a short essay on their experience. The goal is to deepen the participants' IYA experience by providing a hands-on historical experiment that allows them to qualitatively and selectively assess the instrumental constraints under which the 17th-century discoveries were made. The contrast between then and now may even have lessons for the experienced modern observer. Case studies (equipment, techniques, results) presented on the poster illustrated progress to date.

Figure 10 — A "Galilean" sketch of the Moon.

The ARP Atlas of Peculiar Galaxies
Rémi Lacasse (Montreal Centre)

Following on the talk, this poster showed more of Arp's galaxies.

Starlight Cascade Observatory
Kevin Kell and Kim Hay (Kingston Centre)

This was a great poster but Kevin and Kim were shy to provide an abstract. However, track them down and they'll be more than happy to tell you about the observatory.

From Galileo's sketchbook to my own
Kathleen Houston (Saskatoon Centre)

This is my third year as designer for the Saskatchewan Summer Star Party pin in Cypress Hills. I focused on Galileo's discovery of the "stars" around Jupiter, to create a design that also honoured International Year of Astronomy and the General Assembly. This set me on a journey back in time to study paintings of Galileo, his drawings, published works, writings, and translations, using Internet resources to learn more about this unique time of discovery in January of 1610.

Christian Banti's painting of Galileo helped me to create the persona of Galileo, who looks at the Medicean stars with his telescope, in Cypress Hills. The final drawings of the Galilean moons were based on several sources. A scanned sample of Galileo's drawings and notes found on the Internet created a personal feel. In the published, cleaned-up drawings from *Sidereal Messenger,* (*Archives of the Universe,* Pantheon books 2004), Jupiter was a star and the moons were splats. I redrew Galileo's drawings of Jupiter, which he used in the week of January 7 — 13 to follow the movement of the moons until he had observed all four. Galileo describes his aha! moment as "moving from doubt to astonishment" when it became clear that the moving stars around Jupiter were indeed moons, echoing the Sun-centred model of our Solar System.

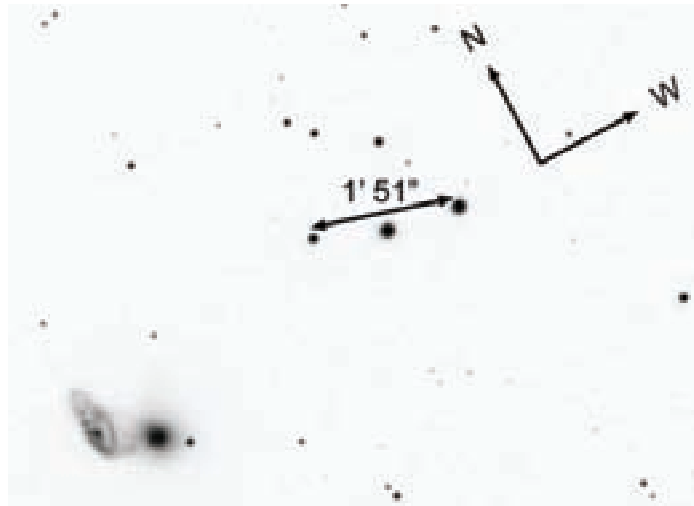

Figure 11 — Remi's image of ARP 91 - the apparently interacting pair of NGC 5953 and 5954.

Light Abatement Forum
Fighting Casino Spotlights through the Saskatchewan Environment Management and Protection Act
Richard Huziak (The Rural Environment Preservation Association of Saskatchewan)

On 2007 August 10, the *Saskatchewan Indian Gaming Association* turned on 2.32-billion-candlepower up-facing spotlights on the first of what eventually became six casinos that were lighted in this manner. A group of concerned local residents whose dark, country skies were directly affected by this light pollution formed an Environmental Non-Governmental Organization (ENGO) called *The Rural Environment Preservation Association of Saskatchewan* (REPAS). REPAS mounted a challenge under *Section 63* of the *Saskatchewan Environment Management and Protection Act* charging that "the intentional *discharge* of excessively bright light from the *Teepee of Light* and parking-lot lighting at the Dakota Dunes Casino *is at an amount, concentration or level* that has caused and is causing an *adverse effect that impairs the environment contrary to the EMPA, 2002.*" Although REPAS lost this challenge, their investigation found that hundreds, if not thousands, of migrating warblers died as a result of being caught in Yorkton's casino lights. This paper explored avenues that may exist to potentially ban these, and other, up-facing spotlights on environmental grounds.

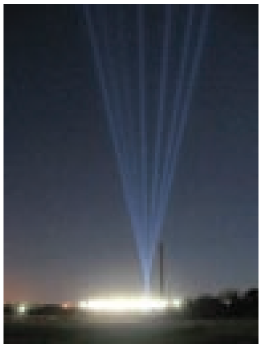

Figure 12 — Now that's light pollution.

Living in Harmony with Nature
Rena Woss (Lethbridge Astronomy Society)

Creating a balance between development and our human need to connect with the Universe is central to the work we do on the light-pollution front. Citizens and politicians are listening to us. Dark-sky parks and preserves have been and continue to be established throughout the world and in our country. Evidence of this should encourage all of us to continue in our effort. Margaret Meade reminds us of this in her famous quote: "Never doubt that a small group of thoughtful committed citizens can change the world; indeed, it's the only thing that ever has."

Light-Abatement Success Stories
Patrice Scattolin (Le Centre francophone de Montréal)

Mont-Mégantic Observatory's scientific survival depended on an aggressive light-pollution program partially funded by the Observatory. With a total of $1.7 million spent over 3 years, much was accomplished, including adoption of multiple municipal bylaws regulating exterior lighting and an extensive luminaire retrofitting program near the observatory. Both the importance of the observatory to the region and the tireless work of Chloé Legris were key ingredients for the first IDA Dark-Sky preserve in Canada.

In contrast, in the city of Brossard, Québec, the adoption of a luminaire replacement program on Rome Boulevard was the result of favourable circumstances. The convergence of informal discussion with a local city councillor, the availability of unexpected external funding from the Hydro-Quebec Energy Wise program, and a political climate favouring sustainable development made the project a reality.

Two different situations led to two completely different successful light-pollution abatement projects. The local circumstances will indicate the most successful approach.

Aboriginal Sky Lore of the Pleiades Star Group in North America

by Frank Dempsey, Toronto Centre (frank.dempsey@sympatico.ca)

Introduction

Many winter constellations are bright and distinct, and the tiny cluster of stars known in contemporary Western astronomy as the Pleiades is a group of stars that is easily recognizable even among the large and brilliant constellations of the winter sky. Not surprisingly, native cultures across the continent used the appearance of this tiny but conspicuous cluster to organize their calendars and some critical agricultural functions. Although not an "official" constellation recognized by the International Astronomical Union, the cluster was recognized as a separate grouping and featured in many of the legends and stories of aboriginals involving people and natural creatures. Story telling, singing, and dancing were major forms of communicating and passing on knowledge, and various legends involving this constellation have been found to have some common themes. Themes that appear in the Pleiades legends and mythologies include dancing children, wandering or lost people huddling together, proper conduct and the punishment of wrongdoing, groups of animals, and escape to the sky to avoid some sort of trouble on Earth.

Figure 1 — The Pleiades star cluster. Photo by Jay Anderson, Winnipeg Centre.

Dancing Children

Various aboriginal cultures in different language groups saw the

Pleiades cluster as dancing or wandering children. In a legend of the Onandaga Nation, one of the constituent groups of the Confederacy of Iroquois in the region south of Lake Ontario, a group of eight children got tired of helping their family with the daily chores and met away from their village to dance for hours at a time every day. One day, they decided to ask their parents for food to take with them, but all of the parents refused, telling them to eat their meals at home and then go and play. The children continued to meet and dance every day, even though they were hungry, ignoring frequent warnings from a strange old man who told them that they must stop. One day, the hungry and lightheaded children began to rise into the air while dancing. Some parents saw them and tried to stop them, but it was too late, except for a small boy who, looking down, recognized his father and then fell to Earth as a falling star. The seven dancing children continued dancing faster and rising higher into the sky. They are now known as "Oot-kwa-tah," "There They Dwell in Peace," and are seen as a pretty band of dancing children (Macfarlan 1968).

In a legend of another northeastern culture but of a distinctly different language group (of the Algonkian family), the Wyandot natives of the region south of Lake Huron, the stars are the "Singing Maidens" and the daughters of the Sun and Moon. They were born at the same time and sang together sweetly and danced beautifully in their home in the sky. One day, they wanted to go to visit some relatives, but their father, the Sun, forbade them. They went anyway and when they returned home, their father was very angry and sent them to dwell in a place in the sky so distant that they would be barely visible. Today they continue their singing and dancing together in the sky, but they are much diminished in brightness (Miller 1997).

This theme of seven dancing children was a widespread legend. The Cherokee, originally in the region of North Carolina, referred to the stars as Ani'tsutsa ("The Boys"), while the Delaware, also near the Atlantic coast, saw the Pleiades as the "Seven Prophets" who were forced to flee to the sky to escape harm. In the southern Great Plains, the Kiowa and Jicarilla Apache tribes had legends describing the Pleiades as six hunters and a girl (Miller 1997). In southern Arizona, the Tohono O'odham tribe saw the group as young women who were moved to the sky by an older woman as visible and conspicuous punishment for singing and dancing so freely and carelessly that they lost their way and became homeless (Miller 1997).

To the Skidi Pawnee of the central Great Plains, there were several interpretations associated with the cluster. In one legend, the seven stars were given the name Chaku by Tirawahat (the supreme chief who created and placed all of the stars). Chaku was placed in a position and on a path across the sky to serve as a guide to the people. Another Skidi Pawnee legend involved a girl who was pursued by a rolling skull. She was saved when she reached a lodge, where six brothers in the lodge smashed the skull into pieces. In return for saving her, she planted and helped them to grow beans, corn, and squash. In another version (given in more detail by Chamberlain 1982), the girl was adopted into the family of seven brothers and then produced a child. Eventually the girl, along with the seven brothers, the child, and the father of the child, became the stars of the Pleiades cluster in the sky, as there are ten stars that could be seen (with good eyesight). The Arikara, a group that lived in the state of North Dakota and were closely related to the Pawnee, had a legend in which a bear was pursuing a girl and her brothers who eventually were saved when they got onto a rock and climbed to the sky to escape, becoming the "Bunched Stars" (of the Pleiades).

The Assiniboin, in the southern region of the province of Manitoba, had a legend in which the Pleiades represented seven persons: Wise-One and his six brothers (Miller 1997). They had no parents and eventually transported themselves into the sky, by use of a spider-web, to become the cluster. In a legend of the Cheyenne, a tribe in the northern Great Plains, a girl was seized by a bull and carried away, eventually to be rescued by her youngest brother. The brother transformed her, his other brothers, and himself into the Pleiades (Miller 1997). The Blackfoot natives, also in the northern Great Plains, had a legend of the Lost Children, in which six poor children got separated from their village, wandered off together, and eventually got taken up into the sky where they are still together and called the Lost Children or the Bunched Stars (Wissler & Duvall 1995).

Groups of Animals

The Pleiades constellation was also described as a group of animals in legends of some aboriginal cultures. For the Shasta natives in the forested regions of the state of California, the Pleiades represented young raccoons (in a legend involving the trickster character Coyote, described in more detail by Bastian & Mitchell 2004) who stay in their home together during the winter months. During the summer, they are out hunting and so cannot be seen in their den in the sky (Monroe & Williamson 1987). To the Carrier peoples of the subarctic region of the northern part of the province of British Columbia, the cluster was seen as a herd of caribou (Miller 1997). The Inuit of Alaska saw the cluster as Sakiattiak, the little foxes (Macdonald 1998).

Agricultural and Calendar Functions

Several distinct groups of natives, particularly in the southern Great Plains and desert southwestern regions, regarded the Pleiades as an important component of the calendar and for agricultural planning. The Navajo, in northern Arizona, give considerable respect and significance to following and living with the natural cycles of seasonal weather and planting in accordance with the position of the cluster. The Navajo name for this constellation, Dilyehe, refers to the seed-like sparkles of the stars of the cluster (Begay & Maryboy 2005). When the cluster disappeared into the western horizon (late May), it was time to plant and when the cluster re-appeared in the pre-dawn sky (late June or early July), then it was time to stop planting. More importantly than just an agricultural symbol, the Navajo see the role of the Dilyehe as a significant component of the natural order of the Universe (Cajete 2000). For the Pima natives of central Arizona, the appearance of the Pleiades on the eastern horizon at dawn indicated the time to harvest the saguaro and prepare for the wine festival (Miller 1997). The Hopi, in central Arizona, timed the stages of their ceremonies by watching the movement of the Pleiades (and other stars) from their kivas (ceremonial structures) (Bol 1998). To the north, in the Lake Ontario region, the Cayuga Nation (another constituent group of the Confederacy of Iroquois) set the date of their Midwinter Ceremony by watching for the Pleiades to appear directly overhead just after sunset following the first New Moon of January. This date marked the start of a five-day interval until the "Stirring Ashes Rite" for the Ceremony (Bol 1998).

Finally, a completely different interpretation of the Pleiades cluster is provided by Ojibway groups of Ontario and the Great

Lakes region. Various Ojibway legends all describe the Pleiades cluster as a hole in the sky between Earth and the sky or in sacred lore as the point of exchange between the Earth world and the sky world (Miller 1997).

Summary

In summary, various aboriginal legends involving the Pleiades star cluster have been found to involve some common themes. Legends related to misbehaving or rebellious children, as well as wandering or lost people (usually children) have been found across the continent and in the various different language families of North American native groups. A related theme is the representation of the Pleiades as a group of people (again, most often children) who have fled to the sky world to escape some sort of harm on Earth. Besides being seen as a cluster of people, some native mythologies represented the Pleiades as a group of animals. The distinctiveness of the Pleiades cluster is the basis for the role that this constellation plays in the calendars of various aboriginal groups, including modern life and agricultural practice of the Navajo Nation, with significant importance attached to watching and timing the natural cycles coincident with the motion of the Pleiades across the sky.

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Frank Dempsey has been a member of the RASC Toronto Centre for more than three decades, and observes variable stars and everything else in the sky. He is an Ojibway and member of Dokis First Nation, and uses cloudy nights for researching and collecting constellation starlore.

Earliest and Latest Sunrise and Sunset

by Jeremy B. Tatum, University of Victoria

It is well known, to those who have more than a passing interest in astronomy, that, although the shortest day (in the sense of interval between sunrise and sunset) occurs on the date of the winter solstice, the date of latest sunrise (the "darkest morning") occurs some days after the solstice, and the date of earliest sunset (the "darkest evening") occurs some days before the solstice. The reason for the phenomenon is based on the rapid change in the equation of time (the Right Ascension of the mean Sun minus the Right Ascension of the apparent Sun) during December. While the local *apparent* solar time of sunset is, of course, earliest at the winter solstice, the local *mean* solar time (by which we govern our daily lives) is not. The subject often comes up, whether in casual conversation or in letters to the local newspaper, around the time of Christmas. Each year, as it comes up, I find myself forgetting not only the dates of darkest morning and darkest evening, but indeed, whether the darkest morning is before or after the equinox. In any case, these dates depend upon one's latitude. I also find myself wondering whether there is a similar phenomenon in the summer, such that, although the longest day occurs on the date of the summer equinox, the brightest mornings and evenings do not occur exactly on this date. In addition, what is the situation for those who live in Earth's southern hemisphere?

I therefore Decided to calculate, once and for all, the dates of darkest mornings and evenings near the winter solstices, and the brightest mornings and evenings near the summer solstices, for all temperate latitudes at intervals of five degrees, as well as my own latitude of 48.5° N (Table 1). I did not perform any calculations for tropical latitudes, since there is little variation in the times of sunset and sunrise there, nor for polar latitudes, since the Sun does not rise or set on many days in those regions.

I took the apparent local solar time of sunrise or sunset to be the hour angle of the apparent Sun when its zenith distance is 90° 51′ (which accounts for the radius of the Sun and for the atmospheric refraction). The mean local solar time (which is the required time in this context) at sunrise or sunset is then the apparent local solar time minus the equation of time. The calculation is, in principle, a simple one, although I discovered a small difficulty that has doubtless been discovered by anyone who has ever tried to calculate the time of sunset - namely, that the time of sunset depends on the declination of the Sun *at the time of sunset* (which, of course, you don't yet know!). The same difficulty arises in calculating the equation of time, which is changing rapidly during late December, and indeed this rapid change, as pointed out above, is the very cause of the phenomenon in which we are interested. However, these irritating but important details were duly dealt with while calculating the results presented.

A perusal of the results shows that the effect occurs at both solstices, but it is greater at the December solstice than at the June solstice, because the equation of time is changing faster in December than in June. The effect is also greater at lower latitudes than at higher latitudes.

The exact dates of darkest or brightest mornings and evenings may differ, according to the year (because of the vagaries of the Gregorian calendar) or one's longitude, by one day (or possibly, rarely, by two) from the dates given in the table. The dates given in the table were calculated for the Greenwich meridian and the year 2009, for which the solstices were on June 21 and December 21.

Dr. Jeremy Tatum is a retired Professor of Physics and Astronomy at the University of Victoria, where for 31 years he taught and conducted research on atomic and molecular spectroscopy, the composition of comets, and the orbits of asteroids — particularly near-Earth asteroids. Asteroid 3748 bears the name "Tatum" in honour of his work.

	Northern Winter		Northern Summer	
	Date of		Date of	
Latitude	Latest sunrise	Earliest sunset	Earliest sunrise	Latest sunset
25°	Jan. 13	Nov. 29	Jun. 8	Jul. 3
30°	Jan. 9	Dec. 3	Jun. 11	Jul. 1
35°	Jan. 7	Dec. 5	Jun. 13	Jun. 29
40°	Jan. 4	Dec. 8	Jun. 14	Jun. 28
45°	Jan. 2	Dec. 10	Jun. 15	Jun. 27
48.5°	Dec. 31	Dec. 12	Jun. 15	Jun. 26
50°	Dec. 30	Dec. 13	Jun. 16	Jun. 25
55°	Dec. 29	Dec. 14	Jun. 17	Jun. 24
60°	Dec. 27	Dec. 16	Jun. 18	Jun. 23
65°	Dec. 23	Dec. 19	Jun. 20	Jun. 21

Table 1 — Earliest and latest times of sunrise and sunset.

In Memoriam: Leo Enright 1943-2009

by David Levy, Honorary President, Kingston Centre

Figure 1 — Leo Enright 1943-2009.

Sometimes, you just know when meeting a new person will turn into a lifelong and precious friendship. To write about a friend and mentor who has passed from the scene is extraordinarily difficult, made even more so by the value that I placed in his friendship. Leo was always there, a quiet, unassuming man with an expertise in Latin (who can understand Latin nowadays?), mathematics, and above all, a love of astronomy.

Born in 1943, Leo joined the Kingston Centre at the age of 30. He became more active as time passed, inviting members to his "Villa Leonis" home near Sharbot Lake, about an hour's drive north of Kingston. He also grew interested in the Holleford impact crater, also north of Kingston, and prided himself on offering tours, virtually anytime, to anyone who wished to see it. Leo was President of the RASC's Kingston Centre from 1977 to 1979, and edited its newsletter, *Regulus,* for many years. Leo also helped launch the Centre's Astronomy Day activities with an event in Kingston's largest mall in the spring of 1979. He has been active for many years, at the national level, with astronomy outreach, and national Astronomy Day activities.

Leo's interests, however, spread far beyond astronomy. According to his friend, Ken Kingdon, as a young man he was a "star baseball player...and an expert at slalom water skiing, able to carve sharp turns just inches off the surface; a photo of him in his life jacket shows a handsome, fit, broad-shouldered water skier built like a small, strong bull." During my frequent visits to his home we enjoyed lively discussions about hockey (his favourite sport), and he was always ready for a good discussion about almost any aspect of Canadian politics.

The year before I met him, he invited the entire Kingston Centre to his Sharbot Lake home to enjoy the Perseid meteors. As he grew older, he became much more particular about the programs that he wanted to continue with; but once he decided to handle something, he gave it his usual attention to the last detail. The idea to create a RASC-friendly "Levy List," which now appears annually in the RASC *Observer's Handbook,* was his alone, although I deeply enjoyed working on it with him.

Leo's passion for astronomy was virtually without a match. When he would accept a new project, such as editing *The Beginner's Observing Guide,* he would do it with a single-mindedness that was hard to match. He produced five editions of this book, although he did not live to complete the sixth and latest version.

It was difficult to persuade Leo to leave the Sharbot Lake home he loved so much. He did travel with Denise, his wife, on a total-eclipse expedition, in which the lunar shadow tracked over the *Regal Empress* cruise ship just 20 minutes after sunrise on 1999 August 11. He enjoyed that trip immensely, and as a bonus, he got to enjoy the Perseid meteor shower with the St. John's Centre in Newfoundland two evenings later. A few nights after that, while sailing around the northeastern tip of Newfoundland, he shared with me one of the nicest aurora borealis displays I have ever seen. That trip was a watermark for him, one of his best travels overseas. Alas, less than a month later, he knocked on his neighbour's door. "I think I am having a heart attack," he said. The aneurysm nearly claimed his life then, but quick surgical intervention saved him.

In his final ten years, Denise relocated to Bonita Springs, Florida, and Leo spent three months every winter in Florida with his wife. In June, I interviewed him for our *Let's Talk Stars* radio show; that interview is still posted at `www.letstalkstars.com`. A month later, I completed an article about him for my "Evening Stars" column in *Astronomy.* However, Leo did not live to see its publication. On August 11 this year, while sleeping at his home at Sharbot Lake, he quietly passed away. His many friends are grateful that he was given an additional ten years after his first medical crisis, but they are saddened that he was denied more. Leo's life symbolizes what a passionate amateur astronomer should be. With his head in the clouds, and his feet planted firmly on the ground, he made the sky more enjoyable for all of us.

Figure 2 — Leo with David Levy and Past President Peter Jedicke.

David Levy is well known to the members of the RASC, joining the Montreal Centre in his childhood and continuing an association ever since. His main interest — for which he has an international reputation — is hunting for comets, and now has 22 of them carrying or sharing his name. He is best known as a co-discoverer of Comet Shoemaker-Levy 9, which impacted Jupiter in 1994. Currently residing in Vail, Arizona, David maintains an active relationship with astronomy in many public forums.

A Sturdy Mount for Small Telescopes

by Michael K. Gainer, Unattached Member (kizinski@aol.com)

As we enter our senior years, it becomes more and more of a chore to set up and use medium to large telescopes. The "grab and go" telescope becomes the "one I can use." You might call this inverse aperture fever. Particularly attractive are the small, high-quality, Maksutov-Cassegrains and short-focus refractors currently available at relatively low cost. Despite their limits in types of observations, they have sufficient aperture and magnifying power to provide a lifetime of useful and pleasurable observing. Providing sharp, crisp high-contrast images of the Moon and planets, they can also be used for tracking solar activity, observing lunar occultations, monitoring variable stars, and measuring widely separated binary stars (Gainer 2007).

In the quest for the ideal small telescope for my personal use, I have settled on two that satisfy my criteria for portability, high quality, and low cost. These are an Orion 102-mm Maksutov-Cassegrain, purchased as a used tube assembly, and a 90-mm f/5.6 refractor that I cobbled together from spare parts and a lens from Surplus Shed. I use the Mak for lunar, planetary, and binary-star observing, and the refractor for variable-star measurements and observations of brighter deep-sky objects.

However good the optics, their mounts leave more than a little to be desired. The ideal mount should combine low weight, versatility, portability, stability, and accurate tracking at a modest cost. The German-equatorial mount provided by most manufacturers is usually undersized. Some have adequate equatorial heads that are attached to hopelessly inadequate tripods. The problem with them is that the weight of the instrument is concentrated at a point where the three legs, if extended, would meet at the top. Slight torques about an axis through this point, are amplified by any lack of rigidity in the legs. A tripod more stable than those provided is heavier and more expensive.

I prefer the German-equatorial mount for its tracking ease and stability. I also wanted a relatively low-cost mount on which the Mak and refractor could be conveniently interchanged. I have found the EQ2 mount, sold by Orion and other suppliers under different names, a good choice. The EQ2, with its optional motor drive, is good for unguided exposures up to 15 seconds with accurate polar alignment. This is long enough for digital photos of the Sun, Moon, planets, bright variable stars, binary stars, and bright star clusters.

Figure 1 — The tabletop mount with a 100-mm Maksutov-Cassegrain on the three-leg table.

My solution to the tripod problem was to construct what I call a tabletop chopping-block mount (Figure 1). It consists of an EQ2 mount fastened to a 12 × 16 × 1.25-inch chopping block available at most kitchen-supply stores. This provides a dense vibration-free, not excessively heavy base for the equatorial head. With the equatorial head attached to the block in the manner illustrated, adjustments in azimuth and inclination are still accessible.

Before attaching the mount to the block, I drew a line with indelible marker perpendicular to the north edge, through the centre, to the opposite edge, and continued down the front and rear faces. This line is a north-south meridian to be used for polar alignment. With carrying handles fastened to both ends and the counterweight and telescope removed, the mount can easily be carried and placed on a rigid table.

For use at sites where an adequate table is not available, I constructed a sturdy three-leg table (Figure 1). The 14 × 18-inch top and shelf are ¾-inch plywood. The 28-inch-long by 2-inch-square legs and attaching hardware can be found at most home and hardware supply stores. The dimensions of the shelf are such that it fits snugly against the table legs. It is fastened to the rear leg with a steel right-angle bracket bent to the proper angle. With the shelf in place, I fastened the horizontal brace to the front legs and glued the bottom of the shelf to it.

This chopping-block mount on the three-leg table has proven to be more stable and much lighter than any reasonably sized tripod I have found. Small vibrations are rapidly damped out by the wooden block and table surface. The shelf, brace, and thick one-piece legs all contribute to the rigidity. I can focus at high magnification without annoying image vibration and observe from a comfortable seated position with accessories available at my fingertips. The three-leg table is light enough to be carried with one hand and fits nicely in the back seat of my car. It's also not a bad-looking display with the telescope placed on it in a corner of my study.

Figure 2 illustrates the method I used for attaching my instruments to the mount so they would be easily interchangeable. I made bars from standard ⅛ × 1-inch aluminum bar stock, drilled and tapped for ¼ × 20 screws at a separation equal to that of the holes in the plate on the mount. I drilled and countersunk others to accommodate either tube rings or the Mak mounting block. Rather than wing nuts to attach the tubes to the mount, I used standard electronic control knobs drilled and tapped with a ¼ × 20 thread. Polar alignment and use of the mount can be facilitated through the following procedures.

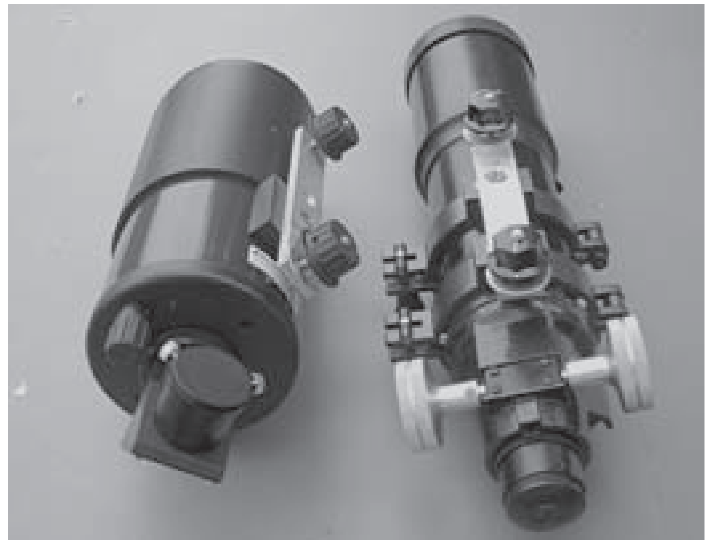

Figure 2 — Interchangeable telescopes

A table and tabletop equatorial mount can be easily aligned with the celestial pole by establishing a north-south meridian line during a meridian transit of the Sun. A gnomon for this purpose can be made from dowel attached to a small board (Figure 3). Its inclination is not critical. Draw a line the length of the board perpendicular to its north edge and through its centre. Align the table so that it is approximately perpendicular to the north-south direction. A magnetic compass will be accurate enough for this. On a sunny day, at exactly the time of the Sun's meridian transit, rotate the board so that the shadow cast by the rod lies exactly on the north-south line. Make marks on the table surface coincident with the north and south ends of the board. Draw a line across the table through these marks. This will be a north-south meridian for aligning the telescope mount. Use a compass to measure and record as, accurately as you can, the difference between the north-south meridian on the table and the direction of magnetic north. This will permit polar alignment each time you set up your table up by reference to a compass.

Figure 3 — A gnomon for polar alignment.

Accurate polar alignment of the mount is now achieved by positioning it so that the north-south line on the base is coincident with the meridian line on the surface of the table. Use a carpenter's protractor level to adjust the inclination of the polar axis to local latitude.

Figure 4 — The tabletop mount on a large table.

The same procedure can be used on a sturdy, permanently located larger table (Fig. 4). With the mount on a large table, observations of the southern sky are made from the north side of the table. For circumpolar objects, slide the mount to the south side. This method has the advantage of being applicable to southern-hemisphere polar alignment as well. Solar transit times can be obtained from the *Observer's Handbook* or from *Guide 8.0* software.

The EQ2 mount is standard with the Orion 102-mm Mak and other similar instruments from other suppliers. Converting it to a tabletop mount is a relatively simple procedure. Adapting any of the small Maks and short-focus refractors on the market to this mount will provide a relatively low-cost versatile observing system that is easy to set up and use. Add a low-cost point-and-shoot digital camera, and you will be amazed at what is possible.

These small telescopes, using the mounts described here, have given me more hours of pleasant and productive observing than larger instruments would have at this point in my life. For those of us in our senior years, inverse aperture fever can be a good thing.

Michael K. Gainer is an emeritus professor and former chair of the physics department at St. Vincent College, Latrobe, PA. He taught introductory astronomy there for 35 years. Since retiring in 1997, he teaches astronomy at the Carnegie Mellon University Osher Institute for Life Long Learning. He is also a member of the AAVSO, with particular interest in long-period variables.

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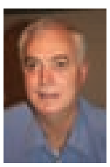

On Another Wavelength

by David Garner, Kitchener-Waterloo Centre (jusloe1@wightman.ca)

The Crescent Nebula

The Crescent Nebula (NGC 6888), a small emission nebula, is not easy to find by amateur astronomers but is often studied by professionals, particularly at radio, ultraviolet, and X-ray wavelengths. You can find it in the western sky at this time of year, by first locating Deneb in the constellation Cygnus. Follow along the line from Deneb to the central star Gamma Cygni ("Sadr," where the wings cross the body), continue on southwest for half the previous distance, and you are at the Crescent Nebula (Figure 1). To find the nebula with your telescope, go to RA $20^h\ 12^m\ 7^s$ and Dec +38° 21′ 17″.

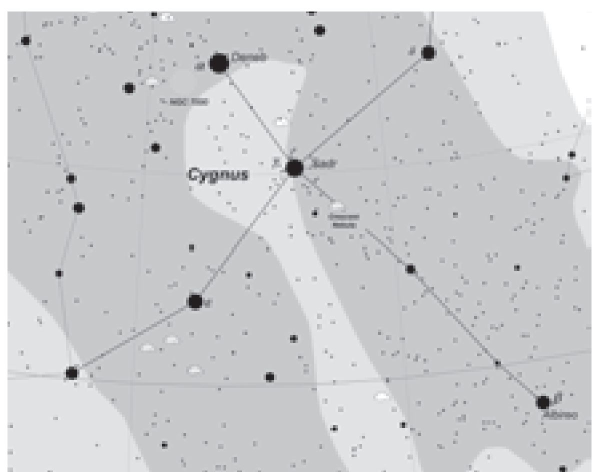

Figure 1 — The constellation Cygnus and the Crescent Nebula.

With an apparent magnitude of approximately +8.8, the Crescent Nebula appears to be around 18′ × 13′ in size, representing dimensions of 25 × 16 ly at its distance of 4700 ly. The nebula looks like a crescent to a backyard observer, but in photographic images, it appears to have more of a complete oval shape (actually ellipsoid), depending, of course, on the imaging time and filters applied (Figure 2).

NGC 6888 was discovered by Sir William Herschel (and his sister Caroline) in 1792, who described an 8th-magnitude star "with a faint, south proceeding milky ray joining to it." At the centre of the Crescent Nebula is a very luminous, massive star known as HD 192163 (a.k.a. WR 136). The nebula itself looks somewhat like a supernova remnant, but is actually a rare planetary nebula

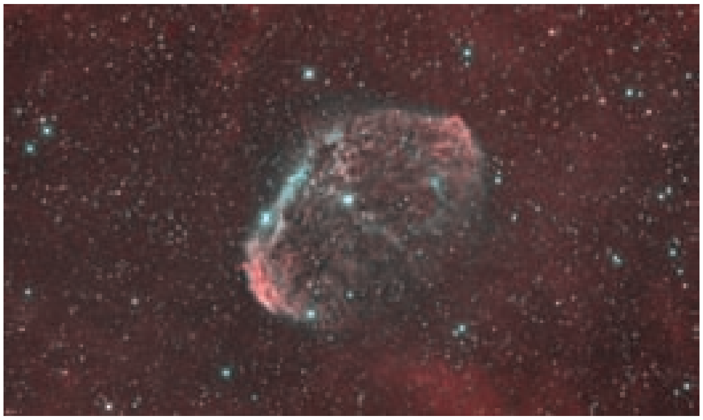

Figure 2 — Crescent Nebula, courtesy of Stephen Holmes, K-W Centre. The image is narrowband based on 8 hours of OIII and 6 hours of Hα. Stephen used a QHY9 camera through an 8-inch f/6.4 GSO Ritchey-Chretien on an EQ6 mount, autoguided with *KWIQGuide*.

surrounding the Wolf-Rayet star. These types of stars are extremely hot, with surface temperatures in the range of 25,000 K to 50,000 K. They are short-lived, typically losing the equivalent of the Sun's mass every 10,000 years.

Current theory suggests that when this star was only 4.5 million years of age, it expanded to become a red supergiant and began ejecting its mass in the form of a strong stellar wind, which travels at an estimated 30,000 km per hour. After a couple of hundred-thousand more years, the star had shed all of the hydrogen gas in its outer layer, leaving its helium core exposed. This hot inner layer is now pushing gas away at speeds of nearly six million kilometres per hour.

A dense shell, called a planetary nebula, is formed when this high-speed stellar wind slams into the earlier low-speed wind. The force of the collision creates shockwaves moving both outward and inward from the dense shell. The outward shockwave creates a thin external filamentary structure, whereas the inward shockwave produces a bubble of hot gas surrounding the central star. X-ray emissions from this bubble are generated as the hot gas cools after the passage of the shockwave. Photographically, it forms a complex network of glowing hydrogen filaments inside the bubble.

To compound the interpretation of this interesting object, the radiation of the hot Wolf-Rayet star in the centre of the shell excites the gases (helium, oxygen, nitrogen, and sulphur) in its surroundings, causing them to glow. In Figure 2, the bright visible patches of emission from the nebula are a result of photoionization of the shell by the UV flux from the central star. The nebula's short-term fate is not promising. As the stellar wind blows past the shell of dense gas, the surrounding interstellar pressure is expected to drop, allowing the shell to expand and leading to a steady decline in its brightness. Eventually, in perhaps a few hundred-thousand years, the Wolf-Rayet star will end in a supernova explosion. The then-nascent shell will be compressed and begin glowing again, at least for a while.

Dave Garner teaches astronomy at Conestoga College in Kitchener, Ontario, and is a Past President of the K-W Centre of the RASC. He enjoys observing both deep-sky and Solar System objects, and especially trying to understand their inner workings.

Astrocryptic

by Curt Nason

The solution to last issue's puzzle

1 M	I	2 N	T	3 A	K	4 A		5 D	I	6 C	K	7 E
A		I		C		L		E		A		L
8 C	I	G	A	R		9 I	N	E	R	T	I	A
U		H		U		O		P		S		R
10 L	A	T	E	X		11 T	E	S	S	E	R	A
A		W				H		K		Y		
12 E	T	A	L	13 O	N		14 C	Y	B	E	L	15 E
		T		R		16 B				N		Y
17 S	S	C	Y	G	N	I		18 T	H	E	B	E
W		H		A		G		Y		B		L
19 A	L	M	A	N	A	C		20 C	O	U	D	E
N		A		I		A		H		L		N
21 S	O	N	I	C		22 T	R	O	J	A	N	S

Shuttle Wastewater Dump

by Clair Perry

On the night of September 9, I set up to photograph the *International Space Station* and the Shuttle after hearing on CTV that they were only going to be a minute apart, which meant I could get them in the same frame of a shot. The night before I had photographed them tracking beside each other, one only slightly ahead of the other — a great shot, as I had not seen them so close together before. They had undocked that afternoon, on the 8th. That side-by-side photo appeared on the local paper next morning and impressed the readers, many of whom had been alerted beforehand by CBC TV, not only for that event but also the one on the evening of the 9th.

Photos were taken from a ball field on the edge of Charlottetown using a Canon 40D with a 17-35 f/2.8 lens, set wide open. I used a 30-second exposure and ISO 500 in a sequence of eight shots. We actually watched the dump of water, which appeared as a lump of grayish condensate material materializing out of nowhere, and which we unknowingly thought was a small cloud. I was accompanied by four others and we all saw this blob of "whatever" appear and then disappear within 10 to 20 seconds. The images on the camera revealed a sight that we could not explain — we were totally taken aback.

My photography started at 21:07 ADT — the predicted time for the Shuttle to appear, about a minute ahead of the ISS — and ended about four minutes later. I realized this image had to go too, so by 22:30 I had sent off two images. Sure enough, they were on the front page the next morning. Almost immediately, I received emails from several sources applauding the shot; one email came from a gentleman connected with Haystack Observatory in Massachusetts, USA, that oversaw the dump. A phone call was also received Friday night from the scientist responsible for the implementation of the dump procedure. The image created quite a hubbub, both locally and across the globe.

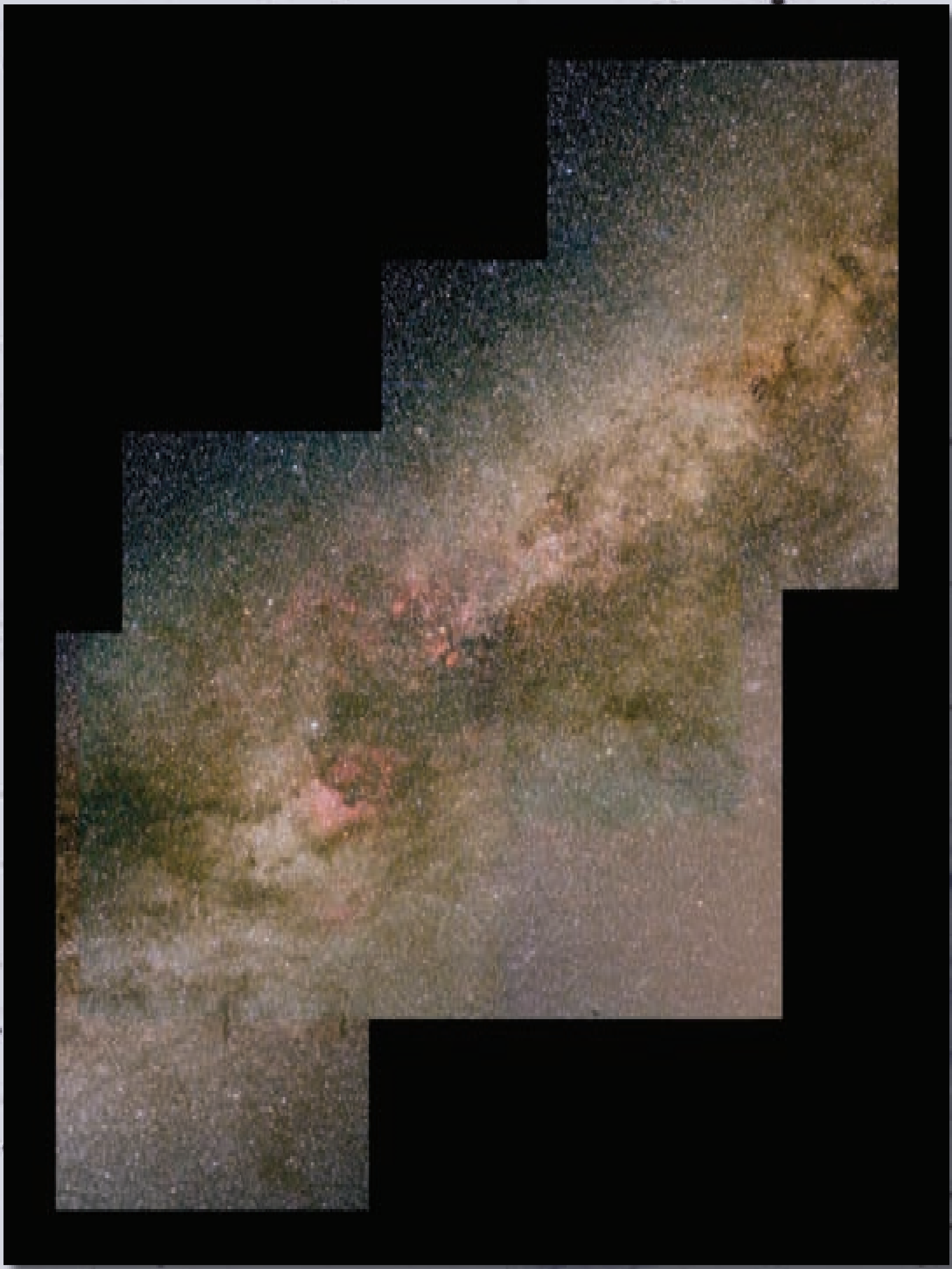

Figure 1-2 — This superb five-image wide-field study of the Milky Way was compiled by Victoria Centre's W. John McDonald from images taken at the Island Star Party on July 18. John used a modified Canon 350D with a 50-mm fixed-focal-length lens on an Astrotrack mount. Fifty individual exposures, each 4 minutes at f/4 and ISO 200, were combined to make the five separate images. They were aligned and stacked in *ImagesPlus,* then combined in *Photoshop.*

Figure 3 — Chris Schur collected photons for this image of M16 with a home-built 12-inch f/5.5 Newtonian and an SBIG 10XME NABG camera with enhanced water cooling from Payson, Arizona. Exposures: LRGB = 180:40:40:40 where L = 3-nm CS Hα. The image has been rotated to better display the characteristics that give the image its Eagle nickname.

Figure 4 — Winnipeg Centre member Jennifer West photographed the Perseids from Mantario Lake in Manitoba's Whiteshell region and composited the single images into this memorable photograph. Jennifer collected 458 exposures of 15 s using a Canon 20Da at ISO 1600 with a 15-mm lens set at f/2.8. Several sporadic meteors were also captured during the exposures.

Great Images

Twilight Trio

by James Edgar, Regina Centre (jamesedgar@sasktel.net)

On the early morning of 2009 September 16, my wife, Jodie, woke me to say that the Moon and Venus were putting on quite a show, and that I should get a picture of them. So, I was quickly out onto the front step with my camera and tripod (plus a number of early morning mosquitoes!). I also noticed a bright star in the frame, Regulus, which complements the two prominent beauties above. I used a Canon 50D camera, at f/5, through an 18-200-mm lens at 80-mm for 3 seconds and ISO 100; processed with Adobe Lightroom 2.4.

Second Light

by Leslie J. Sage (l.sage@us.nature.com)

The Most Distant Object Known in the Universe

On 2009 April 23, a gamma-ray burst went off (just as they do almost every day).

This one, however, turned out to be quite exceptional. As reported by Nial Tanvir of the University of Leicester and his colleagues, and separately by Ruben Salvaterra of the Osservatorio Astronomico de Brera (in Italy) and his colleagues, the burst came from a galaxy at a redshift z=8.2 — the most distant object so far seen in the Universe (see the October 29 issue of *Nature*).

Long gamma-ray bursts are thought to arise from the supernova explosion of a particularly massive star (as many readers may know, given that I've written about them before). The gamma-rays are observable to very high redshifts (z~20 or more), and in principle, the ultraviolet/optical light should be visible to z>15, though the amount of UV/optical light, relative to the gamma rays, is quite variable.

All of the photons coming from a gamma-ray burst (gamma rays, ultraviolet, optical, radio) are redshifted because of the expansion of the Universe. The wavelength of the photon becomes longer by a factor of (1+z), so a photon emitted at z = 8.2 with a wavelength of 5000 Angstroms (approximately the middle of the visible band) is seen at Earth as a photon with a wavelength of 4.6 microns — in the infrared. This complicates our study of very-high-redshift objects in the following way. Much of the study of the local Universe (supernovae, nearby galaxies) has been done in fairly narrow ranges of wavelengths, such as the optical band. Placing a supernova at a redshift of 8 shifts its optical light to a range (mid-infrared) where it's difficult to observe from the surface of Earth because of bright emission lines and absorption bands arising from the atmosphere.

When I was a graduate student (25 years ago), a high-redshift object was at z~1. Ten years ago, high-z was 5 or so. The previous highest redshift that had been spectroscopically confirmed was for a galaxy at z=6.96 (published in *Nature* back in 2006). The new burst allowed Tanvir and Salvaterra to find the host galaxy, which now has the highest confirmed redshift of any known object. Although there are a few claims for higher redshifts, they have not been confirmed and are not widely accepted.

At a redshift of 8.2, the Universe was only 630 million years old (it is about 13.7 billion years old now). Salvaterra comments that the properties of the burst are not much different than those of bursts that were much more recent. Personally, I don't find that too surprising, if the bursts arise in particularly massive stars that do not have much contamination by elements heavier than helium ("metallicity" in astronomers' parlance). Assuming that to be the case, then the bursts' properties ought to be roughly the same no matter when they take place. They just get less frequent with time, as low-metallicity environments become more rare, and therefore massive stars with the right properties to make a burst have difficulty forming.

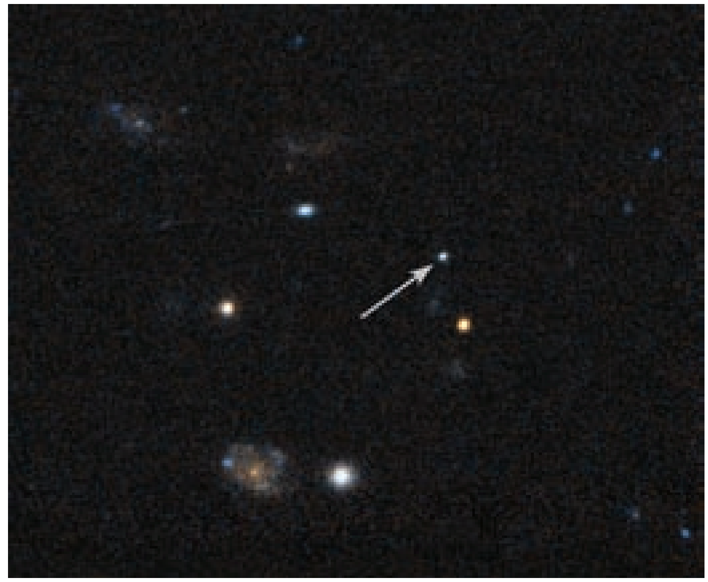

Figure 1 — A *Hubble Space Telescope* image of a distant fading gamma-ray burst. This object, GRB 080319B, lies at a distance of 7.6 billion light-years, and for a time was the intrinsically brightest object ever seen on Earth. Its light arrived on 2008 March 19; this image was taken on April 7. Image courtesy NASA, ESA, STScI.

Although the jump from z=6.96 to z=8.2 looks impressive, in terms of look-back time (or age of the Universe at that time) it's less startling — it's a difference of only about 150 million years. I'm very much looking forward to the discovery of bursts at redshifts of 11 or higher, where they start sampling the time when the first stars were forming.

Leslie J. Sage is Senior Editor, Physical Sciences, for Nature Magazine *and a Research Associate in the Astronomy Department at the University of Maryland. He grew up in Burlington, Ontario, where even the bright lights of Toronto did not dim his enthusiasm for astronomy. Currently he studies molecular gas and star formation in galaxies, particularly interacting ones, but is not above looking at a humble planetary object.*

Orbital Oddities

by Bruce McCurdy, Edmonton Centre (bmccurdy@telusplanet.net)

Magna Coniunctio

"Proposing great and surpassingly wondrous sights, and offering everyone, but particularly philosophers and astronomers, phenomena observed by Galileo Galilei, Florentine patrician and public mathematician at the University of Padua, on the face of the Moon, on numberless fixed stars, in the Milky Circle, and in cloudy stars; but particularly in four planets revolving with remarkable speed at differing distances and periods around the star Jupiter. They have been known to no one up to this day, and the author was the first to discover them. He has decided to call them the Medicean stars."
— Galileo Galilei, translated from the title page of *Sidereus Nuncius (The Starry Messenger)*

Galileo may have been prone to overstatement, but his "Medicean stars" have delivered on the promise of surpassingly wondrous sights. His proposed name, a particularly blatant display of sycophantism, did not take; instead, the four major moons of Jupiter are now more appropriately known as the Galilean satellites in honour of their discoverer. For four centuries they have entranced observers with their clockwork dance around the giant planet.

I have enjoyed countless observations of mutual events — transits, shadow transits, occultations, eclipses — between the satellites and Jupiter, or more occasionally between two satellites. Among the most treasured observations were a triple-shadow transit, a partial eclipse of Callisto, and an exceedingly rare "shadow occultation" (McCurdy 2001, 2002). It seems appropriate that the International Year of Astronomy has provided a whole series of satellite-on-satellite events, as well as a rare opportunity to observe the giant planet without any apparent satellites at all.

The Jupiter-without-satellites (JWS) phenomenon is uncommon; just 25 such occurrences in this century according to Jean Meeus (1997), whose work largely confirmed the early 20th-century results of the Italian amateur astronomer and calculator, Enzo Mora. Some of those are unobservable due to Jupiter being too close to the Sun, while from a given location most such events do not meet the two basic requirements: Jupiter above the horizon, Sun below.

Galileo himself very nearly observed JWS on 1611 March 15, what he termed a *"magna coniunctio"* or "great conjunction: no planet was visible, but all were absent because of the vicinity of Jupiter." He was sufficiently impressed by the event's significance to use the date as a reference point to help him find periodicities in his tables. Meeus (2002) has subsequently determined that Io reappeared just 8 minutes before Callisto was occulted, but Galileo's telescope was too crude to resolve either so close to the limbs.

It was left to William Molyneux to make the first documented observation of a true JWS, from Dublin on 1681 November 12, later recorded in a letter to John Flamsteed, the first Astronomer Royal. Flamsteed responded he had made such an observation himself, but provided neither date nor details. Let's return to that later.

The 2009 JWS event featured nearly perfect circumstances for some 15 Edmonton Centre members who thronged to the Public Observatory at Telus World of Science. It was a few weeks after opposition, so the giant planet was well placed in the late-evening sky at a very favourable elongation of 159°. The weather was excellent and the seeing very nearly so. It happened to be an Observers' Group meeting night, and many of us headed directly from the meeting over to the Observatory.

For sure, it was an opportunity not to be missed. Assessing Meeus' table of these events, the next observable such event will occur 2038 December 9 (in the pre-dawn hours, if you're setting your calendar). Moreover, the last to be observable from our part of the world was back in 1932, the year RASC Edmonton Centre came into existence! So it was very appropriate that our Honorary President (Doug Hube) and sitting President (Sherry Campbell) were both there with their "first spouses," as well as a couple of Past Presidents and a number of very long-standing members.

To call the event "Jupiter without satellites" was a misnomer, because the satellites were front and centre, literally. There were no fewer than six pairs of mutual events in just a few hours, and at least one satellite was visible in front of Jupiter for not quite all of the time.

Observers started to trickle in around 21:30 MDT, when three satellites were still visible. Within an hour, Io disappeared behind one limb of Jupiter, then Europa and Ganymede passed in front of the opposite limb. The latter took by far the longest, as Ganymede is both the largest and slowest of the three. My timing of about 8 elapsed minutes between first and second contacts was consistent with an object of its diameter and orbital speed (5262 km/10.9 km/s = 482 s). Even in transit, Ganymede was directly observable for the most part, either bright against the darkened limb of Jupiter upon ingress, or charcoal grey against the beige equatorial zone throughout most of its transit. There was a brief transition time from bright to dark when it was not easily seen, and since neither shadow transit had begun at that point, Jupiter did appear to be strangely alone in the eyepiece.

In the sky, not so much. Jupiter without moons? Ha! There was *The* Moon, a day and a half from full, not five degrees away, generally being a nuisance by illuminating the smoky sky and bathing the observatory in harsh white light. I generally like conjunctions, but this one I could have lived without.

A few minutes after Ganymede's ingress, the ink spot of Europa's shadow crept onto the limb, and before long the seeing settled down enough that we were able to spy the odd couple of Europa's shadow and Ganymede, the latter a little larger but less distinct. The two moved along slightly different latitudes within the equatorial zone so that they never "touched," and clearly moved at different speeds. Over the course of a few minutes, Europa's shadow overtook Ganymede and began to pull away.

The mass disappearance of the Galileans endured for 106 leisurely minutes, very long as these things go. The gradually dwindling numbers of observers shuttled among four telescopes. The views in the 7-inch Astrophysics Starfire refractor at 200× and the Celestron C-14 at 185× were the best to my eye. Even when shadow and satellite were at their closest, they were easily split in either scope. In occasional moments of excellent seeing, it was barely possible to spot white Europa against the beige equatorial zone.

It being a week night, we decided to shut the observatory down around midnight. Of course, as soon as I got home, I dragged out the 8-inch to observe a while longer. A lot happened in short order, as Io reappeared from Jupiter's shadow some distance from the planet, then Ganymede's shadow fell on one limb just as Europa was becoming intensely bright along the other. For a few minutes the two moons (and their shadows) were clearly visible against the disc of the giant planet. It was interesting to see the distinctly oval shape of Ganymede's shadow near the limb, the result of a circular shadow striking the spheroid at an oblique angle, coupled with Earth's position off to one side of the line of sight. On the other side, Europa bubbled on the limb and then floated free. The double-shadow transit continued for a while longer, but after a few minutes I packed up and crashed. In retrospect, I wish I had stayed to watch the Callisto reappearance as Larry did. I never did see the outermost satellite first or last, as it leisurely passed first behind Jupiter itself and then through its shadow, the combined occultation/eclipse lasting over 9 hours.

Callisto is the wild card that ensures JWSs are rare. The inner three satellites share a 4:2:1 orbital resonance that sees them co-align frequently, with two on one side of the planet and one on the other (never all three on the same side). These alignments repeat every 7.0509 days, slightly less than integer numbers of rotations for each satellite, so that the re-alignments precess by 5.8° per period. The similar circumstances from one iteration to the next means such phenomena as double-shadow transits tend to occur in "seasons": those involving Ganymede and one of the inner moons will repeat for several consecutive passages of Ganymede (roughly 7 d 4 h) and those involving Io and Europa in about half that time. Moreover, it is not at all uncommon for the third satellite to be co-aligned in occultation/eclipse at the same time. But most of the time, incommensurate Callisto is out in the open during such events. Indeed, the outermost satellite will go years on end without having any mutual events at all, as its distance from Jupiter sees it pass above and below the planet when the system is "open," or near its solstices. Only when the system is "closed" near the Jovian equinoxes, or roughly half of each 11.86-year revolution of the giant planet, are events involving Callisto possible. Even those are relatively widely spaced, given its leisurely period (roughly 16 d 16 h). In all my years of observing Jovian events, I've only seen a relative handful involving Callisto.

So I was taken off guard when, later that same month, while on a routine Sunday-night observatory shift, I had a second opportunity to observe all four satellites bunched closely around Jupiter, involved in an almost-breathtaking sequence of mutual events of every possible type. Shortly after our 19:00 opening, all four satellites interacted with Jupiter in short order. There was also an eclipse of Io by Europa (which I didn't see, as it was too close to sunset and probably not a deep fade in any event), followed a while later by a central transit of Ganymede by Europa, which I observed quite clearly. The two were moving in opposite directions very near the planet, so their relative speed was near the maximum possible. Seeing was good enough in the Starfire scope to resolve different sizes and colours of the discs: Europa, tiny and bright white, Ganymede, larger and yellowish, nearby Callisto, a muted blue-grey. Europa and Ganymede approached and made visual contact, becoming a "snowman," then a distended disc, and finally for just a minute or so, a circular disc just the size of Ganymede. I could not quite resolve the disc of Europa within that of Ganymede, but I could certainly tell where it was, since the fused disc was noticeably brighter on the hemisphere through which Europa was passing.

By chance, I had found through observation a crude period involving all four satellites of 25 days minus ~4 hours. I did some quick calculations, which suggested to me that 14 revolutions of Io, 7 of Europa, 3.5 of Ganymede, and 1.5 of Callisto would occur in ~24.8 to 25.0 days. The timing isn't perfect — there's a difference of ~0.2 d — but the events are not instantaneous either. Satellites disappear when in transit of Jupiter on the near side, and during both occultations *and* eclipses on the far side. All of these take a couple to several hours.

In 2009, it didn't work out that both were JWSs; on Sept 27/28 at least one moon was visible throughout. I guessed that there should be occasions when, if the conditions of the initial JWS were just so, a second event should be possible.

So, of course, I looked it up when I got home, and sure enough — in four centuries of JWS data provided by Meeus, there are four paired events at intervals of 25 days minus 4 or 5 hours. Success!

In a historical sense, I was particularly interested to read Meeus' assessment of Flamsteed's opportunities to observe JWS, "as possible dates are 1672 April 20, 1672 May 14, 1677 October 20, and possibly 1681 November 12 itself." Imagine if Flamsteed had happened to see *both* of those 1672 events just 25 days apart, in a similar manner as my own observations. He might well have concluded that JWSs are not only possible, but perhaps even fairly commonplace and therefore not especially interesting!

Bruce McCurdy has shared the Galilean satellites and other surpassingly wondrous sights with tens of thousands of visitors at the Observatory of Telus World of Science, where he has volunteered since 1987.

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Through My Eyepiece

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

Santa Scopes

'Tis the season to think about buying a telescope either as a present for someone or for yourself. I wrote about this in this column a few years ago, but since then I've had the chance to use a number of new and different telescopes, and thought I'd take a fresh look at what I recommend for beginners and not-so-beginners.

My main recommendation for beginners remains unchanged: a 10-inch Newtonian on a Dobsonian mount. The greatest difficulty beginners encounter is actually *seeing* things through their telescopes and, for this, aperture is the answer both in terms of resolution and light gathering. There's not much difference in size and cost between a 6-inch and 10-inch Dob, so I'd say go for the 10-inch right from the start, and enjoy bright, crisp images.

Bigger

Aperture fever! Who doesn't long for a humungous telescope that will make those faint fuzzies look like Andromeda? I've used a few big scopes and been really thrilled by them. But then reality sets in. I *really* don't like observing without my feet on solid ground. To be honest, I really prefer observing sitting down. It's easier to keep my eye aligned with the telescope's exit pupil, plus I just see more and better when I'm in a relaxed seated position. That's one reason I've become a convert to Schmidt-Cassegrains in recent years. Even with quite a large SCT, the eyepiece doesn't move much as you point the telescope around the sky, and I've come to really appreciate that.

A recent development has been increasingly short focal ratios for big Dobs. Until a few years ago, it was rare to see a Newtonian with a focal ratio less than f/6. Now focal ratios between f/4 and f/5 have become very common, not just in high-end custom scopes, but even in mass-market jobs. Meade has a 16-inch f/4.5 Dob and Orion has just announced a 14-inch f/4.6 Dob. The resulting scopes are more compact and transportable than anything widely available until now, and, more importantly, their eyepiece heights at the zenith are now accessible without needing a ladder. Custom Dobs are now slipping below the f/4 limit. All of these bring the hazards of coma, which means that Tele Vue will be selling a lot of Paracorr coma correctors.

Smaller

A major new development in the last few years has been the dropping prices for apochromatic refractors. For decades these have been priced high and have had decade-long waiting lists. Suddenly a number of manufacturers in the Far East have started producing apochromats at far more affordable prices and without waiting lists.

I got on the bargain apo bandwagon back in 2003 when Orion came out with their 80-mm f/7.5 ED refractor. This amazing little scope (Figure 1) produced such exquisite images that I ordered the 100-mm f/9 version as soon as it was announced, which, too, is an amazing performer. These scopes have proven very popular with both visual observers and imagers, and have inspired a host of imitators. Although optically fine, they were mechanically crude, but have recently been upgraded with two-speed Crayford focusers and shiny polished tube assemblies. I recently tested the 120-mm f/7.5 version, and found it to be superb, both optically and mechanically — and beautiful to look at too.

Figure 1 — The author's favourite 100-mm Orion refractor.

Different

How about a Big Mak? I've always had a soft spot for Maksutovs. It was a 90-mm Maksutov-Cassegrain that got me back into astronomy in 1997, and the Russian 6-inch Maksutov-Newtonian that I purchased 9 years ago has long been my optical standard of reference to which all other telescopes are compared. I've recently tested a couple of new entries into this field: Orion's 180-mm f/15 Maksutov-Cassegrain and 190-mm f/5.3 Maksutov-Newtonian. While both these are impressive achievements, it seems to me that the "sweet spot" for these designs is a bit smaller. I sometimes regret having sold my Orion 127-mm Mak-Cass to Guy Nason, and I know I'll never part with my 6-inch Mak-Newt.

Brainier

Telescopes with brains? Twenty years ago, who would have believed it? Yet computerized telescopes have been the greatest astronomical innovation in the last two decades. I resisted this for a while, until I was sent a telescope with digital setting circles for testing. After finishing my tests, I suddenly got the notion of programming its controller to locate my favourite variable-star fields. I quickly discovered that not only could I cover a lot more variables in an evening, but I could intersperse this with quick looks at favourite deep-sky objects and double stars.

I'd long been a starhopping purist and felt that a beginner could only get to know the sky intimately if they learned their way around the sky "the hard way," *i.e.* as I did fifty years ago. However, the reality is that the sky has changed (for the worse: light pollution) and the typical amateur astronomer has changed also. People are very busy today, and hobbies must be squeezed into a variety of other activities. Not everyone has the luxury of long evenings spent with telescope and star atlas under pleasant summer skies. I'm convinced, from studying my log books, that there are far fewer clear nights in the year today than there were 50 years ago. When it's clear, I want to pack as much astronomy as I can into the available time. Computers help that.

There are two routes to follow. Digital setting circles are quiet and consume very little electricity. Motorized GOTO telescopes tend to be noisy and eat up batteries at an alarming rate; an external power supply is almost an essential. Most GOTO systems are based on altazimuth mounts, which requires two motors to be operating constantly. I recently tested an equatorial GOTO mount, and found this to be a pleasing alternative. Most of the time only the RA motor is operating, which cuts down on noise, power consumption, and results in a smoother operation.

Most telescopes and mounts today come with a standardized dovetail system based on the Vixen design. This enables you to mix and match telescopes and mounts, something that I do a lot.

New toys: just one of the things that keeps our hobby (and ourselves) fresh and young!

Geoff Gaherty recently received the Toronto Centre's Ostrander-Ramsay Award for excellence in writing, specifically for his JRASC column, Through My Eyepiece. Despite cold in the winter and mosquitoes in the summer, he still manages to pursue a variety of observations, particularly of Jupiter and variable stars. Besides this column, he writes regularly for the Starry Night Times *and the* Orion Sky Times. *He recently started writing a weekly column on the* Space.com *Web site.*

A Moment With…

by Phil Mozel, Toronto and Mississauga Centres (dunnfore@gmail.com)

Dr. Leslie Sage

Turn to page 245 of this issue of the *Journal* and you will see a long-running column entitled Second Light. At the end is an abbreviated biography of the author, Dr. Leslie Sage. What caught my eye early on was the fact that he grew up under the light-polluted skies of Burlington, Ontario, while I grew up under the light-polluted skies of adjacent Oakville. "Neighbours" under the stars (and in the *Journal's* pages), it seems logical that we connect for a moment.

A pristine night sky was not going to be the spark that set Dr. Sage off on his astronomical odyssey. Instead, it was the double whammy that jump-started many astronomers, both amateur and professional: *Star Trek* and the *Apollo* Moon program. Add membership in the Toronto Centre of the RASC to that, and he was well on his way. After a Ph.D. from Stony Brook University in New York, Dr. Sage took up post-doctoral positions at New Mexico Tech and the Max Planck Institute for Radio Astronomy. He currently holds a research associate position at the University of Maryland, in addition to his "day job" as the astronomy editor of *Nature.*

Dr. Sage's primary research interest involves the study of gas content and star formation in galaxies beyond the Milky Way. This interest came about when, considering topics for his Ph.D., his faculty advisor provided a list of potential research topics that included star formation in galaxies. This was in the early 1980s when, coincidentally, results from the *Infrared Astronomical Satellite* (*IRAS*) were pouring in.

IRAS was the first observatory to conduct an all-sky survey at infrared wavelengths. It discovered about 350,000 infrared sources

Dr. Leslie Sage

(including three asteroids, among them, 3200 Phaethon, the parent body of the Geminid meteors) and six comets. *IRAS* found dust disks around many stars, notably Vega, and made the first images of the Milky Way's core. About 75,000 of the sources are believed to be starburst galaxies, *i.e.* galaxies that are churning out new stars at a high rate. M82 is the classic example. More to the point, very strong infrared emission was detected from *interacting* galaxies. And therein lies a bone of contention.

Based on early investigations for his Ph.D. thesis, Dr. Sage had an idea of how galaxy interactions affect gas content, but someone pointed out that, in their view, galaxies do not interact. Before *IRAS* demonstrated otherwise, Dr. Sage was invited to "do the math": divide the number of galaxies by the volume of the Universe to see that there was simply so much room out there that interactions and collisions were unlikely. Furthermore, the whole concept of interactions was viewed with some distaste in many quarters due to the increasingly eccentric ideas of Halton Arp and his theories about galaxies ejecting quasars at high speeds. Now, however, interactions *are* thought to play a key role in the evolution of galaxies.

After his thesis, Dr. Sage realized that he did not really know the gas content of an "average" galaxy, so he did a survey on his own to see how much gas there is in normal, non-interacting galaxies. He found plenty. Starting in the mid-90s, he surveyed lenticular and elliptical galaxies with Dr. Gary Welch and found more gas than was generally expected.

Like many astronomers, Dr. Sage has done his share of globetrotting to use the best available instruments. Besides *IRAS,* he has used the 305-m Arecibo radio telescope in Puerto Rico, the Institut de Radioastronomie Millimetrique 30-m on Pico Veleta near Granada in Spain, the Effelsberg 100-m radio telescope of the Max-Planck-Institut fur Radioastronomie, the Swedish-ESO submillimetre telescope at La Silla, Chile, and has spent quite a lot of time with the 12-m dish of the Arizona Radio Observatory. However, observing has not always been a positive experience. Cloudy skies, blizzards, thunderstorms, and primitive software have all caused problems from time to time.

Equipment has improved over the years. Dr. Sage is thankful that he no longer needs to spend five hours obtaining stellar spectra as his Ph.D. supervisor did in the early days of millimetre-wavelength astronomy. Observing remotely from the comfort of an office is now commonplace. But, there is a potential penalty for this convenience: face-to-face chats in lunchrooms and impromptu discussions in hallways, where new ideas may be quickly hashed out, have declined and only partly been compensated by other forms of communication such as email. Ever larger collaborations among astronomers may also be contributing to a loss of collegiality and the difficulty of determining who is actually contributing to a project.

Vast amounts of data have been and will continue to be accumulated by astronomers, and Dr. Sage hopes that a few major facilities, such as the Canadian Virtual Observatory, will archive this information. It may then be made available to whoever is interested. (Not everyone is participating. For example, the Keck Observatory's data is proprietary). Nevertheless, while this is a great idea in principle, Dr. Sage sounds a cautionary note: in practice, the best analysis is usually done by those who collected the data in the first place, since they are familiar with the equipment used in its acquisition and that equipment's associated errors. There have been instances, for example, where erroneous conclusions have been drawn from bad data and only recognized when the original researchers had a look. He is also concerned that young people going into astronomy will be doing more data mining and have less training on the actual hardware.

Amateur astronomers are certainly welcome to use such data but, without the proper background, they will often be limited in what they can accomplish. An exception is gamma-ray bursts (GRBs). Apparently, GRB researchers have used up many of their favours with the telescope-wielding astronomers, who they call on to quickly study these ephemeral targets. Amateurs with large scopes who subscribe to *SWIFT* and *FERMI* satellite alerts can not only react quickly but also stay on target for hours at a time, collecting data and generating light curves.

Fortunately for the amateur community, Dr. Sage helps keep us in touch with these kinds of developments in his column. Friend and former *Journal* editor David Turner asked him to start the column, and each editor since has asked him to continue. Over 70 columns later, he is still at it.

Now, if you never have, why not flip over a few pages and have a first look at *Second Light*?

Phil 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.

Astronomical Art & Artifact

by R.A. Rosenfeld, RASC Archivist (randall.rosenfeld@utoronto.ca)

Who is the Society's Muse?

Memory is important to astronomers. Barnard's Star, BD +04°3561a, Proxima Ophiuci, V2500 Ophiuchi, Gliese 699: the catalogue designations that we savour, like some higher initiate's occult poetry, known to us but a mystery to others, recollect celestial events, observational histories, discoverers, and their discoveries. NASA's naming of its Great Observatories pays homage to the memory of four of the last century's major figures in the realms of observational cosmology and theoretical astrophysics. Every time we casually speak those names, we recall the men (dedicatees and project scientists) behind the ideas, now transformed into research machines. The symbols we select, sustain, and use are equally things of memory, from planetary logograms to constellation figures, to mathematical notations.

More than a few of the centenarians and *their* elders among current astronomical institutions possess seals and emblems that are themselves artifacts of astronomical history, however much they have been "retrofitted." A glance at the inside back cover of the *Journal,* or the title page of the *Observer's Handbook* will bring the reader fact-to-face with one of these institutional emblems. In amongst the Latin motto, bilingual legend, Royal crown, and the backdrop of maple leaf and Big Dipper, the muse of astronomy, Urania, is augustly seated. She is there partly due to convention, but principally because of memory. Who is she?

Figure 1 — The Society's Urania.

Urania

She is a Greco-Roman deity, one of the nine daughters of Zeus and Mnemosyne (memory), known collectively as the Muses — elements of whose later canonical literary identity can be discerned as early as the 8th century BC (Hesiod 1999, 5, 13; 2006, 8-9, 30-31). The Muses can be imagined as ever-dancing (reminiscent of classical conceptions of the heavenly clockwork) and singing of the laws governing all things.[i] They represent "truth," function as educators, and inspire intellectual work (Walde 2009). From this list of appealing traits, they seem eminently suited as figureheads for our nobler activities, and aspirations. The reader of these pages would doubtless concur that astronomy has a prime — though costly — place among our finer pursuits. It would be well, however, not to lose sight of the Muses' less savoury characteristics. They can have associations with funerals and cults of the dead, and may at times display a truly divine contempt for humankind (Walde 2009; Schachter 2003, 1002).

We like to think we can know a muse when we see one. They can appear before our eyes labelled, or set in a suggestive context, or bearing clearly identifying attributes.[ii] The latter are a crucial part of The Muses' long-established iconography, and the attributes are a subtler, more traditional, and more evocative way of showing who's who than appending a mere label. I fear we come perilously close to depending on the déclassé name tag to identify our Society's muse, for, relying on the Latin motto and starry context, we have left her bereft of her customary attributes.

The attributes that she ought to have are interesting. The most frequently depicted one is a celestial globe, or armillary sphere. Next in popularity is the addition of a measuring device, either a rod with or without divisions (presumably representing a specific unit system), or a pair of dividers. These were usually thought to be sufficient. They could be augmented by a much richer array of instruments, particularly in the 16th to the 18th century: quadrants, astrolabes, Jacob's staves, dials, clocks, telescopes, charts, and so on.

A vivid description of Urania's basic attributes can be found in one of the most popular late-antique astronomical texts of a literary cast, Martianus Capella's *Marriage of Philology and Mercury.* It is actually a description of Astronomia (astronomy), but it well describes Urania's kit, albeit with the goddess set *inside* the globe:

> *And behold, a certain globe of ethereal light, enclosing a certain maiden [Astronomy] - the curved strength of a transparent fire, so it seemed; with a gentle rolling, gradually the globe glided.... The crown of her head was starry, and her hair sparkled.... In one hand she held a shining cubit-long rule [approx. 50 cm], and in the other a divine book in which were the predetermined paths and the direct and retrograde courses of the planets....*[iii]

Perhaps if we squint long enough at the Urania on the present version of our seal we can imagine we see Alioth and Megrez sparkling in her locks. The customary globe and measuring instrument are nowhere to be seen, alas.

Urania and the RASC

We acquired our seal in 1905, and one of the first places that it appeared in print was on the cover of T*he Royal Astronomical Society of Canada Transactions for 1905*. The president at the time, C.A. Chant, even devoted a section of his formal address, delivered on 1906 January 23, and entitled *Astronomical and Astrophysical Progress 1905,* to the new seal:

> *For a number of years the Society has had under consideration the selection of a design for an official seal, and I am happy to say that during the past year the work was brought to a completion. The central portion of the design is the figure of Urania, the muse of Astronomy. The sketch is after a sculpture by Flaxman.... The sketches from which the seal was cut were made by Mr. John Ellis, and I think great praise and our sincere thanks are due him for the infinite pains he took with the work* [Chant 1905, 23].

The interesting detail here is the claim that the image is after a sculpture by Flaxman. I shall return to this shortly.

As with the Latin motto, the choice of Urania for our seal was hardly surprising, given the time and cultural setting. Gentlemen astronomers would have studied the Greek and Latin tongues and their associated classical histories and literatures as a matter of course. Ideals of civic virtue, rhetoric, and aesthetics in the arts were heavily influenced by the period's conception of the classical past. Contemporaneously with the RASC choosing Urania for its seal, numerous European observatories were founded and named after the muse, such as the Berliner Gesellschaft Urania of 1888, the Urania-Sternwarte Zürich 1907, and the Wiener Urania Sternwarte 1909-1910, to name a few.[iv] Others adopted her for their seals, such as the United States Naval Observatory (Dick 2002, frontispiece, and ii; USNO seal — predating the RASC by several decades), and commemorative medals, as did the Specola Vaticana (Maffeo 2001, fig. 30).

The artist Chant mentioned, John Ellis (1837-1923), was a RASC member, and son of a Toronto engraver and lithographer of the same name (Broughton 1994, 12). Why would Ellis have chosen to base the RASC's Urania on a "sculpture by Flaxman"?

In Chant and Ellis' day, visual preferences that had been established in the enlightenment period had by no means been pushed aside by Romanticism, or Victorian eclecticism. Dorpat Observatory, Pulkovo Observatory, and the administration building of the David Dunlap Observatory were all built in variations of Neo-Classicism. The English sculptor and draughtsman John Flaxman (1755-1826) was one of the high priests of the style (Bindman 2008). He was responsible for numerous representations of Urania (Wark 1970, 68-75; Tattersall 1979, 52; Irwin 1979, 176-177; MET 2006; Fitzwilliam Museum C.17-1911 2009). All of them show the goddess with one or more of her traditional attributes, the globe and the measuring device. In Flaxman's finest "mass-produced" image of the muse of astronomy (Figure 3), she is shown standing (Wark 1970, 74; MET 2006; Fitzwilliam Museum C.17-1911 2009), although he did depict Urania seated at times (Figure 4), even quite informally (Wark 1970, 69). The form of her body is clearly evident and skilfully crafted beneath the folds of the drapery. And, even in the most restful of the images, there lies more than a hint of animation in the figure. None of Flaxman's figures of Urania are posed as the RASC Urania, seated on a chair, looking into the middle distance, with her arms resting in her lap. The Flaxman Uranias are as different from the RASC Urania as they could be within the confines of Neo-Classicism. Whatever the paternity and affiliations of our Urania, she cannot be attributed to the influence of any piece by John Flaxman. Why did Chant assert the Flaxman connection? Who is the Society's muse?

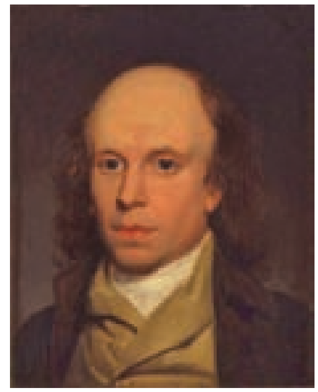

Figure 2 — John Flaxman.

Will the true father of the RASC Urania identity himself?

There are no artistic DNA tests that can settle the case. It is most unlikely that Chant would invent such a spurious claim himself. He was not trained in higher-art criticism or history; without that background would he have been emboldened to knowingly front an artistic forgery? On the other hand, his lack of experience might have made it relatively easy for someone else to make a forged attribution, which he would innocently repeat. Given that we do not know the whereabouts of the original correspondence regarding the design of the Society's seal, or the original drawings, we can only speculate on the course of events.

If Chant is to be excluded from the ranks of Society forger, then that leaves the original designer of the seal himself as the prime candidate, in the absence of other names of RASC members known to have worked on the project. As a graphic artist himself, John Ellis would have known of the famous John Flaxman and his work, and Ellis would have had the graphic skills to design a Urania who, if she lacks the characteristic features and grace of a true Flaxman image, at least is recognizably late Neo-Classical. For a possible motivation we need look no further than the protective power a famous name can lend to a project; a work claimed to be "after a sculpture by Flaxman" could not be criticized without casting grave doubts on the taste of the one making the criticisms. If none of Ellis' fellow members had a practised eye in forensic art analysis, then the chance that he could bring the deception off was fairly good. The more high-profile RASC members were convinced of the claim, and satisfied with Ellis' results, the safer the deception became. An unchallenged run of over a century is something of which the forger can be proud. And, having grown used to our pseudo-Flaxman Urania, I would certainly be loath to see her go.

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Walde 2009: Walde C. 2009, "Muses", in Brill's New Pauly, ed. H. Cancik & H. Schneider (Brill, Leiden) `www.brillonline.nl.myaccess.library.utoronto.ca/subscriber/entry?entry=bnp_e812670` (accessed 2009 October 8)

End Notes

i. A direct connection between the muses and the movements of the spheres of heaven is made by the late-Roman 5th-century author Martianus Capella (1977, 16; 1983, 12).

ii Vultus uraniae is a fine though brief introduction to Urania's iconography in the age of print, but, as it is confined to materials in the Biblioteca "Guido Horn d'Arturo" of the Dipartimento di Astronomia dell'Università di Bologna, its statements are in need of some adjustment when dealing with a wider range of materials; `http://www.bo.astro.it/~biblio/Vultus-Uraniae/Face_cap4I.html`

iii Martianus Capella 1977, 317; 1983, 307. The translation is by the author. Aspects of this 5th-century text may seem odd to a modern sensibility, but no more so than the later 19th-century explanation of the United States Naval Observatory seal by the USNO Superintendant (USNO seal).

iv This can be seen as the continuation of a well-established tradition, as in Tycho's (1546-1601) Uraniborg, and Schröter's (1745-1816) Urania-Tempel und Sternwarte.

R.A. Rosenfeld was appointed RASC Archivist after being surrounded by antique celestial atlases that wouldn't take "no" for an answer. Before that, he was headmaster of a borstal for errant footnotes. He is currently seeking a robotic telescope that can respond to commands in Latin.

Figure 3 — Standing image of Urania by John Flaxman, 1780s?, pencil. This image features the attribute of a celestial globe with a band of stars. Drawing by R.A. Rosenfeld.

Figure 4 — image of Urania by John Flaxman, 1777, bisque. Note the attributes of a celestial globe, and a measuring rod, or rule. Drawing by R.A. Rosenfeld.

Carpe Umbram

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

East Is East and West Is West...

Oh, East is East, and West is West, and never the twain shall meet,
Till Earth and Sky stand presently at God's great Judgment Seat....
From "The Ballad of East and West"
By Rudyard Kipling

"Never," Rudyard? Never say never. Last summer East did meet West, when this Easterner met a few Westerners in British Columbia, where together we stood twixt Earth and Sky to have some fun doing a bit of astronomical research. In July, I had reason to spend a few weeks on the left coast. So naturally, I checked the predictions of the International Occultation Timing Association (IOTA) at `www.asteroidoccultation.com` to see if there might be an occultation or two worth doing while I was there during the two-week interval between family weddings. Indeed there was one that caught my eye. (Figure 1)

Figure 1 — IOTA's predicted path of the occultation of the tenth-magnitude star TYC 5781-00823-1 by asteroid (586) Thekla on 2009 August 31.

I emailed my friend Dave Bennett (Victoria Centre) to ask if he might be interested in chasing asteroid (586) Thekla as it intercepted a 10.3-magnitude star on the evening of Sunday, 2009 August 30. He replied with an enthusiastic "Yes!" When I informed IOTA of our intentions, several other Westerners hopped on our bandwagon and an expedition took form.

Dan Collier and Phil Morris (both of Vancouver Centre), Mike Hoskinson and Mike Noble (both of Edmonton Centre), and Guy Mackie (Okanagan Centre) took a look at the predictions and saw that the shadow path would come close enough to their homes to give it a try. Dan and Phil would observe from the Gordon Southam Observatory (GSO) in Vancouver; Mike Hoskinson would be in Fort McMurray that weekend and would observe from there; Mike Noble was happy to drive several kilometres west of Edmonton to set up his station near the edge of the path; and Guy Mackie (Okanagan Centre) said he'd try, too, probably from the southern 1-sigma zone.

Three evenings before the event, Dan and Phil did a test run to check sightlines from the GSO. They feared that the target star in southern Aquarius would be obscured from the observatory's 0.5-metre telescope by a line of trees. Therefore, they wanted to check the feasibility of using the Vancouver Centre's 0.43-metre Dobsonian on the forecourt. I was in the neighbourhood at that time, so they invited me along for the test run (Figure 2). As the evening progressed, an intermittent stream of passers-by stopped to ask if we were looking at Mars. This was August 27, the night when, according to the Internet, Mars would be as big as the full Moon. Everyone wanted a look! My job was to patiently explain the hoax and act as a buffer between the disappointed masses and Dan and Phil, who were painstakingly star-hopping to the target and shaking down the telescope-video combination so all would be ready three nights later.

Figure 2 — Test run at Gordon Southam Observatory in Vancouver. Left to Right: Dan Collier, Guy Nason, and Phil Morris. Credit: P. Morris.

It turned out that the big Dobsonian could do the job, but, thanks to a well-placed dip in the tree line, the 0.5-metre Cassegrain inside the dome would also be able to see the target star on Sunday. So the decision was made to put the Dobsonian back in the closet and use the main telescope instead.

On Saturday, I boarded the ferry to Vancouver Island — Dave Bennett met me and took me to his home, where I enjoyed a very nice visit with him and his wife, Susan. We discussed our plans for the next day, sorted out Dave's two telescopes: a 200-mm SCT for me and a 13-mm refractor for Dave. Because it had been several years since Dave had done an occultation, he preferred that we observe together, rather than set up two independent stations several kilometres apart. Since we had only one vehicle, and this is cougar and grizzly bear country, we agreed that sticking together within jumping distance of the truck was the right thing to do. With that settled, we went off to bed with visions of disappearing stars dancing in our heads.

Meanwhile, others were doing their own planning. Guy Mackie would travel nearly 90 km west from Kelowna to reach the 1-sigma line and guard against a southward shift in the path. Les Disher would try from his home in Courtenay, 12 km north of our station (with respect to the occultation path). In Alberta, Mike Noble found a place to his liking west of Edmonton; Mike Hoskinson, at Fort McMurray, would set up two stations — one operating autonomously — several kilometres apart.

Came the day, Dave and I saddled up his giant SUV, "The Blue Whale," and headed up Vancouver Island to a nice quiet place about 20 km south of Courtenay, where we set up our telescopes about three metres apart. Both of us would use the eye-and-voice method, visually observing the target star while our tape recorders would record our voices and our short-wave radios tuned to WWV to provide time references. (Dave was not equipped for video and my ancient video gear was too bulky to bring on the plane.) This arrangement proved to be fortuitous. We tuned our radios to two different frequencies. Dave's receiver, at 5 MHz, pulled in WWV from Colorado in fine form. Mine, at 10 MHz, ignored the guy in Ft. Collins and gave me the nice Hawaiian lady on WWVH, instead. As so often happens, the signals drifted in and out of reception, but never at the same time, so at least one source was always "loud and clear." I resolved to use this two-radio system for all my future occultations.

We found the star without too much difficulty. We started recording about four minutes prior to the predicted time of central occultation and settled in to watch and wait. D-time (disappearance time) came and went and I was getting concerned that we had observed a miss when the star suddenly disappeared, 16 seconds late! "Out," we yelled. A little more than three seconds later, we called "Back!" as the star returned to its rightful place in the Universe. Whoo-hoo! We had a hit!

Back in Victoria, we analyzed our tapes and agreed that we had witnessed a 3.3-second occultation from 05 h 59 m 15.5 s UTC to 05 h 59 m 18.8 s UTC. This was considerably shorter than the predicted central occultation time of seven seconds. Clearly, we were somewhere between the centre and the edge of the asteroid. But which edge? We wouldn't know until the others had filed their reports.

Les Disher discovered that trees obscured the view from his fixed telescope, so he bowed out. Mike Hoskinson's remote station recorded a 6.4-second occultation, but he suffered frustrating equipment problems at his manned location. Dan and Phil in Vancouver, and Mike Noble near Edmonton, observed clean misses. Guy Mackie was done in by haze from the central-B.C. forest fires raging at the time, and was unable to see anything dimmer than Jupiter through the smoke. Later, we learned that Steve Preston, who manages IOTA's occultation prediction Web site, watched from his home in Washington State, just in case there was a large southward shift in the path. There was not, so he missed by a wide margin, as expected. Figure 3 shows our results as they were computed by IOTA's Brad Timerson in Newark, N.Y.

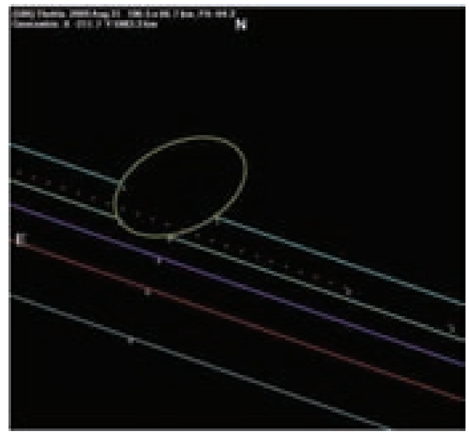


Figure 3 — Sky-plane plot derived from observations on 2009 August 31 (UTC). Credit: Brad Timerson.
Chord 1: Mike Hoskinson.
Chord 2: the predicted location of the asteroid at the times of the observations. It was expected to occupy the large space between the 2s on the right.
Chord 3: Dave Bennett and Guy Nason
Chord 4: Mike Noble
Chord 5: Dan Collier and Phil Morris
Chord 6: Steve Preston

All in all, this was a pretty good event, despite the relative scarcity of observers. We learned that either asteroid (586) Thekla was a little north and quite late with respect to its predicted position, or that star TYC 5781-00823-1 wasn't quite where it was purported to be — or some combination of both these possibilities. We also measured one profile of the asteroid, which seems to be a 106-km × 62-km ellipse, rather than an 82-km spheroid as previously thought. Mike Noble attained a good constraint on the south side of the rock, Mike Hoskinson was probably near the centre of the path, and Dave and I were somewhere in between. It was unfortunate that no one was available to observe the northern half, or we might have had an even better, more precise result. Still, this Easterner and several Westerners met in friendship between Earth and Sky and learned a tiny little bit about the world in which we live - and about each other, too!

Guy Nason currently lives in Toronto. He joined The Royal Astronomical Society of Canada in 1985 and has served on Toronto Centre Council continuously since 1986 (currently Coordinator of Observational Activities). He joined the International Occultation Timing Association (IOTA) in 1990, and successfully observed several lunar grazing occultations, total lunar occultations, and — so far — 11 asteroidal occultations. He owns and operates Gneiss Hill Observatory at his cottage, 80 km northwest of Kingston, Ontario.

Gizmos

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

Little Observatory on the Prairie

Innovation has always been one of the hallmarks of astronomy. How after all, do you measure the distance to a star when you can't stretch a tape? Or how do you build a mount for the masses out of materials you can buy at building supply store? You innovate. So it should not have been much of a surprise to me that after writing articles about our roll-off observatory and discussing the relative merits of roll-offs and domes, I received an email from Saskatoon Centre member Tenho Tuomi to tell me that he had built something completely different.

And different it was — different enough to make me want to have an up-close look at it. So, after getting rained out of the SSSP and before heading back west, we detoured a little east and a little north to see Tenho's observatory.

Figure 1 — Tenho Tuomi opens his clamshell observatory. The triangular end panels simply lift out and store in the open roof. The tarp is because it was raining.

Or at least we thought it would be a little. How were we to know that they measure distance differently in Saskatchewan? Suffice it to say that we came to Saskatchewan to get away from big-city lights... and so we did.

The Tuomi farm is 13 miles southeast of Lucky Lake, which is 5 blocks long and 3 blocks wide and has neither a Walmart nor a casino. On a clear night, Lucky Lake produces a short string of tiny lights on the horizon, but other than that, there are only Moon and stars in the Tuomi sky — stars that Tenho observes and captures on prize-winning photographs from an observatory that should win a prize for innovation.

It has no rotating dome. It has no warming room. It has no red-shielded computer monitors and no remote offsite control.

But it shelters the scope from the wind, and it gets out of the way when you want to see stars. It was inexpensive, and it could be built by anyone with some basic carpentry skills.

I don't think there was ever a blueprint done for this, but the design is based on making full use of standard materials. That means the whole thing came out of seven sheets of 3/8″ plywood, eight 4-foot lengths of 4×4 and fourteen 8-foot lengths of 2×2. In addition, you would need six strap hinges, a fistful of screws, 44 1/4×1¼″ hex bolts with nuts and washers, and, oh yes, 6 feet of rope.

You should have change left out of a $200 bill.

Tenho began by digging 4×4 posts about two feet into the ground: one at each corner and another half way down each side. Since it's based on the dimensions of a sheet of plywood, this observatory is eight feet square and the side walls are two feet tall. To make these, the posts were wrapped with half sheets of plywood and the spaces between them framed with 2×2.

The roof shells look difficult but might be easier than you would think. The steep lower portion is a full 4×8 sheet and the upper portion is a half sheet. I think I would begin by cutting the gable ends first. One side is four feet long and the other a little less than two feet so that the upper panels lap the lower ones. The angles would be determined beforehand by drawing this carefully to scale. The gable ends would be lined with 2×2 and the roof panels assembled to them. More 2×2 at the corners and edges, hinges to the walls below, and that would be the basic structure. There is still a gap between the roof shells and the end walls however, and Tenho built infill panels to close it, lapped and fitted to stay securely in place and to shed water. That might even have been the most challenging aspect of the whole structure. Every panel must lap every other in such a way that water runs off without finding its way in. This observatory didn't have a huge budget, but it got a huge amount of thought.

Figure 2 — Tuomi observatory. Ready for the night.

The finished structure is an attractive barn shape that echoes the buildings near it. It is oriented north and south, and one or both sides of the roof can be folded back to open the view in either direction. When only one side is open, the other forms a wind screen, and when both sides are closed they are a snug enclosure for the reflector and the Byers mount within.

Tenho locks this with a hook and eye at each end because of the prairie wind. If you live a little closer to the big city lights, you might want to use padlocks, and not because of the wind.

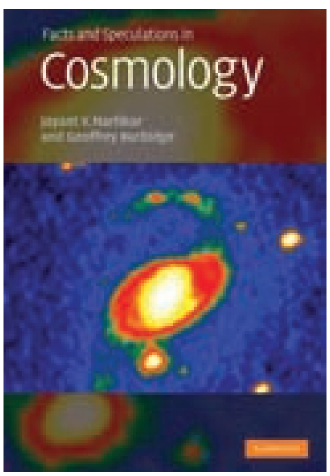
Thanks to Tenho Tuomi for showing us his observatory. And thanks also for showing us once again that big organizations and big budgets will never displace the imagination and ingenuity of the individual.

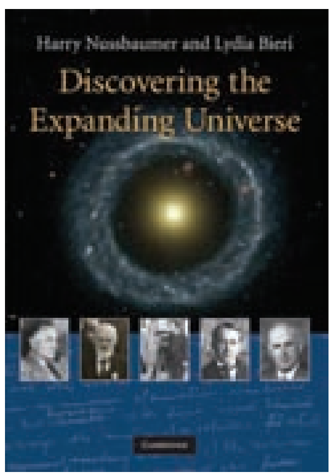
Don and Elizabeth van Akker are members of the Victoria Centre. After living almost their entire lives on the "Wet Coast" they have learned how to get rained on almost anywhere. Don would like to hear about what you have dreamt up. Contact him at dvanakker@gmail.com

Reviews / Critiques

Facts and Speculations in Cosmology, by Jayant V. Narlikar and Geoffrey Burbidge, pages 287 + viii, 17 cm × 25 cm, Cambridge University Press, 2008. Price $60.00 US hardcover (ISBN-13: 978-0-521-86504-3).

Discovering the Expanding Universe, by Harry Nussbaumer and Lydia Bieri, pages 226 + xvii, 17 cm × 25 cm, Cambridge University Press, 2009. Price $59.00 US hardcover (ISBN-13: 978-0-521-51484-2).





Cosmology, including its philosophical and historical aspects, is one of the few fields of science that sells well and appeals to a broad audience. These two new books published by Cambridge University Press not only bear witness to the general appeal of cosmology, they also illustrate its diversity and the uneasy relationship between cosmology as a science and as a product of historical development. Many introductory and popular expositions of modern cosmology are framed historically, in the sense that earlier ideas are presented as the background for the more scientific versions of cosmology that appeared in the 20th century. *Facts and Speculations in Cosmology* follows that tradition, but it differs from most other books by not considering the standard hot Big Bang model as the crowning achievement of the long quest of understanding the Universe. On the contrary, the book argues consistently and passionately that the consensus Big Bang picture of the early Universe, based on inflation and grand unified theories, is speculative and scientifically unjustified.

This message is no surprise, given that the two authors have fought for long the standard Big Bang model and advocated the alternative of an eternal universe of the steady-state type. Both are highly distinguished scientists as well as seasoned controversialists. A student of Fred Hoyle, Jayant Narlikar was instrumental in reviving the steady-state theory and turning it into the more sophisticated and flexible Hoyle-Narlikar theory. Geoffrey Burbidge, too, was an early collaborator of Hoyle and one of the authors of the pioneering B^2FH theory of stellar-element formation. (The other authors were Margaret Burbidge, William Fowler, and Hoyle.) Together with Hoyle, Narlikar and Burbidge published in 2000 a comprehensive and technical account of the problems of current cosmology, entitled *A Different Approach to Cosmology,* in which they presented their favoured alternative known as the quasi steady-state cosmology or QSSC. (I reviewed the work in *Sky & Telescope,* 100, 84-85.) The present book can be seen as a popular version of the earlier one, an attempt to make alternative cosmological views known to a wider group of readers. Written in a clear and engaging style, it presents its arguments pedagogically and convincingly, if also one-sidedly.

The historical framework of the book serves two purposes: to introduce cosmological concepts and to support the authors' crusade against the Big Bang theory. Unfortunately the historical part is not only sketchy and selective, it is also over-simplified, anecdotal, and generally unreliable. Among the numerous errors, let me only mention that, according to the book, the model found by "William de Sitter" in 1917 was expanding, Georges Lemaître was a Jesuit priest, and the magnetic effect of electric currents was discovered by André-Marie Ampère. The historical examples include the counter-Earth of Philolaus of Croton and the infamous process against Galileo. In both those and other cases, the authors use history, or rather quasi-history, to illustrate and support their basic claim that modern mainstream cosmologists are biased and unwilling to consider alternatives. Non-baryonic dark matter is the modern version of the ancient anti-Earth, and the cosmological establishment responds to alternative ideas in essentially the same way as the Roman Inquisition responded to Galileo's view of the planetary system.

Narlikar and Burbidge discuss the QSSC model in considerable detail, arguing that their model is methodologically superior to the standard model and can explain observations equally well or better. For example, by assuming the existence of tiny iron whiskers in the intergalactic dust, the model explains the microwave background as the result of thermalized starlight, not by an allegedly mythical event in the early Universe. Of course, Narlikar and Burbidge realize that, if seen from a sociological point of view, their favoured alternative has been a failure. As they see it, the greatest problem with the model is indeed of a sociological and ideological nature and not because of its scientific insufficiency. It is "due to the fact that very few professional cosmologists know about, and very few work on it in an era when all the publicity is on the other side" (p. 279).

The key message of *Facts and Speculations in Cosmology* is not so much that QSSC is right as that Big Bang cosmology is wrong. Objections to the standard model of the Universe, inflation included, are not new and they are far from restricted to supporters of a steady-state universe. The objections are mostly of a methodological nature but also include sociological elements, in particular that cosmologists allegedly are biased in favour of the Big Bang paradigm. Non-baryonic dark matter, the inflation field, and dark energy are "flights of fancy" that have little foundation in science but are taken seriously because of the "clever marketing strategy" that fit them to the ruling paradigm. It is as if the majority of cosmologists and physicists are engaged in a conspiracy for the purpose of maintaining belief in the Big Bang and denying alternative views a legitimate place in cosmological science. Cosmology, we are reminded, needs to be grounded in good observations and those, however inconvenient they are, must be taken seriously. It is claimed that in the present situation, where cosmology is governed by the Big Bang paradigm, that is not the case. Most observers "know that they will get more favourable treatment from their colleagues, editors, funding agencies, and others who assign telescope time if they concentrate on tests confirming the Big Bang" (p. 249). In short, Narlikar and Burbidge charge that the approach of mainstream cosmology precludes that observations can ever disprove the basic framework of the Big Bang model — which, at least according to Popperian standards, is about the same as saying that it is unscientific.

Science is constantly in need of critical voices, not least in cases where a theory has obtained paradigmatic status. If only half of the charges that Narlikar and Burbidge level at the community of modern cosmologists are true, it has a serious problem. I believe that cosmologists should listen to the objections of well-informed skeptics and that the tendency, if there is such a one, to dismiss unconventional views is unsound. But I also believe that Narlikar and Burbidge do not help their cause by presenting it in such an emotional and exaggerated way as they do in the book. It is surprising that the authors do not see that their own views and arguments share many of the objectionable features that they so vehemently claim are characteristic of mainstream cosmology and its many advocates. I am inclined to view *Facts and Speculations in Cosmology* as an interesting and well-written polemical work wrapped up in a questionable semi-historical framework.

Although *Discovering the Expanding Universe* by Nussbaumer and Bieri covers some of the same ground as the Narlikar-Burbidge volume, its content and aim is very different. First of all, it is a historical account of a key episode in the history of modern cosmology, not a polemical contribution to the contemporary debate concerning the structure of the Universe. The main part of *Discovering the Expanding Universe* is a detailed and carefully documented description of the period from about 1910 to the early 1930s, from Melvin Slipher's first observations of galactic redshifts to the recognition that the Universe expands in accordance with the equations of general relativity. As a prelude, the book includes a precise account of highlights in the earlier development, starting with the medieval world picture taken over from the ancients. The main subject is the road toward the expanding Universe, not the Big Bang universe, but of course the two cannot be strictly separated. Nussbaumer and Bieri end with a chapter on the origin of the concept of the explosive universe in which they understandably focus on the seminal contributions of Lemaître. A summary chapter carries the story up to the present, but too briefly to be of any value. Gamow is credited for having predicted the cosmic background radiation in 1948 (p. 181), although the prediction was in fact not Gamow's but that of his collaborators Ralph Alpher and Robert Herman.

Discovering the Expanding Universe is intended for a broad readership and is a fine example of a non-academic yet seriously researched history of science. It will possibly appeal to astronomers in particular, but is written in such a straightforward and non-technical language that it is accessible also to other readers. I am quite impressed by the amount of lucidly presented information included in this relatively slim volume. No less impressive is the richness of details that in some cases go beyond what can be found in other works. For example, there is an excellent chapter on Harlow Shapley's stellar universe, and the chapter on Lemaître's expanding model of 1927 is equally detailed and excellent. In Nussbaumer and Bieri's book, the Belgian physicist and priest receives full recognition as an outstanding pioneer of modern cosmology.

Discovering the Expanding Universe starts with an interesting foreword by Allan Sandage in which the eminent observational cosmologist praises it for being "the complete story" of the discovery of the expanding Universe. He repeats several times that it is the "definitive book" on the subject. The book is indeed detailed and valuable, but it is neither complete nor definitive. The whole notion of a definitive historical work is nonsensical and irreconcilable with the very nature of history. In spite of the many qualities of the book, it is far from complete or free of weaknesses. For one thing, political, economic, and institutional contexts are largely missing. For another, the book mostly deals with what we today recognize as important discoveries and other highlights of the development, and it does so in a very standard way. Many scientists and theories that do not fit into the standard story are left out or only briefly mentioned (which is understandable, given the size and aim of the book). Nussbaumer and Bieri have based their history largely on the scientific publications, which they present in a way that is both authoritative and pedagogical. They have consulted very few of the historical works written by historians of science. Had they paid more attention to the literature — such as Robert Smith's *The Expanding Universe* (1982) and Erich Paul's *The Milky Way Galaxy and Statistical Cosmology* (1993) — they might have produced an even better work, more contextual, and historiographically more sophisticated.

The objections that can be raised against *Discovering the Expanding Universe* are however few and not very important. The bottom line is that it is an excellent work that combines scholarship and technical expertise with a clear and accessible presentation. The many fine illustrations add to the usefulness of the book, and so does the extensive mathematical appendix intended for readers with a taste for the technical aspects of relativistic cosmology. *Discovering the Expanding Universe* is the best internalistic history of the discovery of the expanding Universe that I know of, and one that should be read carefully by all with an interest in the historical development of modern cosmology.

— Helge Kragh

Helge Kragh is professor of the history of science at the University of Aarhus, Denmark, and serves as president of the European Society of

History of Science. His research focuses on the history of the physical sciences since 1850, including quantum theory and cosmology. His books on the history of cosmology include Conceptions of Cosmos *(Oxford University Press 2006),* Matter and Spirit in the Universe: Scientific and Religious Preludes to Modern Cosmology *(Imperial College London 2005), and* Cosmology and Controversy: The Historical Development of Two Theories of the Universe *(Princeton University Press 1999). His two most recent books are* The Moon that Wasn't: The Saga of Venus' Spurious Satellite *(Birkhäuser-Springer 2008), and* Entropic Creation: Religious Contexts of Thermodynamics and Cosmology *(Ashgate 2008).*

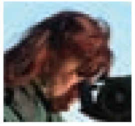
Society News

by James Edgar, Regina Centre (jamesedgar@sasktel.net)

All's quiet on the RASC front! We have had a rather uneventful period since last issue, except that on Friday, October 2, Parks Canada and The Royal Astronomical Society of Canada designated the Grasslands National Park near Val Marie, Saskatchewan, as our newest Dark-Sky Preserve (DSP). This is the largest DSP in the world, with 527 square kilometres at present and plans to eventually expand it to 921 square kilometres (92,100 hectares). Great news for the two LPA Committees who put it all together, both at the national level and provincially — well done!

Just recently, another of Walter MacDonald's "quietly working in the background" projects has come to fruition. He has created a section of the Web site devoted to the history of our Honorary Members (see `www.rasc.ca/honorary/hmlist.shtml`). Hats off to Walter for this wonderful recorded addition to our rich history.

By the time you read this, the Executive Committee and Executive Secretary, Jo Taylor, will have completed another "Maritime Executive Retreat" in Halifax over the October 22 to 25 weekend. Judging by the success of the MER meetings held last year, the Executive decided to carry this forward into an instant tradition! It is a great way for us to get all our ducks in a row, to make short-term and long-term plans, and to discuss at length the many and varied items that crop up in the running of a large organization, in preparation for the fall National Council Meeting.



Quick Picks for Observing

by Kim Hay, Kingston Centre (cdnspooky@persona.ca)

December 2009	Event
Wednesday, December 2 7:30 UT	Full Moon "Cold Moon"
Monday, December 7 3:00 UT	Mars 5° N of Moon
Wednesday, December 9 0:13 UT	Last-quarter Moon
Monday, December 14 5:00 UT	Geminid meteor-shower peak
Wednesday, December 16 12:02 UT	New Moon
Friday, December 18 8:00 UT	Mercury 1.4° S of Moon
Sunday, December 20 5:00 UT	Jupiter 34´ S of Neptune
Monday, December 21 17:47 UT	Winter Solstice
Tuesday, December 22 22:14 UT	Ursid meteor-shower peak
Thursday, December 24 17:36 UT	First-quarter Moon
Tuesday, December 29 1:00 UT	Moon in Pleiades (M45)
Thursday, December 31 6:00 UT	Moon 0.8° N of open cluster M35
Thursday, December 31 19:13 UT	Full Moon (Blue Moon): second full Moon of the month of December
Thursday, December 31 – 2010 January 1.	Partial lunar eclipse — see pages 130 and 147 of the 2009 *Observer's Handbook* for more information.

January 2010	Event
Saturday, January 2	Earth at perihelion
Saturday, January 3	Quadrantid meteor shower peaks – average 40 meteors/hour
Tuesday, January 6	Moon passes under Saturn
Thursday, January 8	Comet Wild east of Saturn
Wednesday, January 7	Third-quarter Moon
Thursday, January 15	New Moon. Annular solar eclipse over Africa, India, Burma, China
Saturday, January 17	Crescent Moon and Jupiter in western sky at sunset
Saturday, January 23	First-quarter Moon
Monday, January 25	Moon sets with Pleiades in morning
Thursday, January 29	Mars at closest point to Earth (0.664 AU = 99.33 million km). Apparent diameter of Mars is 14"
Friday, January 30	Full Moon, under Mars
Saturday, January 31	Asteroid Pallas beside M5

February 2010	Event
Monday, February 2	Moon together with Saturn after midnight
Thursday, February 5	Third-quarter Moon
Saturday, February 7	Mars above the Beehive
Friday, February 13	New Moon
Monday, February 16	Jupiter and Venus in conjunction low in evening twilight
Tuesday, February 17	Vesta beside Algieba in Leo
Thursday, February 19	Asteroid Urania under Regulus
Saturday, February 21	Moon sets beside the Pleiades
Saturday, February 21	First-quarter Moon
Saturday, February 28	Jupiter at conjunction
Saturday, February 28	Full Moon

Meteor Showers for October to December are available from `www.imo.net/calendar/2009`, including several minor and major showers. See page 258 of the 2009 *Observer's Handbook*. Visit the North American Meteor Network at `www.namnmeteors.org`

2009 International Year of Astronomy

As we celebrate the global celebration of Astronomy, make sure you visit `www.astronomy2009.ca` for more information on Canadian and local events.

In the closing months of IYA, we can look back at a successful RASC campaign that introduced hundreds of thousands of Canadians to the night sky.

Take some time to visit the International IYA web-page at `www.astronomy2009.org`. See the wonderful events that have happened and will be happening in the future.

The IYA experience will leave its legacy for years to come — you can continue to be part of it!

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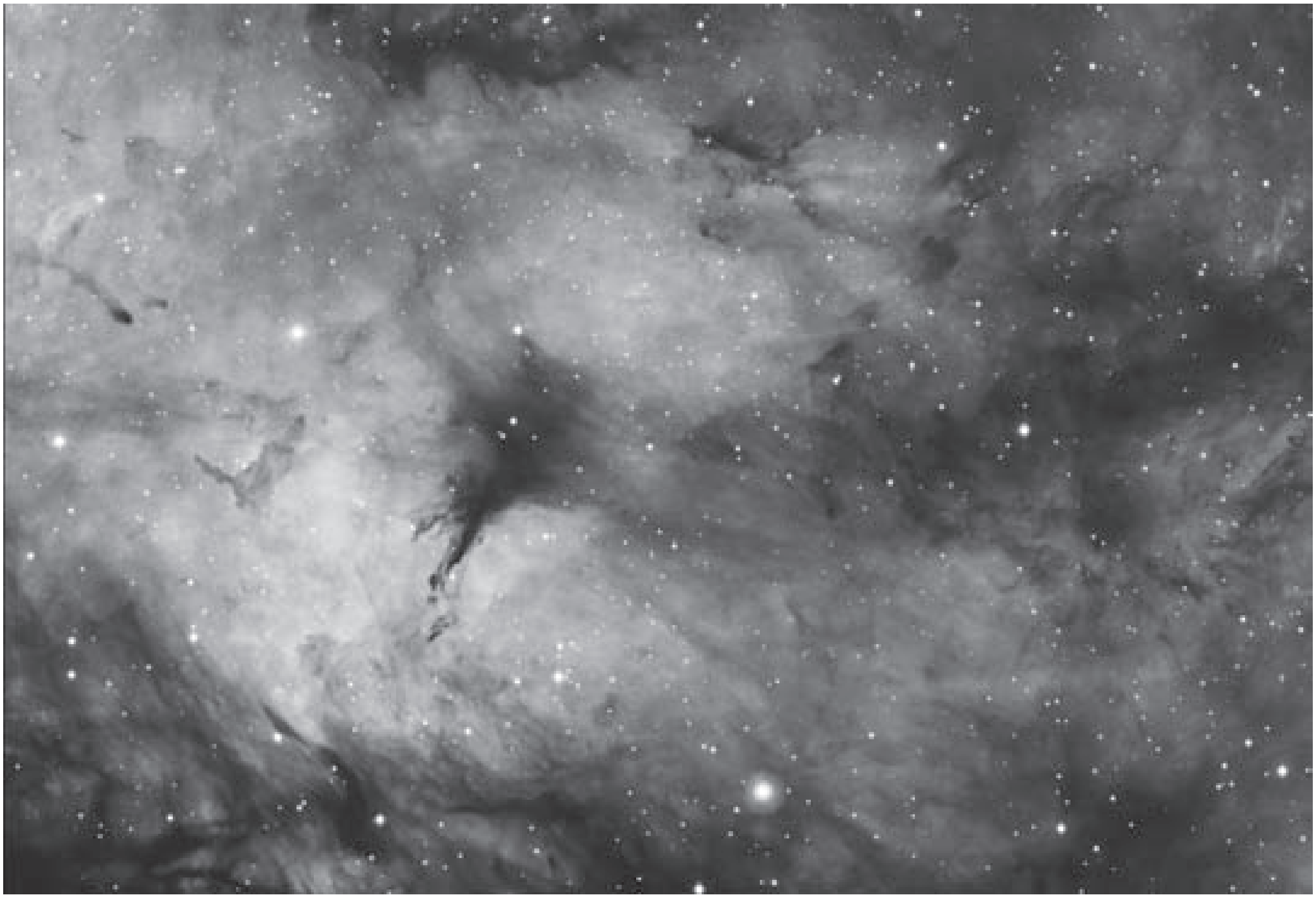
Great Images



The Butterfly Nebula, otherwise known as IC1318c, is a part of the extensive nebulosity that makes up the Cygnus HII complex surrounding Gamma Cygnus (Sadr), though the nebula is much more distant than the star, at a distance of 5500 light-years. The dust lane in the centre of the image is 20 light-years thick and is a part of the emission nebula and its parent molecular cloud complex. Serge Théberge captured this image on August 12 after five hours of H-alpha imaging (15 frames x 20 minutes). Serge used a Takahashi FS-152 at f/8 and an SBIG ST-10XME with an AstroDon H-alpha 6-nm filter.

A note of appreciation from Denise Sabatini, wife of the late Leo Enright

I don't even know where to begin to thank the members of the RASC. Leo loved the RASC and everything it stands for. He always had so much respect for the members and the contributions each of you made. He didn't have many instructions as to what to do with his possessions but he did bequeath his logs to this great organization.

I also want to thank you for the beautiful flowers that were sent to honour him. It meant the world to me — your support.

Sincerely,

Denise

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

NATIONAL OFFICERS AND COUNCIL FOR 2009/CONSEIL ET ADMINISTRATEURS NATIONAUX

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Editor of *Observer's Calendar*	Dave Lane, Halifax
Executive Secretary	Jo Taylor, 203 - 4920 Dundas St W, Toronto ON M9A 1B7 Telephone: (416) 924-7973

* Deceased 2009 August 11

CENTRE ADDRESSES/ADRESSES DES CENTRES

The most current contact information and Web site addresses for all Centres are available at the Society's Web site: **www.rasc.ca**

Belleville Centre
c/o Greg Lisk, 11 Robert Dr, Trenton ON K8V 6P2

Calgary Centre
c/o Telus World of Science, PO Box 2100 Stn M Location 73, Calgary AB T2P 2M5

Charlottetown Centre
c/o Brian Gorveatt, 316 N Queen Elizabeth Dr, Charlottetown PE C1A 3B5

Edmonton Centre
c/o Telus World of Science, 11211 142 St, Edmonton AB T5M 4A1

Halifax Centre
PO Box 31011, Halifax NS B3K 5T9

Hamilton Centre
576 - Concession 7 E, PO Box 1223, Waterdown ON L0R 2H0

Kingston Centre
PO Box 1793, Kingston ON K7L 5J6

Kitchener-Waterloo Centre
305 - 20 St George St, Kitchener ON N2G 2S7

London Centre
c/o Peter Jedicke, 82 Barrydale Cres, London ON N6G 2X4

Mississauga Centre
PO Box 98011, 2126 Burnhamthorpe Rd W, Mississauga ON L5L 5V4

Centre francophone de Montréal
C P 206, Station St-Michel, Montréal QC H2A 3L9

Montréal Centre
18455 Meloche St, Pierrefonds QC H9K 1N6

New Brunswick Centre
c/o Paul Gray,1068 Kingsley Rd, Birdton NB E3A 6G4

Niagara Centre
PO Box 4040, St. Catharines ON L2R 7S3

Okanagan Centre
PO Box 20119 TCM, Kelowna BC V1Y 9H2

Ottawa Centre
1363 Woodroffe Ave, PO Box 33012, Ottawa ON K2C 3Y9

Prince George Centre
7365 Tedford Rd, Prince George BC V2N 6S2

Québec Centre
2000 Boul Montmorency, Québec QC G1J 5E7

Regina Centre
PO Box 20014, Regina SK S4P 4J7

St. John's Centre
c/o Randy Dodge, 206 Frecker Dr, St. John's NL A1E 5H9

Sarnia Centre
c/o Marty Cogswell, 6723 Pheasant Ln, Camlachie ON N0N 1E0

Saskatoon Centre
PO Box 317 RPO University, Saskatoon SK S7N 4J8

Sunshine Coast Centre
PO Box 577, Sechelt BC V0N 3AO

Thunder Bay Centre
286 Trinity Cres, Thunder Bay ON P7C 5V6

Toronto Centre
c/o Ontario Science Centre, 770 Don Mills Rd, Toronto ON M3C 1T3

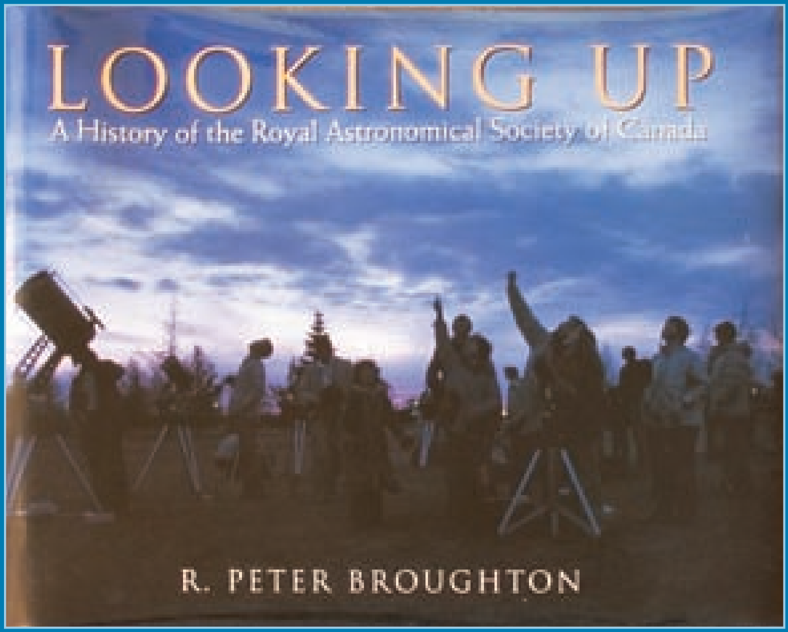
Vancouver Centre
1100 Chestnut St, Vancouver BC V6J 3J9

Victoria Centre
3046 Jackson St, Victoria BC V8T 3Z8

Windsor Centre
2831 Alexandra Ave, Windsor ON N9E 2J8

Winnipeg Centre
PO Box 2694, Winnipeg MB R3C 4B3

Great Reading



Looking Up Digitized

R. Peter Broughton's important and thorough *Looking Up: A History of the Royal Astronomical Society of Canada* (1994) has been digitized! Peter, a Past National President of the RASC and veteran of many positions on National Council (winner of the Service Award 1987), is a recognized historian of astronomy in Canada and the English-speaking world, with many publications to his credit. Thanks to the work of Walter MacDonald (Kingston Centre, Service Award 2009), *Looking Up,* long out of print and virtually unobtainable, is now available at www.rasc.ca/publications/lookingup/index.shtml

Don Fernie, in *Cassiopeia,* gave the work high praise: "If you count yourself a Canadian astronomer, this book is part of your heritage; you will be pleased to have it on your bookshelf." Now it can grace the shelves of virtual libraries around the world.

The passage of time has made the jacket image of *Looking Up* itself an intriguing artifact of Canadian astronomical history from the age of film emulsions. It was taken by Alan Dyer (Calgary Centre, winner of the Simon Newcomb Award in 2007), a renowned Canadian astrophotogapher and astronomy writer, a contributing editor of *Sky & Telescope, SkyNews,* and a collaborator with Terence Dickinson on acclaimed projects. Alan writes that the photograph was "taken at one of the 1970s Starnights we held annually in Coronation Park, Edmonton, outside the old Queen Elizabeth Planetarium. The Edmonton RASC and Planetarium organized Starnights each year, carrying on a tradition begun in the 1960s. The Starnights started as space exhibits at the Jubilee Auditorium, then in the 1970s when travelling NASA exhibits were no longer available, evolved into observing sessions in the Park, using portable telescopes supplied by the Planetarium and RASC members.

"The current Observing Deck at the TELUS World of Science-Edmonton, now 25-years-old this year, is a direct result of those events, giving the city a permanent home for public telescopes, to carry on the tradition of those early Starnights. Indeed, the Celestron 14 telescope depicted at left in the cover photo is still in use at the TWS Observing Deck. Hundreds of thousands of people must have looked through it by now (it has superb optics)."