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Journal

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Orbitus Astrologica: Astronomical Progress in Mediaeval Europe

Photometric and Polarimetric Measurements of the Saturn System

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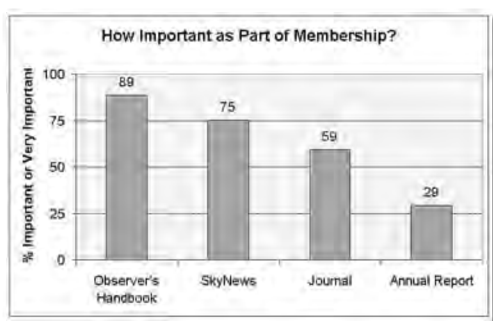

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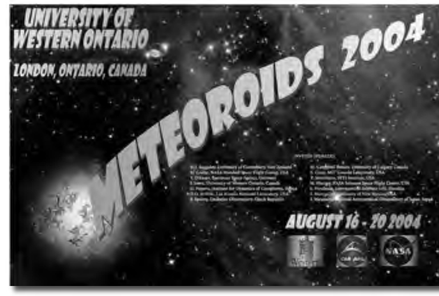

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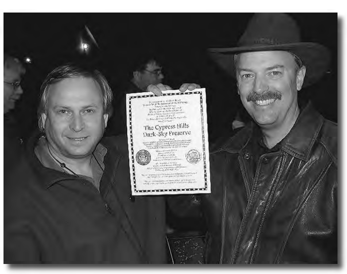

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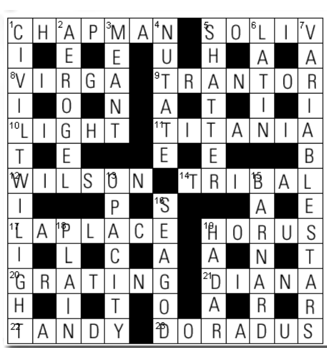

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Editorial

by James Edgar (jamesedgar@sasktel.net)

There is much happening these days at the RASC, with many new initiatives that could and should spark your interest. We have a new slate of officers in the Executive, and that always seems to bring on a fresh perspective to any organization. Our National President, Peter Jedicke of London Centre, in addition to the more mundane duties of being our great leader, promises to add that extra bit of zaniness for which he is famous. First Vice-President Scott Young of Winnipeg is grooming for President sometime down the road. Second V-P Dave Lane of Halifax Centre is grooming for Scott's job. Treasurer Dave Clark of London would like to have a tight rein (reign) over Society finances, but doesn't. And, finally, Kim Hay from Kingston is looking to help her new replacement get used to being National Secretary.

Apart from that, one of the biggest things going on right now within the Executive, Council, and Committees is analyzing the results of the 2004 Member Survey (conducted by the Membership and Promotion Committee, a.k.a. "MAP") and trying to decipher exactly what the results mean and how to implement positive change. These results can (and will) have far-reaching implications for all members, so listen and watch for the changes about to happen within the Society, many stemming from the answers given to the survey questions. Look online in the Members' section of the Web site `www.rasc.ca` to get the results of the survey. While you're there, look over the Observing page, where you can find a treasure-trove of information and helpful links. Look especially for the new Observing Section.

Seldom does the average member get to influence decisions at the top level in a large organization. But you can have a voice in what goes on in this Society; first by telling your National Council representative what you think and how to vote on your behalf at Council meetings; and second by exercising your vote at the Annual Meeting — if you can't be there in person, fill out a proxy for your NC Representative to cast on your behalf. The same goes for Centre meetings — the local Executive officers put long hours into preparing an interesting and informative agenda, so get out and participate!

Finally, and most importantly, get out under the stars and observe. If you don't have any equipment, inquire about getting the loan of a telescope or binoculars from your Centre; most have some kind of lending system. See if you can borrow a scope and some eyepieces from someone who has extras. Don't be afraid to ask questions of the older members; they were young once, too. And you "oldies," don't be impatient with the younger folks; you were young once, too — full of seemingly endless questions and lacking in basic knowledge. We all were. And we can all learn from each other, which makes this pastime of ours such a rewarding experience.

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.

The *Journal of The Royal Astronomical Society of Canada* is published at an annual subscription rate of $80.00 by The Royal Astronomical Society of Canada. Membership, which includes the publications (for personal use), is open to anyone interested in astronomy. Annual fees for 2004, $50.00; life membership is $1,000. Applications for subscriptions to the *Journal* or membership in the RASC, and information on how to acquire back issues of the *Journal* can be obtained from:

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Correspondence
Correspondance

General Assembly '05 Invitation and Call for Papers

The Okanagan Centre invites you to the 2005 General Assembly, the national convention of the RASC, at Okanagan University College in Kelowna on the May long weekend, from Friday the 20th through Monday the 23rd. Chairman Jim Tisdale and the GA organizing committee have planned a full program that will keep attendees busy. Some highlights are a Saturday dinner cruise on Okanagan Lake, a Sunday banquet at a winery located in a striking setting overlooking the lake, and a Monday tour of the Dominion Radio Astrophysical Observatory near Penticton (which includes a very scenic drive *en route*). As always, the main attraction of the GA will be the chance to chat about astronomy with devotees from all parts of the country for four busy days, from breakfast right through the late-night parties!

The invited speakers are Dr. Tyler Foster of DRAO, Ruth Northcott lecturer Dr. Jaymie Matthews of UBC, who will describe the science being done by *MOST* (Canada's astronomy satellite), world-famous astrophotographer Jack Newton, who will be the banquet speaker, and Andreas Gada who will describe the adventures that he and Bonnie Bird have had chasing total solar eclipses around the globe. Jack Newton and Rajiv Gupta will co-host an imaging workshop on Sunday afternoon.

In addition to the invited speakers and the workshop, paper sessions will be held on Saturday. This is your opportunity to share your astronomical experiences, knowledge, or research with us. Please express your interest to speaker coordinators Richard Christie and Alan Whitman at `rchristie@ouc.bc.ca` by March 29, including an abstract and stating how much time you will need to deliver your proposed presentation. Those chosen to speak at the paper sessions will be notified by early April and will know then how much time that they have been allotted, whether 20 minutes, 25 minutes, or 30 minutes. Once notified, that many minutes are guaranteed to you. No speaker will ever have their time allotment cut at the last minute, but on the other hand, no speaker will be able to exceed that time. Another option is to present your results in a poster paper — this is particularly well-suited to complex topics.

The organizing committee strongly encourages astronomy displays of any nature, such as astrophotography, planetary and deep-sky sketching, antique telescopes, meteorites, observatory plans, or? Surprise us. Secure display space and display boards will be provided.

Online registration, inexpensive accommodations at the college, and the details of GA events are available at: `www.ocrasc.ca/ga.html`.

If you do not have Internet access, please request registration information by mail from:

GA 2005
PO Box 20119 TCM
Kelowna BC V1Y 9H2

We hope to see you at the GA in May. We also suggest that you consider allowing a few days or a few weeks to enjoy all that the beautiful Okanagan Valley, western Canada's playground, has to offer. Kelowna International Airport, the country's ninth-busiest because of that tourist traffic, offers easy access. Alternatively, bring your automobile and enjoy spectacular mountain scenery enroute whether coming from the east or the west.

The '05 GA Organizing Committee

Errata:

In the August 2004 *Orbital Oddities* column (*JRASC*, 98, 171), an error occurred in the figures on page 171. The two distribution figures shown should have been labeled Figures 1a and 1b, as both pertained to the caption for Figure 1. Figure 2 was omitted in error, and is reproduced below along with its original caption.

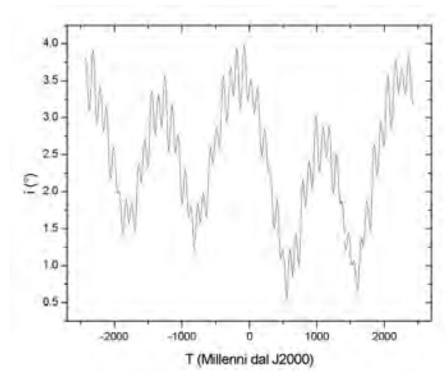


Figure 2 — The long-period evolution of the inclination of Venus displays a super-period of some 1.1 million years. Throughout the present era Venus is near its maximum value, and remains above 3° for several hundred thousand years. This forces the current arrangement of transits always occurring in singles or pairs. Half a million years hence, when the value of i recedes below 1 degree, transits will become much more commonplace. Figure graciously provided by Aldo Vitagliano was originally published in the Italian popular astronomy magazine *Coelum*.

In addition, on page 168 (middle column, last paragraph) a number of dates in the far future incorrectly show minus signs where dashes were intended. The segment should read as follows:

Vitagliano (2004) graciously replied that there will most likely be a triple transit in 166009-166017-166025, and more certainly in 170634-170642-170650 and then again 243 years later in 170877-170885-170893.

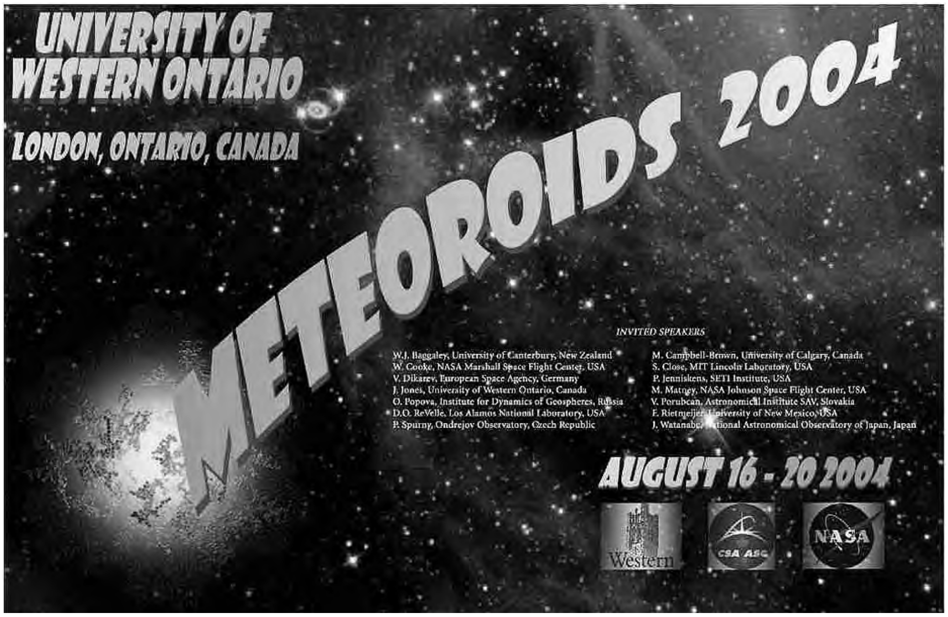
Give Me Some Latitude!

Dear Editor,

In his review of the book *Latitude: How American Astronomers Solved the Mystery of Variation* (*JRASC*, 97, 138), Barry Matthews writes that "The problem played particular havoc with those who worked at sea. The result was the loss of life, ships, and commerce." Of course the calculation of the position at sea was a difficult and important problem, but it concerned only the longitude. The latitude could be found rather easily, for instance by means of the sextant. Secondly, the so-called variation of the latitude is only a very small effect, not exceeding one arcsecond, corresponding to not more than 30 metres on the Earth's surface. I cannot imagine that due to this minuscule error ships could have been lost.

Jean Meeus (Belgium)

News Notes
En Manchettes



METEOROIDS 2004 CONFERENCE

This past August the Department of Physics and Astronomy at the University of Western Ontario in London played host to the Meteoroids 2004 conference. The conference was the fifth in a series of meetings, concerned with all aspects of meteor physics research, that have been held every few years since 1992, the last gathering being held in Kiruna, Sweden in 2001.

The conference accommodated a broad range of talks related to meteoritic research with presentations ranging from the dynamics, sources, and distribution of meteoroids in the Solar System to the chemistry and physical processes in the interplanetary medium. A number of researchers presented talks on the physics of meteoroid interactions with the Earth's atmosphere, while others considered the problem of meteoroid impacts upon spacecraft and the hazards associated with space exploration. Other topics discussed and reviewed at the conference related to observational methods, the detection of interstellar meteoroids, the development of computer models to describe meteoroid stream evolution, and the laboratory study of meteorites, micrometeorites, and interplanetary dust. The next meteoroids conference will be held in Spain in 2007.

QUANTUM COMPUTING — SMALLER, FASTER, AND MORE POWERFUL

We live in a world where it seems that computer technology just keeps on advancing — but silicon-based improvements can't last forever. "Moore's Law" predicted how quickly inventors could miniaturize wires, transistors, and chips. But around the year 2020 computer circuitry will have shrunk down to the size of mere atoms and molecules. In this quantum world, the physical laws we're used to break down. Our classical laws of nature won't apply. Fortunately, there is a way to adapt to the new paradigm and exploit the differences. Digital information, for example, doesn't have to flow as just "ones" or "zeros." It can be both "ones" and "zeros" at the same time! This is called "Superposition." Harnessing this new dynamic will create a language "beyond digital" and is one reason why quantum computers will have unimaginable power.

Raymond Laflamme and his research associates at the Institute for Quantum Computing (IQC) are one group working in the area of quantum computing and an overview of their work was presented at the CASCA/CAP meeting in Winnipeg this past June. The IQC labs and associated international researchers are the focus of a one-hundred million dollar public/private initiative on campus at the University of Waterloo. The inventor of the RIM "Blackberry" email device, Mike Lazaridis, personally donated over 33 million dollars to get the research started.

The experiments build on Laflamme's earlier work at Los Alamos National Laboratory in New Mexico. Laflamme says their work "is akin to the early experiments of the '40s in which the first computers were made from entire rooms filled with transistor tubes — and were about as powerful as a modern hand-held calculator." In other words, these researchers are using big equipment — large superconducting magnets and racks of electronics — to manipulate just a handful of quantum bits, or "qubits." They use a technique called nuclear magnetic resonance (NMR) in which liquid or solid samples (about 1 centimetre in scale) are placed in very large magnetic fields (about 100,000 times the earth's magnetic field). Because nuclei have a quantum property called "spin," which makes them slightly magnetic, the large field slightly orients these little nuclear magnets along its direction. This bias towards one direction or another allows the experimenters to manipulate and read the "spin" quantum state. The spin "up" is akin to a "one." The spin down is like a "zero."

While Laflamme's pioneering work has been carried out with liquid samples to date, future solid-state devices are anticipated. So Laflamme set up part of his lab at IQC to accommodate solid-state NMR experiments, headed up by post-doctoral fellow Jonathan Baugh. Baugh says "in the liquid state we have been able to demonstrate control of the evolution of small quantum system, in the solid state we'll be able to set up the initial state in an efficient manner and gain control on much larger systems. We are at present demonstrating the building blocks of this new approach." The control techniques now being developed by Baugh and Laflamme are at the cutting edge and will have applications in the quantum world beyond the NMR systems.

Quantum computers will be able to solve complex problems that modern-day computers can't. For some problems we already know the power is exponential. That means if one quantum computer has the power of 10 classical computers, two quantum systems will have the power of 100 modern-day units, three quantum machines will equal 1000, and so forth! For example, quantum computers will be superb at factoring large numbers. Numbers so large — even secret government codes could be cracked. On the other hand, quantum mechanics provides perfectly secure protocols — part of a closely related new field known as "quantum cryptography." In fact, the very nature of quantum information ensures it can't be hacked because the act of snooping changes the quantum data!

Just as the steam engine jump-started the Industrial Revolution, and controlling electromagnetic waves brought us modern-day communications, the world is now entering a new era — the Quantum Age. This will be the century we outgrow Moore's Law and learn to exploit stranger new laws inside the atom — like quantum superposition — to process and store information.

Figure 2 — Raymond Laflamme (right) and Mike Lazaridis (inventor of the RIM Blackberry) shake hands following the announcement of Mike's $33.3 million personal donation for quantum computing research at the IQC. The two are standing in front of the 16.5 Tesla NMR magnet in one of the IQC labs. (photo: Chris Hughes)

STUDYING ANTIHYDROGEN

Scientists from York University and collaborators from as far a field as Harvard University, Forschungszentrum Juelich, Max-Planck-Institut fuer Quantenoptik in Garching, and Ludwig-Maximilians-Universitaet in Munich, Germany have been working at CERN in Geneva with the aim of producing trappable antihydrogen atoms. An overview of their experimental research was presented at the recent CASCA/CAP meeting in Winnipeg this past June.

Using purely mathematical considerations Paul Dirac predicted the existence of the antielectron in the late 1920s. Since then it has become a well-established fact that for each elementary particle — and thus for the constituent particles of matter atoms — there exists an antiparticle with equivalent properties, such as mass, but with opposite electrical charge. Appropriately 100 years after the birth of Paul Dirac in 1902, the researchers have succeeded in producing thousands of "cold" antihydrogen atoms.

When, in 1996, the first observation of a few high-velocity atoms of antihydrogen was reported it was realized that these atoms where probably the most expensive elements in the world; however, speculation on them for financial gain was not advised. Though being unrealistic, this substance is known as the dream material for rocket propulsion in science-fiction movies. Antihydrogen is, however, most valuable for studies in science to answer fundamental questions of physics: symmetry, natural constants, gravity, and the existence of the Universe consisting solely of matter. Hydrogen is the simplest matter atom with an electron orbiting a proton. Antihydrogen atoms are the simplest antimatter atoms. The antihydrogen atom is formed when replacing the proton with its antimatter counterpart, the antiproton, and the electron with its antimatter counterpart, the antielectron or positron. Though presently accepted theorems in physics predict the identity of such systems, the inequality of matter and antimatter existence in the universe would require that differences between them exist or at least existed during the history of our Universe.

NORTHERN BRUCE PENINSULA PROCLAIMED A "DARK SKY COMMUNITY"

"This is just wonderful!" said local resident and avid astronomer Doug Cunningham as he praised what he termed an historic decision to proclaim the Municipality of Northern Bruce Peninsula a "Dark Sky Community." The municipality is about three hours northwest of Toronto and is quickly building a reputation as a "natural retreat" destination.

Cunningham has been quietly plugging away for several years in an effort to raise awareness of the problems related to light pollution and the loss of our ability to appreciate the night sky — not to mention its effects on our health. He rarely turned down a chance to meet with groups or individuals to explain the increasing encroachment of unnecessary or inappropriate outdoor lighting on the night environment, and to point out the simple things that could be done to limit its negative impacts. The Bruce Peninsula Environment Group (BPEG) joined the cause and began seeking support for the concept of a "dark sky" area on the Peninsula, one of the few places in southern Ontario that hasn't succumbed to the "night-glow" that emanates from so many municipalities. BPEG Members Graham Thomas and Don McIlraith put in many hours researching the problems and providing the local Council and community with information.

At its August 23, 2004 meeting, Council responded with a proclamation that recognizes the need for exterior lighting but also endorses and encourages the application of dark sky compliant practices. Councilors Tom Boyle and Betsy Stewart both later commented that Council had been concerned with the issue for several years and they were pleased to finally see something in place. "It's a great start!" said Boyle. Stewart echoed these sentiments. "I'm happy to see this come to pass," she said, "and hopefully we can now work towards a by-law once all the bits and pieces are in place."

It has been the Municipality's practice for some time now to install, retrofit, or replace municipal lighting with dark-sky-friendly fixtures that ensure light falls where it's needed — eliminating glare and stray light (referred to as light trespass), while at the same time saving money and conserving energy. The proclamation calls for future site plans and subdivision agreements to be reviewed by Council to "encourage the use of dark-sky compliant practices for exterior lighting." Deputy Mayor Patricia Greig, who chaired Monday's session, said she was pleased that Council was able to take action now, before the issue of light pollution becomes a bigger problem.

The proclamation is the first for a municipality in Bruce and Grey Counties and calls for other local governments to consider taking similar action. With this first step Northern Bruce Peninsula has joined an ever-growing group of communities around the world that recognize the need to preserve, protect, and enhance our use and enjoyment of the natural environment of the night.

DRAFT DARK SKY PROCLAMATION

MUNICIPALITY OF NORTHERN BRUCE PENINSULA

WHEREAS, outdoor lighting is needed for a variety of purposes to the benefit of our community including: enabling people to undertake work or recreational activities at night; facilitating the safety and security of persons and property; emphasizing features of architectural or historical significance; and advertising and promoting locations, products and services or calling attention to commercial premises by way of area lighting or signs; and

WHEREAS, dark-sky compliant outdoor lighting practices will preserve, protect, and enhance our community's use and enjoyment of the natural environment of the night by: eliminating hazardous and annoying glare from poorly designed light fixtures; reducing light trespass by installing light fixtures in locations that prevent light from unnecessarily falling outside the boundaries of the property on which a light fixture is installed; and minimizing light pollution from unnecessary and inappropriate use of lighting fixtures which result in the degradation of the night-time environment; and

WHEREAS, dark-sky compliant outdoor lighting practices will conserve energy and resources; and

WHEREAS, the Bruce Peninsula is a unique location in North America where people can still experience the wonders and benefits of the dark night sky and preserving this will ensure the quality of life, good health, safety, and economic well-being of its residents and the general public; and

WHEREAS, the Bruce Peninsula is increasingly becoming a popular "Natural Retreat Destination" for tourism and is already designated by UNESCO as a "World Biosphere Reserve" and protecting and encouraging the appreciation of the dark night sky is in keeping with the spirit of these initiatives; and

WHEREAS, proclaiming the Municipality of Northern Bruce Peninsula a "Dark-Sky Community" will protect our night-time environment and promote our community identity; and

WHEREAS, the Municipality is prepared to lead by example and is committed to improving where necessary, by retrofitting or replacement, all municipal lighting to ensure dark-sky compliance; and

WHEREAS, the Municipality shall, through the review of future exterior lighting within Site Plans and Subdivision Agreements and by the education of all property owners to the benefits, encourage the use of dark-sky compliant practices for exterior lighting.

NOW THEREFORE, BE IT RESOLVED THAT the Corporation of the Municipality of Northern Bruce Peninsula hereby proclaims this Municipality as being a "Dark-Sky Community"; and

THAT this Municipality formally request that the County of Bruce include a dark-sky policy within their Official Plan to ensure compliance by all future developments and also encourage all other Bruce County municipalities to consider adopting similar proclamations; and

THAT this proclamation be forwarded to the Provincial and Federal Governments and UNESCO for their information and future support and recognition of this position.

BY THE LIGHT OF A QUASI MOON

Following hot on the announcement a few months ago that Venus has a quasi-moon (minor planet 2002 VE_{68}), Martin Connors (Athabasca University) and co-workers from across Canada, the USA, and Finland have recently announced in the August issue of the journal *Meteoritics and Planetary Science* that the Earth too has a quasi-moon. The new moon, minor planet 2003 YN_{107}, is not an obvious naked-eye object, its size being estimated as a lowly 20-m across. The results presented by Connors *et al.*, follow a detailed numerical study of the dynamical behaviour of 2003 YN_{107}. The term quasi-moon indicates that the moon is actually in orbit about the Sun, but that due to its orbit being nearly identical to that of the Earth's (at the present time), 2003 YN_{107} spends extended periods of time close to the Earth. The numerical studies by Connors and co-workers indicate that 2003 YN_{107} will remain within 0.1 AU of the Earth until about 2006. Discovered on December 20, 2003 by the LINEAR project, as a magnitude 18.8 object, 2003 YN_{107} adopted its present quasi-moon status in 1997.

Call for Nominations — Secretary of the Society

The term of the current Secretary of the Society, Kim Hay, will be expiring at the RASC Annual Meeting on May 22, 2005. A new Secretary will be elected (or acclaimed) at this meeting. Candidates must be presented, to the Secretary, by the RASC Nominating Committee or by a private nomination supported by the signatures of five members of the Society, at least 60 days prior to the Annual Meeting. As chair of the Nominating Committee, I invite you to send suggestions for our new Secretary to me for the Nominating Committee's consideration. Please send any suggestions by email, no later than January 31, 2005.

The duties of the Secretary are specified in the Society's bylaws, which are available in the password-protected portion of the RASC website.

Rajiv Gupta
Chair, Nominating Committee

RASC Membership Survey – What you said

By Denis Grey (denis.grey@sympatico.ca) and John Hrycak (john.hrycak@sympatico.ca)

As most RASC members are aware, a comprehensive membership survey was conducted from May-July 2004. The purpose of this survey was to answer some key questions about the Society and its membership as the Society adjusts to financial pressures and the impact of electronic publishing and service delivery.

As an indication of the vitality of the RASC and the dedication of its membership the authors are pleased to report that 953 surveys were returned representing almost 20% of the national membership and providing a low error level of plus or minus 3%, 19 times out of 20. All Centres were well represented. It is useful to consider that the percentages stated in this article are based on our membership of almost 5000 members.

The survey was designed to address a number of critical questions including:

1. What value does the membership place on the various publications delivered by the RASC?
2. What are the feelings of RASC members towards increased membership fees to support programs and services?
3. What opportunities exist for non-fee-based revenues such as donations and bequests?
4. What is our current membership profile?
5. How "computer-savvy" is our membership and are we ready to embrace more programs and services delivered via email and the Web.

In addition to addressing these primary issues, the survey also provided a forum for comments to be delivered to our National Council. These comments have been gathered by the survey subject areas and, where appropriate, tagged by Centre or Region and forwarded to Councillors for review.

Overall Results

The first question was "Considering the services and benefits that you receive as a member of the Royal Astronomical Society of Canada (RASC) and the amount you pay for your annual fees, how satisfied are you with the overall value of your RASC membership."

This question was important to provide a benchmark for the rest of the survey since it was asked "before" the participant saw the remaining survey details and questions. The results were very gratifying to anyone who appreciates our Society and all of the volunteers who contribute so much to its operation. A whopping 90% of members who answered this question were either "Satisfied" or "Very Satisfied" with their membership experience and value for money.

Publications

The next question area answered asked relative value questions about the four major publications currently part of RASC membership: the *Journal, SkyNews,* the *Observer's Handbook,* and the *Annual Report.* Here the issue was "how important is it that a specific publication be part of your membership." The results were clear in that the *Observer's Handbook* and *SkyNews* were most valued while the *Journal* and the *Annual Report* were less so.

Many members expressed the opinion that the *Journal* and the *Annual Report* could be delivered electronically. One of the initiatives being considered is putting the necessary infrastructure in place to support this type of delivery option. At the present time the national membership management system cannot support a Web-enabled interface for members. (*Editor's Note: A new Web-based system to enable early access to the* Journal *has been initiated with this issue; see the October issue, page 182.*)

Membership Fees and Benefits

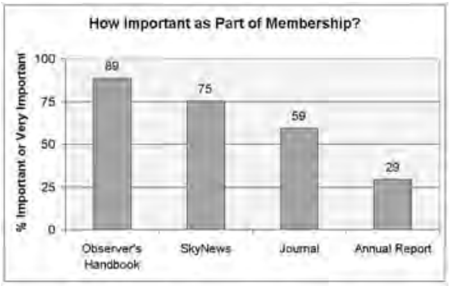
The survey then turned to the value-for-money question more directly and attempted to ascertain the willingness of RASC members to pay more (if necessary) to sustain current service levels. Under the shared financing structure of the RASC only 60% of a fee increase goes to offset costs at the national level. As a result the $6.00 increase approved on July 1, 2004 will result in only a $3.60 increase to offset increased costs at the national level. The results of these questions were enlightening in that they revealed almost 2/3 of members are willing to consider additional fees versus reduced service levels.

The next part of this section addressed four specific options that would likely be considered by National Council. They were:

- "Unbundling" of *SkyNews;*
- Making the *Observers Handbook* an optional membership benefit;
- Reducing the size and/or frequency of the *Journal;* and
- Reducing or restricting various program expenses (committees, council, etc.)

Of these four options, the strongest preference was expressed for a reduction in the size and scope of the *Journal.* Strongest support was for maintaining the existing arrangements with both the *Observer's Handbook* and *SkyNews.*

A final question was the willingness of members to see fees increased to maintain services. While most members indicated a willingness to pay higher fees this was not without limits as two thirds indicated they were in the $0 to $10 range.



Donations / Non-Fee Revenue

As a registered charitable organization the RASC is entitled to receive donations and issue tax receipts for donations when received. Historically this has not been a strong emphasis of the RASC but, as an alternative to fee increases and a way of raising funds for special projects, it was felt that this might be a viable option for the Society.

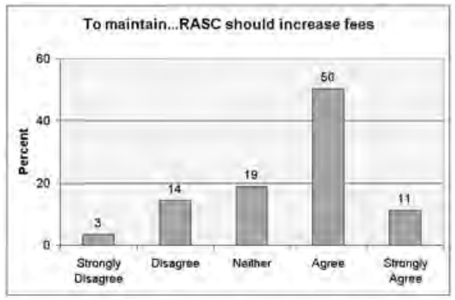
Twenty-one percent of members responded positively to including the RASC as part of a planned giving strategy (essentially leaving a bequest to the Society in their will). Twenty-eight percent of members were willing to consider annual donations to special-project funds. Finally, 21% of members were open to the idea of a "Sustaining Membership" that would be made up of a regular membership plus a donation to the Society. From this information it can be concluded that this area does hold some promise in terms of future financing for the RASC and its programs and that this area needs to be investigated further.

Membership Profile

To better serve our membership it is important we understand its characteristics. To this end a series of demographic questions were asked to provide a baseline of information on the Society. Future surveys will be able to use the same questions to gauge how the Society's membership is evolving.

A typical member has been a member of the RASC for 4-7 years, is between 46-65 years of age and considers him or herself to be an "intermediate" astronomer in terms of their expertise. The membership is also highly educated (as one would expect in a scientific organization) with more than half reporting one or more university degrees.

As the chart below shows there is a very diverse range of interests in the Society with



strong focus on planetary and lunar studies along with deep-sky observing, galaxies and the like. Cosmology and astrophysics also earned high degrees of interest, which suggests that additional programming in this area might be welcomed.

On-line Access and Usage

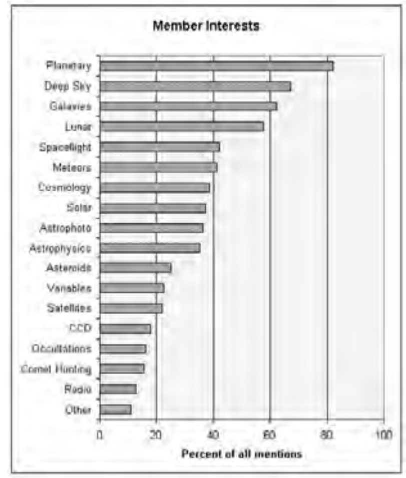
The final major area in the survey was a series of questions related to Internet access and usage. Two questions related to access (*i.e.* the availability of high-speed services) and two more addressed *usage*, in the sense that the respondent was already choosing to access and use a lot of information on-line. The results here were quite compelling in that fully 92% of the membership indicated that they have on-line access and the majority (65%) of those have high-speed services. This suggests that the membership is ready for more on-line services.

Next Steps

The results of this survey along with the raw data have been made available to National Council and all committees for their analysis. A clear consensus exists on Council for the Society to make the necessary adjustments to ensure that we provide excellent value and service to the membership and are financially viable into the long term. The Information Technology, Finance, Membership and Promotion, and Publications Committees will all be working in conjunction with Council and the Executive to put forward specific plans and initiatives to address the financial constraints affecting the Society over the next few months.

Special Appreciation

The authors would like to thank the following members of the RASC, Toronto Centre for



their assistance with the survey project:

Andy Beaton
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John MacRae
Ostap Mojsiak
Bhairavi Shankar

Each member of this team contributed many hours to enter all of the data and comments into a format that could be used by the analysis team. Special thanks are due to *Geoff Gilmour-Taylor* for his creation of the portable data entry software that allowed the survey results to be captured for analysis. Thanks are also due to our team at National Office (*Bonnie Bird* and *Issac McGillis*) who provided logistical support and ensured that the survey was printed and distributed very rapidly to allow for preliminary results to be delivered to National Council by July 2, 2004 and for the whole process to be completed by August 31, 2004.

Finally, additional thanks are due to members of National Council from across the country too numerous to name who provided very helpful feedback and assistance during the design and preparation process for the survey. (Note: The complete survey can be accessed from the RASC Web site, members-only section, at`www.rasc.ca/private/home.html#2004september.`)

Denis Grey is a member of the Toronto Centre and Chair of the Membership and Promotion Committee of the RASC.

John Hrycak is a member of the Kitchener-Waterloo Centre of the RASC and is a survey professional.

Oblitus Astrologia: Astronomical Progress in Mediaeval Europe

by Robert A. Egler (robert_egler@ncsu.edu)

The Middle Ages, while hard to define accurately, are generally viewed by modern scientists as a period of near-complete intellectual stagnation, especially in the areas of science and technology. This was especially brought to my attention when, in reviewing a proposed astronomy textbook, I noted that the author stated that, during the "dark ages" between the fall of Rome (AD 476[1]) and the beginning of the Italian Renaissance (*c.* 1450[2]), nothing of any scientific importance was accomplished in Europe, although Europeans did acquire some scientific knowledge from the Arabs. As a long-time student of European mediaeval history, I feel the need to correct this common misconception about my favourite era of study.

First, the term "dark ages," coined during the Renaissance, is not generally used today among scholars of the mediaeval period. Although there is some debate among mediaevalists as to the start and end of the Middle Ages, for the purposes here it will do to use the term "mediaeval period" to mean the time between AD 800 and AD 1453.[3]

Contrary to popular imagination, societies and learning were not stagnant during the Middle Ages. There were considerable differences in societal relationships between, for example, 1066 and 1200. Armour, dress, and hairstyles were different as well (despite Hollywood's use of generic "mediaeval" costumes for anything set during that 600 year period.)

Additionally, we have only to note that the concept of the university was developed in mediaeval times to see that scholarship also was not stagnant in the period.[4]

But what about science, and especially astronomy itself? I don't think anyone familiar with the period will claim that the Middle Ages were a time of great advances in science in Europe. Certainly much of mediaeval astronomy was imported by contacts between western Europeans and the native population of Outremer, the Christian territories seized from the Arabs during the crusades. But it is not the case that there were no genuine, original contributions to science by mediaeval Europeans, and here are a few examples of such work.

De composicione Astrolabii and De usu astrolabii by Christannus de Prachaticz. Christannus, born in Bohemia around 1360, attended the University of Prague, receiving a bachelor's degree in 1388, and served intermittently as Rector of the University between 1405 and 1434. He is best known for his medical works, along with his theological activities, but he also had contributions to astronomy, chiefly two treatises: *De composicione Astrolabii* (On the composition of the Astrolabe) and *De usu astrolabii* (On the use of the Astrolabe).[5] These works were not simply copied from Arabic sources (which Chaucer's treatise on the astrolabe is suspected to be)[6], but rather original works that were considered "...new and quite good use of the astrolabe..."[7], and which were influential in the later development of astronomical instruments, and were in fact used well into the 16th century.

The Astronomical Clock of Prague, dated to 1410, and built by Nicolaus Kadan in collaboration with the astronomer Johannes Andreae.[8] This justly famous clock shows the revolution of the Sun, the revolution of the Moon (by rotating a half-silvered and half-black ball), and the revolution of the stars.

Canones pro eclipsibus Solis et Lune per... (The rules for a calculation of the eclipses of the Sun and Moon by...) by Johannes Andreae (*ca.* 1400-1420), where he describes a new instrument to determine the dates of eclipses. The great Tycho Brahe (1546-1601) himself later stated that Johannes Andreae had also performed valuable astronomical observations.

De Iride and ***De Natura Locorum*** by Robert Grosseteste (*ca.* 1230), which are works on optics. Grosseteste was educated at Oxford and served as Chancellor from 1215 to 1221. He eventually became the Bishop of Lincoln. Grosseteste believed that a theory must be verified by experimental testing, and in *De Iride* he writes an interesting account of using a lens as both a telescope and a microscope (although he didn't use those words):

> "This part of optics...shows us how we may make things a very long distance off appear as if placed very close,...and how we can make small things placed at a distance appear any size we want, so that it may be possible for us to read the smallest letters at incredible distances, or to count sand, or..., any sort of minute objects."[9]

The Alphonsine Tables (*ca.* 1252), were the work of about 50 astronomers working under the patronage of, and at the request of, Alfonso X of Castile. The Alphonsine tables, tabulating the positions and movements of the planets, are a revision and considerable improvement on the older Ptolemaic tables.

Tractatus de Sphaera (Tract on the Spheres), written by Johannes de Sacrobosco in 1220. *Tractatus de Sphaera* is a four chapter book on astronomy, which deals with the place of the Earth in a spherical universe, the motions of astronomical objects in the sky, the rising and setting of astronomical bodies as seen from different places on the Earth, and a discussion of Ptolemy's theory of the motions of the planets.[10] This was the most widely used textbook on astronomy up until the early 17th century. In 1232, Johannes also wrote a book about time, concentrating on the day, week, month, and year as well as Lunar time, in which he points out that the Julian calendar was 10 days in error and should be corrected, a correction for which he suggests a specific revised calendar to keep the year from slowly advancing.

In ***Planisphaerium*** (The Planisphere), Jordanus Nemorarius (ca. 1250) makes the first suggestion of which I am aware to use letters to denote the brightness of stars, somewhat similarly to the later Bayer system, which of course is still with us today.[11]

Measurement of Angular Separations was a problem greatly helped by the invention of "Jacob's Staff" by Spanish astronomer Levi B. Gershon, (*ca.* 1300) an instrument used by astronomers for that purpose, and used by navigators well into the 18th century.[12]

A more accurate distance to the stars was another achievement of Levi B. Gershon. He did not believe in relying on the measurements of other people, preferring to measure everything himself, and so he did not trust Ptolemy's or Hipparchus' tables. During an era when the general thought was that the stars were on a sphere just beyond the Moon, Gershon estimated that the true distance to the stars was ten-billion times greater, or at least 100 light years if we use modern units of measurement. Additionally, and unusual for his time, he wrote that "...no argument can nullify the reality that is perceived by the senses,...reality need not conform to opinion."[13] And although no one at the time believed him on the subject, he observed the slight variation of the angular separation of two stars, measured at two different times in the same year at different altitudes, from which he concluded that the Earth's atmosphere must slightly bend the light when objects were near the horizon — **Atmospheric refraction**.

The works briefly mentioned above are not, of course, an encyclopaedic collection of mediaeval contributions to astronomy, but they clearly show that the Middle Ages were not a time of utter stagnation in the field, even if most of their contributions have been absorbed into later works and have not propagated to us as distinct works in and of themselves.

In addition to the papers listed in the notes, I might also recommend the following books for people interested in the science and technology of this fascinating period:

White, Lynn 1962, *Medieval Technology and Social Change* (Oxford University Press)

Duhem, Pierre 1985, *Medieval Cosmology: Theories of Infinity, Place, Time, Void, and the Plurality of Worlds* (University of Chicago Press)

And of course a visit to the Museum of the History of Science, at Oxford, either in person, or virtually (`www.mhs.ox.ac.uk/exhibits/index.htm`) is highly recommended! One current virtual tour is "Scientific Instruments of Medieval and Renaissance Europe" (`www.mhs.ox.ac.uk/epact/`), which brings together instruments from the Museum of the History of Science, Oxford, the British Museum, London, The Museum of the History of Science, Florence, and Museum Boerhaave, Leiden.

Notes:

1 The actual date of the fall of the Roman Empire can be debated. The date given here is from Gibbon, Edward, *The History of the Decline and Fall of the Roman Empire*.

2 It is impossible to fix a specific date for the beginning of the Renaissance, although it is generally thought of as beginning around 1450 in northern Italy, and spreading to the rest of Europe by the end of the century.

3 AD 800 is a completely arbitrary, although somewhat common, date to use as the start of the mediaeval period. AD 1453 is often chosen as the end of the Middle Ages as this was the year of the fall of Constantinople.

4 Paris, Oxford, and Cambridge formed *ca.* 12th century, as examples.

5 Hadravova & Hadrava, *Astronomy in medieval Latin manuscripts and old prints I*

6 Gunther, R.T., *Chaucer and Messahalla on the Astrolabe,* Early Science in Oxford 5

7 Hadravova & Hadrava, *Astronomy in medieval Latin manuscripts and old prints I,* quote from mediaeval manuscript from Kalosca.

8 Andreae is also known as Sindel,

Hadravova, and Hadrava, *Astronomy in medieval Latin manuscripts and old prints II*

9 J.J. O'Conner & E.F. Robertson, *Robert Grosseteste*

10 J.J. O'Conner & E.F. Robertson, *Johannes de Sacrobosco*

11 J.J. O'Conner & E.F. Robertson, *Jordanus Nemorarius*

12 Yuval Ne'eman, *Jewish Astronomy in Sefarad (Spain)*

13 P. Veron & J.C. Ribes, *Les Cometes*

Robert Egler is an unattached member of the RASC, and is now prohibited by his wife from commenting on the historical inaccuracies during any film or TV show covering mediaeval times.

Reflections

Solon Irving Bailey

by David M.F. Chapman (dave.chapman@ns.sympatico.ca)

Figure 1 — Solon Irving Bailey, a Harvard astronomer (1854–1931).

The Man

December 29 of this year is the 150th anniversary of the birth of Solon Irving Bailey (1854–1931), a distinguished American astronomer noted for his observations of RR Lyrae variable stars and the discovery of an asteroid. (Do not confuse him with British astronomer Francis Baily (1774–1844), who discovered the phenomenon of "Baily's beads" observed during solar eclipses. For those who keep *JRASC* back issues, the April 1999 *Reflections* column tells his story.) Although Solon Bailey is not well known, he had a profound impact on the development of astronomy, as we shall see.

Bailey was born in Lisbon, New Hampshire, and studied at Boston University and Harvard University. He began working at Harvard College Observatory (HCO) as an unpaid assistant in 1887, eventually becoming Acting Director in the years 1919–1922. He occupied the Philips chair of astronomy at Harvard during the years 1913–1925. In 1931 he wrote a history of HCO.

The Harvard College Observatory has a presence online at `cfa-www.harvard.edu/hco`.

Harvard's "Boyden Station" in Arequipa, Peru

Wealthy Boston inventor and mechanical engineer Uriah Atherton Boyden (1804–1879) left $250,000 to any astronomical institution that would build an observatory on a mountain having better atmospheric-seeing conditions than those available at

Figure 2 — Harvard College Observatory's Boyden Station at Arequipa, Peru.

conventional observatories at the time. His heirs challenged the will, but it was found to be valid. In 1887 the trustees of the Boyden estate awarded the Boyden Fund to HCO, having been persuaded by the Director, Edward Charles Pickering (1846–1919) to build two observatories, one in the northern hemisphere and one in the southern hemisphere, so that the entire celestial sphere could be studied with enhanced scrutiny.

University of Toronto emeritus professor J. Donald Fernie has written three excellent, comprehensive articles on HCO's quest for clear skies in the south, full of detail and anecdotes. They are available online in the *American Scientist* archives: go to `www.americanscientist.org/template/Index` and type "Harvard in Peru" in the search engine. These are highly recommended.

Put in charge of the expedition to find a southern observatory site, the 33-year-old Bailey left for South America in 1889 with his wife, his son, his brother, and 100 crates of equipment and supplies. Their 2-year journey was arduous and the expedition endured bouts of sickness, episodes of bad weather, and political unrest. After considering several sites, they settled on Arequipa, Peru. The founding expedition over, the HCO sent William Pickering (brother of the Director) to head up the station and oversee the construction, while Bailey's party returned home. This choice of station head proved to be disastrous, and Bailey returned to Arequipa in 1893 to take over.

The bulk of the work at the Boyden Station consisted of taking photographs of deep-sky objects such as galaxies, globular clusters, and gaseous nebulae. Bailey also kept comprehensive records of weather conditions. On June 30, 1902, working from Arequipa, Bailey discovered minor planet (504) Cora, also called 1902 LK by modern convention. Taking advantage of the southern skies, Bailey extensively observed RR Lyrae stars in globular clusters.

Cepheids and RR Lyrae Stars

Cepheid variables are named for the group's prototype, delta Cephei, which varies between magnitudes 3.6 and 4.3 in a period of 5.4 days. They are yellow-giant stars that radiate 10,000 times as much energy as the Sun. The period-luminosity relation of Cepheid variables was discovered in 1912 by Henrietta Leavitt (1868–1921) of HCO, working with photographic plates of the Small Magellanic Cloud taken at Boyden Station (likely under Bailey's direction). The relation correlates the period of the variable star to its absolute magnitude. Hence, measuring the *apparent* magnitude of a known Cepheid allows an estimate of its relative distance. Fortunately, Cepheids are common and very luminous, and it is possible to identify individual Cepheids even in other galaxies. This property was later put to good use by Harlow Shapley to investigate the size of our galaxy and by Edwin Hubble to estimate the distance to other galaxies.

Similar to the Cepheid variables, RR Lyrae stars are pulsating variable stars often found in globular clusters or elsewhere in the galactic halo. They are yellow or white giant stars with short periods of 0.2 to 2 days, and relatively large brightness variations of 0.3 to 2.0 magnitude. Some of them have period-luminosity relations that serve as a distance indicators, like Cepheid variables. (At various times, they have been called cluster variables, cluster Cepheids, or short-period Cepheids.) However, RR Lyrae variables are older, less massive, and fainter than Cepheids. Their absolute magnitudes are several units fainter than the Cepheids, limiting their usefulness as cosmic yardsticks.

It was Solon Bailey who suggested to the young Harlow Shapley (1885–1972) that the Cepheids could be used to estimate cosmic distances, and in particular the RR Lyrae stars in the case of globular clusters. This suggestion paid off, and in 1917 Shapley was able to demonstrate that the Milky Way was of the order 300,000 light years across, much larger than anyone had imagined before. The story of how Edwin Hubble (1889–1953) extended this concept to estimate distances to other galaxies was told in the December 1999 *Reflections*. The distinction between Cepheid variables and the RR Lyrae variables was not initially recognized, and later work by Walter Baade (1893–1960) in the 1950s corrected the distance to the Andromeda Galaxy and other galaxies. Not only was the Andromeda galaxy even more distant than Hubble had determined, it turned out to be bigger than our own, a bit of a let down!

Epilogue

Solon Irving Bailey and his wife Ruth had a son, Irving Widmer Bailey, who grew up in South America. Subsequently, he studied at Harvard College and became a distinguished professor of forestry. Irving had a side career as a defence scientist during World War I, advising on the best woods for aircraft manufacture and training engineers on the art of camouflage.

After Solon Bailey's death in 1931, Annie J. Cannon wrote an appreciation of his life and work in the *Publications of the Astronomical Society of the Pacific,* Volume 43, page 317, available online at `adsabs.harvard.edu//full/seri/PASP./0043//0000317.000.html.`

David (Dave XVII) Chapman is a Life Member of the RASC and a past President of the Halifax Centre. By day, he is a Defence Scientist at Defence R&D Canada — Atlantic. Visit his astronomy page at `www3.ns.sympatico.ca/dave.chapman/astronomy_page.`

Locations for the Next Generation of Big Telescopes

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

Where should the next big telescopes be built? That sounds like a question with a straightforward answer: "wherever seeing conditions are best," but it's a little more complicated than that. Michael Ashley of the University of New South Wales and his colleagues there and at the Cerro Tololo Interamerican Observatory have found a place in Antarctica where the seeing is phenomenal (see September 16, 2004 issue of *Nature*). An optical interferometer (like the Very Large Telescope in Chile) could do from that location projects that otherwise could only be done from space. But other factors are important in selecting a site for a working observatory.

As with many things in life, there are trade-offs. If an infinite amount of money were to be made available, then probably the south pole of the Moon would be the preferred spot for many kinds of astronomy, but not all. For example, being located at the south pole (of either the Moon or Earth) would mean that most of the northern sky would be inaccessible. Because modern astronomy has largely (but not exclusively) been done from the northern temperate zones, there is a lot of information already available about sources in the northern sky. That's just one example of a factor that could come into play. To be fair, though, the Magellanic Clouds are inaccessible to telescopes in the north, and the Galactic Centre is low in the sky.

When we find ourselves faced with a limited budget, other factors come into play. How often will people travel there? Will it be used for training students? How easy is it to service the equipment? Is the location suitable for further development, say at other wavelengths? Then there are other atmospheric factors such as cloud cover, water vapour, aurorae, *etc.* In the case of the Antarctic, there's the additional complication of building equipment to operate at extremely low temperatures. The choice of site therefore means compromises, and only some of the issues can be settled scientifically.

Astronomical seeing can be measured, at least in the general terms of the characteristics of the site. Seeing is the twinkling of starlight caused by the light passing through the atmosphere, and generally is stated in units of arcseconds: the smaller the average, the better. As astronomers contemplate the next generation of telescopes (30 to 100 m in diameter), it's important to know what the best sites on Earth are, and what it will cost to build telescopes there.

Seeing at the South Pole station is quite bad — much worse than Mauna Kea, and worse than Kitt Peak. That poor seeing has been attributed to a very turbulent layer of air just above the ground. It has been postulated that this turbulent layer would not be a problem in other areas of Antarctica. As part of a world-wide survey now being done by numerous groups, Ashley and his colleagues have now measured the wintertime seeing over a site on Dome C, which is a plateau about the size of Australia with an elevation of about 3200 m. Some earlier summertime measurements had looked promising, but winter is what is crucial for astronomy, as that is when it is dark. The problem with obtaining the measurements is that no one spends the winter at the French-Italian station on Dome C (unlike the South Pole or McMurdo base). The University of New South Wales developed an autonomous device, with its own power source and satellite communications, and installed it during January 2003 (the southern summer).

The results are nothing short of remarkable. The average seeing is a factor of 2-3 better than Mauna Kea (which is a sort of astronomical "gold standard"), and the best seeing — 0.07 arcseconds — is the best ever recorded on Earth. Mauna Kea is only a factor of 1.5 or so better than Kitt Peak, so the leap to Dome C would be a big improvement.

Now that adaptive optics are prevalent on all large telescopes, it is also important to consider other atmospheric characteristics. The sky over Dome C would permit an adaptive-optics system to operate with fewer actuators and correct a larger region of the sky (three times the diameter, or nine times the area) than at a mid-latitude site such as Mauna Kea or La Palma. The sky is more stable, so fainter guide stars can be used. And of course there's no light pollution. In addition, the atmosphere is very cold and exceedingly dry, which are factors that astronomers consider for infrared telescopes. Ashley concludes that a telescope on Dome C could compete with one two to three times in diameter at a mid-latitude location. All in all, at present Dome C looks to be the best spot on Earth for a large telescope. Dome A, which is higher, might have somewhat better seeing, but it has never even been visited and is very inaccessible.

Getting back to reality, though, is Dome C viable as a site for a major observatory, given the other factors, such as money? My own view is, probably yes. If numerous countries join together to build a 30- to 100-metre-class telescope, which would cost in the of order $1 billion US, then the access and engineering costs will look relatively smaller than they would for a $100 million telescope (such as the Large Binocular Telescope now under construction on Mount Graham in Arizona). Astronomers would certainly not visit the site regularly, and various western countries set aside substantial amounts of money for "polar research." The US National Science Foundation regards the astronomy at the South Pole station to be the crown jewel of its polar program, so not all of the money for such a telescope would need to come out of current astronomy budgets. The Australians are seeking funding for a 2-m telescope at Dome C, which would serve as a demonstrator of the technology, and to investigate the practical aspects of operating an observatory there.

On the other hand, if President Bush is re-elected (which looks fairly likely, as I write this in late September), it is not at all clear how science will fare over the next four years. Realistically, a billion-dollar telescope probably would not happen without substantial US involvement. I know that the European Southern Observatory has its own plans, but I'm skeptical that political and economic realities would allow more than one such telescope to be built, or that ESO could do it on its own.

But let's end on a positive note, and hope that twenty years from now images from a 100-m telescope on Dome C are as common as *Hubble Space Telescope* images are now.

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.*

FROM THE PAST — AU FIL DES ANS

Occultation of B.D. –19°5925 by Saturn

Weather in Toronto on the night of July 22-23 prevented observation of the occultation of this 8.6-magnitude star by Saturn. In Montreal, Klaus Brasch and Geoffrey Gaherty, Jr. (Co-ordinator of the Planetary Section) were able to time the disappearance of the star behind the rings, predicted to occur at 0h 47m E.S.T. (*Observer's Handbook,* p. 60), before clouds obscured the area. Mr. Gaherty reports: "This was certainly more than a minute later than predicted. It was interesting to watch the gradual apparent dimming of the star as it approached the planet. With my 8-inch at 360× the star could be followed quite close to the rings, appearing as a tiny bright projection on the edge of Ring A." Mr. Gaherty will be interested in receiving other reports of the timing for this unusal occurrence.

According to Mr.Gordon E. Taylor of the British Astronomical Association, no planetary occultations or appulses will be visible from Canada during 1963.

by Ruth J. Northcott
from *Journal,* Vol. 56, p. 224, October 1962.

Research Papers
Articles de recherche

PHOTOMETRIC AND POLARIMETRIC MEASUREMENTS OF THE SATURN SYSTEM IN 2003-04

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and Charles Calia

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Abstract. The normalized magnitudes of Saturn + rings for a ring tilt angle of 25° are: $B(1,0) = -8.69 \pm 0.02$, $V(1,0) = -9.72 \pm 0.02$, $R(1,0) = -10.37 \pm 0.02$, and $I(1,0) = -10.61 \pm 0.02$ and the corresponding solar phase angle coefficients are: $c_B = 0.038 \pm 0.009$, $c_V = 0.031 \pm 0.006$, $c_R = 0.024 \pm 0.005$, and $c_I = 0.030 \pm 0.005$. The opposition surges of Saturn + rings for the 2001-04 period are: 0.21, 0.13, 0.12, and 0.12 magnitude for the *B, V, R,* and *I* filters. The 2003-04 magnitude of Titan is $V(1,0) = -1.30 \pm 0.04$, which is close to the 1992-93 value.

Résumé. Les magnitudes normalisées de Saturne et de ses anneaux à d'un angle oblique de 25° sont : $B(1,0) = -8.69 \pm 0.02$, $V(1,0) = -9.72 \pm 0.02$, $R(1,0) = -10.37 \pm 0.02$, et $I(1,0) = -10.61 \pm 0.02$ et les coefficients de la phase correspondante du Soleil sont : $c_B = 0.038 \pm 0.009$, $c_V = 0.031 \pm 0.006$, $c_R = 0.024 \pm 0.005$, et $c_I = 0.030 \pm 0.005$. Pour la période de 2001 à 2004, les augmentations subites de Saturne et de ses anneaux en opposition étaient de 0.21, 0.13, 0.12, et 0.12 magnitudes captées à l'aide de filtres *B, V, R,* et *I*. La magnitude de Titan durant 2003/2004 était de $V(1,0) = -1.30 \pm 0.04$, ce qui est à peu près la valeur enregistrée en 1992/1993.

1. Introduction

Two factors that influence the brightness and colour of Saturn are: 1) the tilt of the rings, and 2) the solar phase angle of Saturn, which is the angle between the Earth and the Sun measured from Saturn. We are gaining a better understanding of how the ring tilt affects the brightness and colour of Saturn; however, the dependence of the brightness of Saturn on the solar phase angle (especially at angles of less than 0.6°) is poorly understood. There is also a chance that Titan undergoes seasonal changes and that these changes may affect the percentage of light this moon reflects. It is for these reasons we have continued to carry out photoelectric magnitude measurements of Saturn and Titan.

2. Magnitude Measurements of Saturn

Schmude made 53 magnitude measurements of Saturn; see Table 1. He used a 0.09-metre telescope along with an SSP-3 solid-state photometer and filters transformed to the Johnson *B, V, R,* and *I* system. The comparison star was iota Geminorum and the magnitudes used for this star are from Iriarte *et al.* (1965). All measurements in Table 1 were corrected for extinction and colour transformation. The check star for a few of the measurements was epsilon Tauri. The measured magnitudes for epsilon Tauri were: $B = 4.56$, $V = 3.51$, $R = 2.83$, and $I = 2.33$, which are close to literature values (Iriarte *et al.* 1965).

The normalized magnitude $V(1,\alpha)$ of Saturn for the *V*-filter was computed from:

$$V(1,\alpha) = V - 5.0\log[r \times d] + 2.5\log[k] + 2.49\sin[B] - 1.33\sin^2[B] - 0.815, \quad (1)$$

where V is the *V*-filter magnitude, r is the Saturn-Earth distance in astronomical units (AU), d is the Saturn-Sun distance in AU, k is the fraction of Saturn's disc that is illuminated by the Sun as seen from the Earth, and B is the angle between the ring plane and the line defined by the observer and the centre of Saturn. The 0.815 term at the end of equation 1 is Δm the magnitude change caused by the rings for $B = 25°$ (Schmude 2003a) where:

$$\Delta m = 2.49 \sin[B] - 1.33 \sin^2[B]. \quad (2)$$

The value of k in equation (1) was computed in the same way as in Schmude (2003a). Normalized magnitudes for the other filters were computed from:

$$B(1,\alpha) = B - 5.0\log[r\times d] + 2.5\log[k] + 2.60\sin[B] - 1.85\sin^2[B] - 0.768 \quad (3)$$
$$R(1,\alpha) = R - 5.0\log[r\times d] + 2.5\log[k] + 2.53\sin[B] - 1.29\sin^2[B] - 0.839 \quad (4)$$
$$I(1,\alpha) = I - 5.0\log[r\times d] + 2.5\log[k] + 3.40\sin[B] - 2.26\sin^2[B] - 1.033 \quad (5)$$

where the symbols are the same as those in equation (1). All normalized magnitudes with $\alpha > 1.5°$ were plotted against the solar phase angle (α) of Saturn; see Figure 1. The solar phase angle of Saturn is the angle between the Sun and the Earth measured from Saturn. The slopes in Figure 1 are the solar phase angle coefficients (c_X) and the *y*-intercepts are the normalized magnitudes $X(1,0)$. Table 2 summarizes the solar phase angle coefficients and normalized magnitudes of Saturn in 2003-04. Uncertainties were computed in the same way as is described by Schmude (1997).

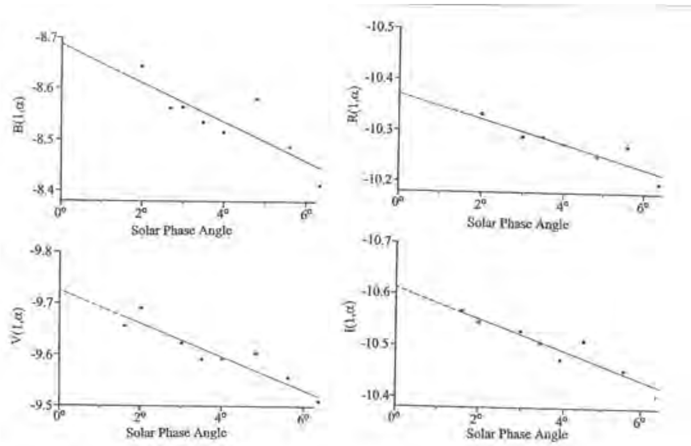

Figure 1 — Plots of the normalized magnitude of Saturn + rings at a solar phase angle α versus the solar phase angle α for the *B, V, R,* and *I* filters.

The normalized magnitudes in 2003-04 are about 0.05 magnitudes fainter than the 2002-03 magnitudes, which are: $B(1,0) = -8.75 \pm 0.02$, $V(1,0) = -9.77 \pm 0.01$, $R(1,0) = -10.43 \pm 0.01$, and $I(1,0) = -10.65 \pm 0.01$. This is due to the difference in ring tilt angle (26.5°) in 2002-03 versus 25° in 2003-04. The 2003-04 normalized magnitudes (*V, R,* and *I* filters) are within 0.02 magnitude of the 2001-02 values; this is probably due to the similar ring tilt angles in the two apparitions combined with the fact that Saturn's disc does not have large brightness changes from one year to the next. The larger discrepancy (0.06 magnitude) in the $B(1,0)$ values between 2001-02 and 2003-04 is probably due to the larger uncertainties in blue filter measurements.

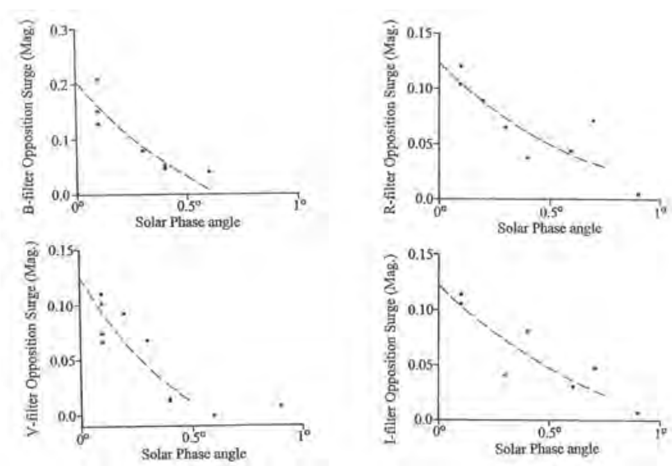

Figure 2 — Plots of the opposition surge of Saturn + rings in the *B, V, R,* and *I* filters for various values of the solar phase angle. The opposition surge is the non-linear brightness surge that occurs when the solar phase angle approaches 0.0°.

3. Opposition Surge of Saturn

The opposition surge is a non-linear increase in the brightness of an object as the solar phase angle approaches zero degrees. The opposition surge is illustrated elsewhere (Schmude 2003a). Figure 2 shows measurements of the opposition surge during the 2001-04 apparitions. The opposition surge (OS) values were fit (using a least squares routine) to an equation of the form: $OS = a + b\alpha + c\alpha^2$, where α is the solar phase angle and a, *b,* and *c* are constants. The resulting equations for the *B, V, R,* and *I* filters are:

B-filter:	$OS = 0.209 - 0.504\alpha + 0.308\alpha^2$	(6)
V-filter:	$OS = 0.125 - 0.336\alpha + 0.223\alpha^2$	(7)
R-filter:	$OS = 0.124 - 0.189\alpha + 0.085\alpha^2$	(8)
I-filter:	$OS = 0.121 - 0.182\alpha + 0.070\alpha^2$.	(9)

Equations 6-9 are only valid for values of α between 0.0° and 0.6°. The opposition surge reaches a maximum value (in magnitudes) when $\alpha = 0°$. Values of the maximum opposition surge, rounded off to two places, are listed in Table 2.

4. Maximum Brightness of Saturn

Saturn reached peak *V*-filter magnitudes of −0.53, −0.53, and −0.54 on December 18.193, 2002, December 31.280, 2003, and January 1.247, 2004; all three measurements were made when $\alpha = 0.1°$. Maximum brightness occurs when $\alpha = 0.0°$ and so according to equation 7: $OS = -0.125$ when $\alpha = 0.0°$ and $OS = -0.094$, when $\alpha = 0.1°$; therefore, Saturn would have been brighter by an additional 0.031 magnitude in the *V*-filter had $\alpha = 0.0°$ on the dates just listed; or in other words, Saturn's magnitudes would have been −0.56, −0.56, and −0.57 at $\alpha = 0.0°$. A maximum brightness of -0.56 ± 0.02 is selected for Saturn. Saturn is believed to have reached this maximum brightness within a couple of hours of opposition on December 18, 2002 and December 31, 2003. Schmude measured the brightness of Saturn on December 13, 1995 to be +1.04; this was near Saturn's minimum brightness. Therefore the range of brightness for Saturn is at least 1.60 magnitude, which is higher than the value proposed by Gaythorpe of 1.18 magnitude (Alexander 1962).

5. Polarization Measurements

The polarization value (P) is computed from $P = [(I_{pp} - I_{pa})/(I_{pp} + I_{pa})] \times 1000$ where I_{pa} is the amount of polarized light that is parallel to the Earth-Sun-Saturn plane and I_{pp} is the amount of polarized light that is perpendicular to the Earth-Sun-Saturn plane; more information can be found in Dollfus (1961). Polarized light can give us information about the particles in Saturn's ring system.

Polarization values for Saturn + rings in the *V*-filter were: 1.4 ± 0.5 (April 27.084, 2003), 2.8 ± 2.1 (April 10.145, 2004), and 5.4 ± 0.6 (April 17.092, 2004). The same equipment (Schmude 2002) and method (Dollfus 1961) were used in the 2004 measurements. All three measurements were made when the solar phase angle was near 5-6°. Lyot reports polarization values of about 4-7 for the centre of Saturn's disc for solar phase angles of 5-6° during 1923-26 (Dollfus 1961). The close agreement between our whole disc measurements and Lyot's centre of disc measurements shows that the light from the rings has a low polarization value like Saturn's disc.

6. Titan and Iapetus

Doug West and Charles Calia carried out photometric measurements of Titan. West used a 0.20-metre Schmidt-Cassegrain telescope along with a CCD camera and filters that were transformed to the Johnson *B* and *V* system. Calia used a 0.20-metre Schmidt-Cassegrain telescope along with an SSP-3 solid-state photometer and a filter that was transformed to the Johnson *V* system. Calia's data had a large scatter because the SSP-3 photometer is less sensitive than a CCD camera. West's CCD data are summarized in Table 3. The normalized magnitude of Titan for the *V*-filter was computed from:

$$V(1,\alpha) = V - 5.0 \log[r \times d] + 2.5 \log[k], \qquad (10)$$

where the terms are the same as those in equation (1). The data in Table 3 were plotted in the same way as in Figure 1. The normalized magnitude of Titan was $V(1,0) = -1.30 \pm 0.04$ and the corresponding solar phase angle coefficient was about 0.006 magnitude per degree. Schmude measured the magnitudes of Titan in 1992 and 1993 (Schmude & Bruton 1993, 1994) and from these data he computed a normalized magnitude of –1.28 for both years. It thus appears that Titan did not change much in brightness between 1992 and 2003.

The average normalized 2003-04 magnitude of Titan based on Calia's measurements was $V(1,0) = 1.22 \pm 0.08$, which is consistent with West's measurements.

West made two measurements of Titan in the blue filter; the selected 2003-04 colour index for Titan is $B-V = 1.24$, which is close to the 1993 value: 1.21 ± 0.04 (Schmude & Bruton 1994) and the literature value: 1.28 (Astronomical Almanac 2002).

West measured the magnitude of Iapetus to be 10.27 ± 0.03 and 11.48 ± 0.04 on January 12.063 and January 30.051, 2004, respectively. This confirms the fact that Iapetus is brighter at western elongation than at eastern elongation; Iapetus reached western elongation on January 2, 2004, and reached eastern elongation 39 days later.

7. Conclusions

Saturn's photometric constants in 2003-04 are close to the values reported in the previous apparition. The opposition surges of Saturn + rings for a ring tilt angle near 26° in the *B, V, R*, and *I* filters are 0.21, 0.13, 0.12, and 0.12 magnitude, respectively. Saturn reached a peak magnitude of: –0.56 ± 0.02 in late 2002 and late 2003. Titan had the same absolute magnitude in 1992-93 and 2003 to within the formal uncertainties.

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Richard W. Schmude, Jr. grew up in Houston, Texas and graduated from Texas A&M University in 1994 with a Ph.D. degree in chemistry under the guidance of Dr. Karl Gingerich. Since 1994, Richard has taught chemistry, astronomy, and physical science at Gordon College in Barnsville, GA. He is a member of the American Association of Variable Star Observers, The Association of Lunar and Planetary Observers (Executive Director), The Atlanta Astronomy Club, The Flint River Astronomy Club, and the Kingston Centre of the Royal Astronomical Society of Canada.

Doug West is an active observer of double stars, variable stars, and Solar System bodies. He is a member of the American Astronomical Association, American Association of Variable Star Observers, and the Association of Lunar and Planetary Observers. His observations and analyses have been published in the Webb Society Double Star Circulars, Double Star Observer *newsletter,* Bulletin of the American Astronomical Association, Journal of ALPO, Information Bulletin on Variable Stars, *and in the* Mid-American Astrophysical Conference. *Doug is an aerospace engineer during the day.*

TABLE 1. Photoelectric magnitude measurements of Saturn made in 2003-04.

Date (UT)	Filter	Ring Tilt (*B*) (degrees)	Solar Phase Angle (deg.)	Measured Magnitude	Normalized Magnitude *B* = 25.0°
Nov. 2.346, 2003	*B*	24.8	5.6	+0.96	−8.49
Nov. 2.360	*V*	24.8	5.6	−0.11	−9.56
Nov. 2.376	*R*	24.8	5.6	−0.82	−10.27
Nov. 2.392	*I*	24.8	5.6	−1.01	−10.45
Nov. 16.275	*B*	24.9	4.8	+0.81	−8.58
Nov. 16.292	*V*	24.9	4.8	−0.21	−9.60
Nov. 16.308	*R*	24.9	4.8	−0.87	−10.25
Nov. 20.281	*I*	24.9	4.5	−1.13	−10.51
Nov. 25.383	*V*	25.0	4.0	−0.23	−9.59
Nov. 25.399	*B*	25.0	4.0	+0.85	−8.52
Nov. 25.411	*R*	25.0	4.0	−0.91	−10.28
Nov. 25.422	*I*	25.0	4.0	−1.11	−10.47
Dec. 1.255	*V*	25.1	3.5	−0.25	−9.59
Dec. 1.271	*B*	25.1	3.5	+0.81	−8.54
Dec. 1.288	*R*	25.1	3.5	−0.93	−10.29
Dec. 1.301	*I*	25.1	3.5	−1.16	−10.51
Dec. 6.222	*V*	25.1	3.0	−0.29	−9.62
Dec. 6.233	*B*	25.1	3.0	+0.77	−8.57
Dec. 6.245	*R*	25.1	3.0	−0.95	−10.29
Dec. 6.259	*I*	25.1	3.0	−1.20	−10.53
Dec. 15.303	*B*	25.3	2.0	+0.67	−8.64
Dec. 15.317	*V*	25.3	2.0	−0.38	−9.69
Dec. 15.328	*R*	25.3	2.0	−1.02	−10.34
Dec. 15.338	*I*	25.3	2.0	−1.23	−10.55
Dec. 18.233	*V*	25.3	1.6	−0.35	−9.66
Dec. 18.249	*B*	25.3	1.6	+0.69	−8.62
Dec. 18.264	*R*	25.3	1.6	−1.02	−10.33
Dec. 18.279	*I*	25.3	1.6	−1.26	−10.57
Dec. 24.211	*V*	25.4	0.9	−0.40	−9.70
Dec. 24.225	*B*	25.4	0.9	+0.65	−8.65
Dec. 24.240	*R*	25.4	0.9	−1.05	−10.36
Dec. 24.255	*I*	25.4	0.9	−1.29	−10.59
Dec. 27.180	*V*	25.5	0.6	−0.41	−9.70
Dec. 27.192	*B*	25.5	0.6	+0.60	−8.70
Dec. 27.206	*R*	25.5	0.6	−1.10	−10.40
Dec. 27.218	*I*	25.5	0.6	−1.33	−10.63
Dec. 31.280	*V*	25.5	0.1	−0.53	−9.82
Dec. 31.291	*B*	25.5	0.1	+0.41	−8.89
Dec. 31.313	*R*	25.5	0.1	−1.18	−10.48
Dec. 31.323	*I*	25.5	0.1	−1.43	−10.73
Jan. 1.247, 2004	*V*	25.6	0.1	−0.54	−9.83
Jan. 1.267	*B*	25.6	0.1	+0.49	−8.81
Jan. 2.111	*V*	25.6	0.2	−0.51	−9.81
Jan. 2.127	*R*	25.6	0.2	−1.16	−10.46
Jan. 3.154	*V*	25.6	0.3	−0.49	−9.78
Jan. 3.169	*B*	25.6	0.3	+0.54	−8.76
Jan. 3.192	*I*	25.6	0.3	−1.35	−10.64
Jan. 3.208	*R*	25.6	0.3	−1.14	−10.43
Jan. 24.231	*B*	25.9	2.7	+0.76	−8.56
Mar. 19.067	*B*	26.3	6.3	+1.08	−8.42
Mar. 19.076	*V*	26.3	6.3	−0.02	−9.51
Mar. 19.093	*R*	26.3	6.3	−0.71	−10.20
Mar. 19.103	*I*	26.3	6.3	−0.92	−10.40

Table 2. Photometric constants for Saturn. The normalized magnitude and solar phase angle coefficient values are for the 2003-04 apparition and the opposition surge is the average value computed for the three apparitions 2001-04.

Filter	Normalized magnitude $X(1,0)$	Solar phase angle coefficient (c_x)	Opposition surge in magnitudes
B	−8.69 ± 0.02	0.038 ± 0.009	0.21
V	−9.72 ± 0.01	0.031 ± 0.006	0.13
R	−10.37 ± 0.01	0.024 ± 0.005	0.12
I	−10.61 ± 0.01	0.030 ± 0.005	0.12

Table 3. Magnitude measurements of Titan made by Doug West.

Date (UT)	Filter	Solar Phase angle (deg.)	Measured magnitude	Normalized magnitude $X(1,\alpha)$
Oct. 4.482, 2003	*B*	6.4	9.54 ± 0.04	−0.02
Oct. 4.482	*V*	6.4	8.31 ± 0.03	−1.25
Oct. 13.431	*V*	6.3	8.32 ± 0.08	−1.20
Oct. 22.422	*B*	6.1	9.40 ± 0.04	−0.08
Oct. 22.422	*V*	6.1	8.16 ± 0.04	−1.32
Jan. 12.063	*V*	1.3	8.05 ± 0.03	−1.26
Jan. 30.051	*V*	3.3	8.03 ± 0.03	−1.32

DISCOVERY OF THE BELLY RIVER METEORITE: NEW INFORMATION

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Abstract. Details concerning the discovery of the Belly River, Alberta meteorite, published by LaPaz (1953) in his preliminary note, require correction. The 7900 g H6 chondrite was not discovered as a result of an aircraft forced landing, nor was it found east of the Belly River at approximately longitude 113° 00´W and latitude 49° 30´N. The correct location of the find is longitude 113° 29´ 22″W and latitude 49° 39´ 44″N.

Résumé. Les détails concernant la découverte du météorite à Belly River en Alberta, tel que publié par LaPaz (1953) dans ces notes préliminaires, doivent être amendés. La chondrite H6 de 7 900g n'a pas été découverte suite à un attérrissage forcé d'un avion, d'autemps plus qu'il n'a pas été retrouvé à l'est de la rivière Belly aux coordonnées approximatives de 113° 00´W en longitude et de 49° 30´N en latitude. Le site actuel de la découverte se trouve plutôt à longitude 113° 29´ 22″W et latitude 49° 39´ 44″N.

Lincoln LaPaz of the Institute of Meteoritics (University of New Mexico, Albuquerque, New Mexico) provided the first description of the Belly River, Alberta meteorite in his *Preliminary Note* (LaPaz 1953):

> "In the winter of 1943-4, a R.C.A.F. plane made a forced landing on the eastern side of and near to the Belly River in southern Alberta, Canada, at a point approximately in longitude W. 113° 00´ and latitude N. 49° 30´.
>
> Chief Photographic Officer B. Wettlaufer was one of those aboard the plane who set out on foot to scout out the area in which the plane had been forced to land. In the course of his reconnaissance, he chanced upon a dark, reddish-brown rock exhibiting such a remarkably pitted and sculptured surface that he picked it up and lugged it all the way back to the plane, altho it weighed in excess of 17 lbs. And his return hike was made in a near blizzard with winds of such force that he was sometimes thrown off his feet…"

The reality was somewhat less dramatic. One of us (Wettlaufer) was an instructor in aerial photography at the RCAF training station at Pierce, near Fort Macleod, Alberta during the 1943-1944 period. My job was to train student airmen in photography. I would take up four students at a time in an Anson aircraft and assign them a number of targets to photograph — a farmer's barn, an elevator, a church steeple, *etc.*, so I flew over every part of the Fort Macleod area. During one of these flights I spotted some tipi rings on the east bank of an old meander of the Oldman River and that weekend my wife and I drove to near the site to see if it was of native or RCMP (Royal Canadian Mounted Police) origin. We parked on the road (Highway 3) just north of the boundary line of the Peigan Indian Reserve a few kilometres south of Fort Macleod.

There was a big wind blowing, so my wife stayed in the car while I went looking. I had a walk of about 500 metres, checked out the tipi rings and started back across the farmer's plowed field. The farmer had stones off the field piled in a couple of piles that I checked for any native artifacts. I found no artifacts, but did find a very interesting stone with a rusty iron appearance and pockmarked surface. It was quite heavy for its size (about 25- to 30-cm long and 15-cm thick) and I recognized it as a meteorite. (LaPaz (1953) gave its mass as 7900 g and it was later classified as an H6 chondrite.) I struggled to carry it back to the car against the wind for a hundred metres; gave up and dropped the meteorite; then, realizing its scientific value, picked it up again and finally made it back to the car.

I kept the meteorite with me through several more RCAF postings — Portage la Prairie, Montreal, Ottawa, and Edmonton. After leaving the service I moved with my family and meteorite to Albuquerque, New Mexico in 1946, graduating from the University of New Mexico as an archaeologist in 1949. During this time I met Dr. Lincoln LaPaz of the Institute of Meteoritics (IOM) and sold the meteorite to him with the proviso that the IOM share it with the Geological Survey of Canada in Ottawa.

With the aid of topographical maps (Canada NTS maps, 1:50000 scale, sheets 82 H/12 (Brocket) and 82 H/11; Fort Macleod) provided by the second author, Wettlaufer was able, in 2004, to retrace the route of his trek and reconstruct the events leading to his discovery of the Belly River meteorite sixty years ago. Wettlaufer's retraced path follows the right (eastern) edge of map 82 H/12 and ends on the left (western) edge of map 82 H/11. LaPaz's published location is down in the right bottom (southeast) corner of map 82 H/11.

The correct location of the find is longitude 113° 29´ 22″W, latitude 49° 39´ 44″N, east of the Oldman River. In the system of land descriptions on the Canadian prairies, the farmer's field is identified as NW 1/4, Section 20, Township 8, Range 26, west of the Fourth

Meridian. This location is 40 km northwest of the location given by LaPaz. Although the name Belly River is inappropriate it has been in use since 1953 and was accepted by the *Meteoritical Bulletin* (no. 8, Moscow, 1958). The authors have been advised by the *Bulletin* that, in the interest of avoiding further confusion, the name will not be changed. Researchers should note the revised location of the fall as it has implications for possible paired falls.

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Boyd Wettlaufer was born in Asquith, Saskatchewan. He joined the Royal Canadian Air Force in 1938 and was stationed in Alberta when he discovered the Belly River meteorite. He subsequently attended the University of New Mexico in Albuquerque, graduating as an archaeologist. His work at Head-Smashed-In Buffalo Jump in Alberta would lead eventually to its designation as a UNESCO World Heritage Site in 1981. In 2004 the Governor General of Canada announced the appointment of Boyd Wettlaufer to the Order of Canada for "his groundbreaking archaeological work in western Canada," no mention being made of his meteorite discovery. Now a Member of the Order of Canada, the 90-year old Wettlaufer lives in Victoria, BC.

Anthony Whyte, a graduate of the University of Alberta, is a life member of the Royal Astronomical Society of Canada and a Past-Secretary and Past-President of the Edmonton Centre. He is a backyard observer and a solar eclipse chaser with 17 minutes of totality. He is the author of a book on Pluto and is presently writing a book on the meteorites of Alberta. He lives in Edmonton.

Gemini: Two Telescopes, One Universe

by Dennis R. Crabtree (Dennis.Crabtree@nrc-cnrc.gc.ca)

You will have received a Gemini Observatory CD with this issue of the *Journal*. The CD contains a "Virtual Tour" of Gemini as well as a collection of images and animations. The RASC and the National Research Council's Herzberg Institute of Astrophysics (NRC-HIA) have partnered to provide you with this exciting CD. I urge you to visit the Gemini Web site (`www.gemini.edu` and `www.gemini.edu/pio/`) for more exciting images and details on the Gemini telescopes, two of the most technologically advanced telescopes on Earth.

The Gemini Telescopes

The era of large modern telescopes began with the construction of 4-metre-class telescopes that began in the late 1960s. While not as large as the Palomar 5-m telescope, the number and wide access to these telescopes initiated a tremendous blossoming of astronomical research.

The first photons were barely hitting the mirrors of the first 4-m telescopes before people started investigating designs for even larger telescopes. While initial studies looked at 20-m or larger telescopes, by the mid-1980s efforts around the world were focused on telescopes around 8-m in diameter.

Canada's entry into the era of 8-m class telescopes was through the Gemini project. The Gemini project brought together the US, UK, Canada, Chile, Argentina, and Brazil to construct and operate twin 8-m telescopes, one on Mauna Kea in Hawaii and the other on Cerro Pachon in Chile. Canada receives 15% of the observing time on each telescope.

The Gemini telescopes were designed to optimize the delivered image quality and infrared performance. The two sites, Mauna Kea and Cerro Pachon, deliver exceptional image quality, and Mauna Kea is one of the best infrared sites on the planet. While Gemini's mirrors are 8-m in diameter they are only 20-cm thick. Such a thin mirror would normally be useless for astronomy as the mirror is not stiff enough to maintain its figure at different orientations, however, an elaborate computer-controlled support system maintains the optimum figure on the mirror surface as the telescope moves around the sky.

While the Gemini mirrors deliver excellent image quality, the clarity of the images is still degraded by turbulence in the atmosphere above the telescopes. In an effort to achieve the same resolution as if the telescopes were in space, Gemini has invested heavily in adaptive-optics technology. In adaptive optics one measures the distortions introduced by the atmosphere, using a nearby reference star, and then uses a "deformable mirror" to correct for these distortions. The hard part is that these corrections need to be made 1000 times per second. Altair, the adaptive optics system on Gemini North was constructed at the NRC-HIA in Victoria, B.C. (`www.hia.nrc.gc.ca`). A wonderful animation that demonstrates how adaptive optics works is included on the CD. In 2005, Gemini will begin using an artificial "laser guide star" as the reference star. A high-powered sodium laser is used to excite a thin layer of sodium 90 km above the Earth's surface to generate the artificial star. The use of the laser-guide-star system will allow Gemini to use Altair anywhere in the sky rather than being restricted to patches close to relatively bright stars.

Gemini is also optimized for performance in the thermal infrared. This region of the electromagnetic spectrum is difficult to observe because objects near 300 K are radiating very strongly at the same wavelengths you are trying to observe. It is almost like trying to do optical astronomy during the daytime. The structures of the Gemini telescopes have been carefully designed to minimize the amount of stray radiation that makes it onto the detectors. Gemini is also the first large telescope to coat their mirrors with silver rather than aluminum. (So far this has only been done on Gemini South) A silver mirror coating reduces the "emissivity" of the mirror surface, greatly lowering the background against which astronomers are trying to detect faint emission. Gemini South is by far the most sensitive telescope for astronomical observations in the mid-infrared (10 to 20 μm). In fact, the Keck observatory is planning to phase out their mid-infrared capabilities as they recognize they cannot compete with Gemini in this area.

Gemini has a suite of very powerful instruments at each telescope and more will be delivered over the next two years. The two most popular, as determined by time requests, are the GMOS (Gemini Multi-Object Spectrograph) instruments, one on each telescope. These are optical spectrographs capable of obtaining the spectra of hundreds of faint galaxies at the same time. The GMOSs were built as a collaboration between the UK and Canada with the Canadian work done at NRC-HIA.

While Gemini is still a young observatory in many ways, the international Gemini community has already started thinking about the big science questions of the future that Gemini can address, and the instrumentation that will be needed. This so-called "Aspen process" culminated earlier this year in a report entitled *Scientific Horizons at the Gemini Observatory: Exploring a Universe of Matter, Energy and Life*. You can download a copy of this report in Adobe Acrobat format at: `www.gemini.edu/files/docman/science/aspen_report.pdf`.

Please visit the Gemini Web site regularly to learn about new scientific results and technological advances.

The Gemini Observatory is operated by the Association of Universities for Research in Astronomy, Inc., under a cooperative agreement with the NSF on behalf of the Gemini partnership: the National Science Foundation (United States), the Particle Physics and Astronomy Research Council (United Kingdom), the National Research Council (Canada), CONICYT (Chile), the Australian Research Council (Australia), CNPq (Brazil), and CONICET (Argentina).

Dennis Crabtree is currently head of the Canadian Gemini Office at NRC-HIA. Prior to this he spent three years as Senior Resident Astronomer at CFHT in Hawaii, and before that was head of the Canadian Astronomy Data Centre.

The Cypress Hills Dark-Sky Preserve — Canada's Newest DSP

by Bob King (bobwking@shaw.ca), Richard Huziak (huziak@sedsystems.ca), and Vance Petriew (vance.petriew@sasked.com)

On September 28, 2004, Canada's newest Dark-Sky Preserve was born: Cypress Hills Dark-Sky Preserve. Seventy senior park managers from across Canada witnessed the declaration while attending a Canada Parks Council Conference, hosted by Cypress Hills Interprovincial Park (CHIPP) this year. The declaration marked the culmination of 18 month's work by the Saskatchewan and Calgary Centres' Light-Pollution Abatement Committees (LPACs), and it marks an important step in a successful partnership between the RASC and the three government agencies that manage Cypress Hills Interprovincial Park and Fort Walsh National Historic Site.

The Dark-Sky Preserve (DSP) will protect some of darkest and most easily accessible dark skies in North America. It consists of the West and Centre Blocks of CHIPP and Fort Walsh National Historic Site. It covers an area of 39,600 hectares (ha) (97,800 acres). This is approximately 20 times larger than the Torrance Barrens Dark-Sky Reserve near Gravenhurst, Ontario, which was the first DSP in Canada. The only other officially recognized DSP in Canada is McDonald Park near Abbotsford, B.C. (see `www.cypresshills.com`,

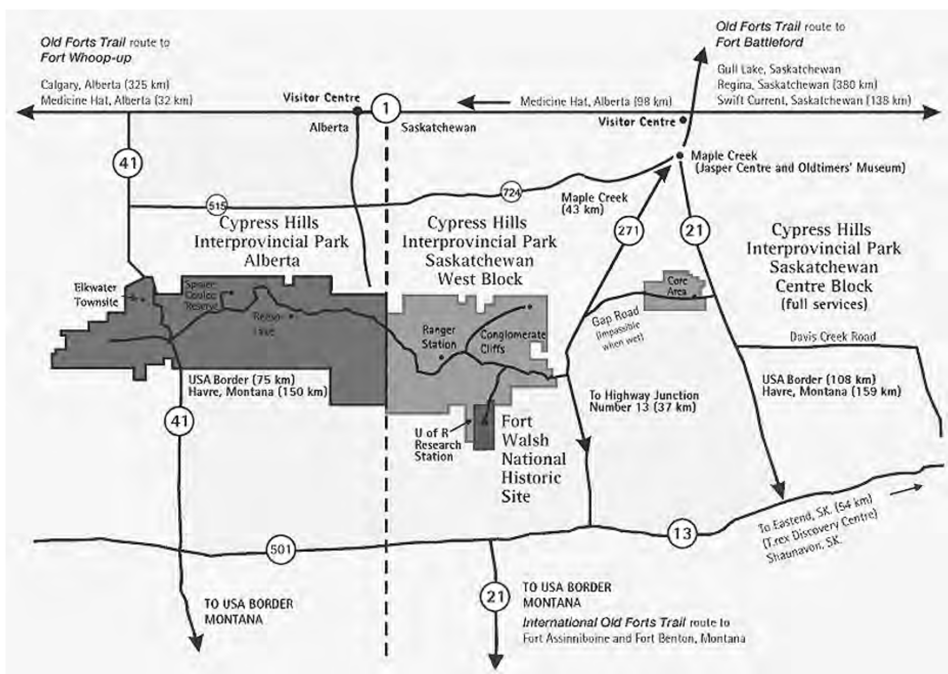


Figure 1 — Cypress Hills Interprovincial Park was left unscathed by the last glaciation and contains many unique features and species not found in the surrounding area. Image (c) 2004 Cypress Hills Interprovincial Park.

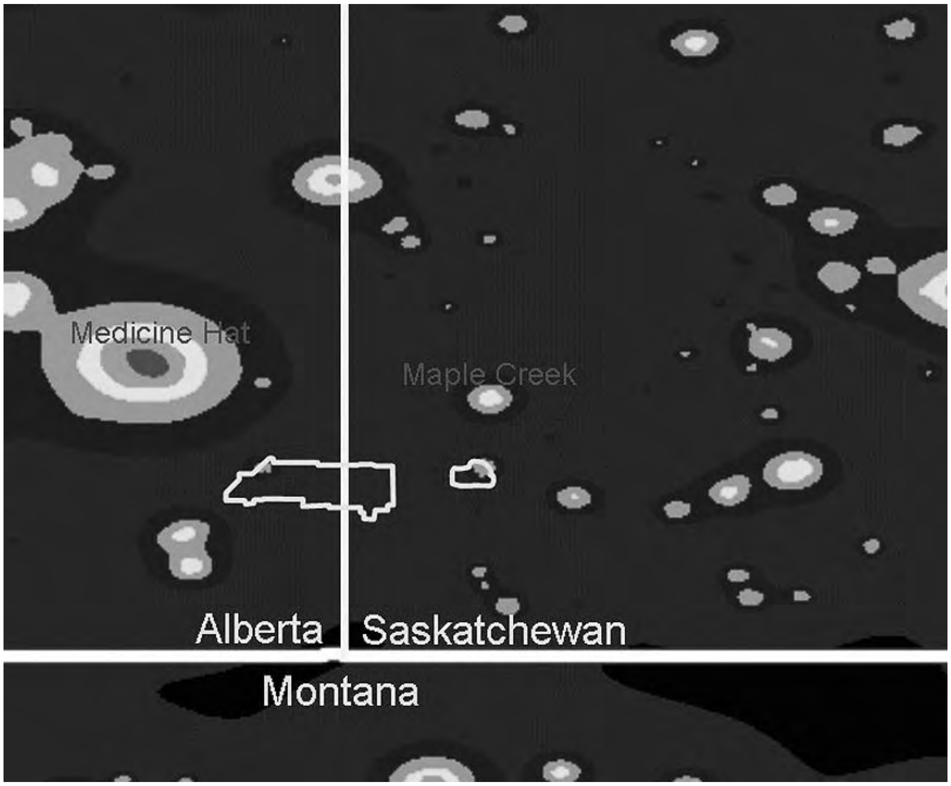


Figure 2 — The Cypress Hills Dark-Sky Preserve projected onto a sky glow map produced by P. Cinzano *et al.* Cypress Hills contains the highest point between the Rockies and Labrador. The sky glow image is taken from Attilla Danko's Clear Dark-Sky Clock. (www.cleardarksky.com).

www.rasc.ca/light/print/muskoka/dsr.htm, and www.fvas.net/dsp.html).

The Cypress Hills DSP also protects the home of the annual Saskatchewan Summer Star Party (SSSP), which is held every August in the Centre Block of CHIPP. CHIPP management expects the DSP designation will help to enhance visitors' appreciation of CHIPP with the night sky as part of the natural, historical, and cultural experience of the park. It will also provide opportunities for new interpretive programs and educational facilities that will attract more visitors and add economic benefits to the local and provincial tourism industries.

Cypress Hills Interprovincial Park and the Dark-Sky Preserve

The Cypress Hills are located in southeastern Alberta and southwestern Saskatchewan. The hills rise abruptly from the prairie about 40 km southeast of Medicine Hat and extend approximately 250 km eastward across southern Alberta and Saskatchewan. The Cypress Hills have escaped glaciations and are the highest point in Canada between the Rocky Mountains and Labrador, with a maximum elevation of 1466 metres above sea level. Generally, they are several hundred metres higher than the surrounding prairie and are an ecological oasis for a variety of flora and fauna. Humans have enjoyed the Cypress Hills for over 7000 years.

During the past 130 years, the hills have been the site of whisky trading, ranching, forestry, and recreational activities. In response to the whisky trading, the Northwest Mounted Police established the Fort Walsh outpost in 1875. It is now maintained as Fort Walsh National Historic Site. Protection of the hills began with the creation of forest reserves in the early 1900s and it was strengthened with the creation of regional parks in the 1950s. In 1989, Cypress Hills Interprovincial Park was created. It is Canada's first and only interprovincial park.

Geographically, the Cypress Hills exist in three blocks: West Block, which straddles the Alberta/Saskatchewan border; Centre Block, located 30 km south of Maple Creek, Saskatchewan, and East Block, which is northwest of Eastend, Saskatchewan. The land that comprises East Block is privately owned and is not part of CHIPP.

The location of Cypress Hills offers superb conditions for astronomers and this is the main reason that the Regina and Saskatoon Centres chose Centre Block to be the home of the Saskatchewan Summer Star Party (SSSP). Centre Block also offers excellent park facilities, including swimming, hiking, horseback riding, and golfing. Astronomical seeing and transparency at the park are usually excellent and the frequency of clear skies is high.

In the 2004 *Observer's Handbook*[1] (pp 64-65), Jay Anderson provides information about the frequency of nighttime cloud cover for North America. It shows that over the Cypress Hills, the frequency of nighttime cloud cover is less than 60% in the April-May period, and less that 30% during the summer. Anderson states: "In Canada [the] best observing prospects are found over southeast Alberta and southwest Saskatchewan.... the Cypress Hills area of Alberta and Saskatchewan experiences the most reliable nighttime skies in Canada."

The superb sky conditions, very dark skies, sparse population, and the isolation from nearby urban centres, made CHIPP a prime candidate for a Dark-Sky Preserve. Map 1 shows an excerpt from the sky-glow maps of P. Cinzano[2] *et al.* for the area around CHIPP. West and Centre Blocks, including Fort Walsh National Historic Site, are outlined on the map. The estimated sky brightness over most of the Cypress Hills DSP is 21.6 to 21.5 mag per sq. arcsecond. Cinzano estimates the sky glow over Torrance Barrens to be 21.3 to 20.8 mag per sq. arcsecond.

There is some minor sky glow at the west end of West Block in Alberta due to the presence of Elkwater, a small resort community, and in Centre Block due to limited cottage and hotel development. At the request of Alberta CHIPP management, Bob King audited the existing

Figure 3 — Park managers and LPA members sign the Cypress Hills Dark-Sky Preserve declaration. At left, top to bottom, Julie McDougall, Richard Huziak, David Rohatensky; at right, top to bottom, Brad Mason, Cheryl Penny, Bob King. Photo by Vance Petriew.

lighting in Elkwater in February 2004. It will be retrofitted in 2005. In Centre Block, lighting retrofit plans are being formulated and the Cypress Hills Cottagers Association and local business owners will be asked to voluntarily improve their lighting.

Creating the DSP

Creating the DSP started in 2003 with independent but convergent efforts by the Saskatchewan Light-Pollution Abatement Committee (the combined effort of the Regina and Saskatoon Centres) and the Calgary Light-Pollution Abatement Committee. In April 2003, Bob King, who was working with another organization on an idea of building an educational observatory in the Alberta side of CHIPP, introduced the ideas of light pollution and responsible lighting to Alberta CHIPP staff. He then formally proposed the creation of a DSP in the Alberta side of CHIPP.

This was well received and led to a similar meeting in Medicine Hat, AB, in July 2003, with the Alberta Parks management for southeast Alberta. The Area Manager of southwest Alberta parks happened to be there, too, and at that meeting, the Area Manager for southeast Alberta decided that CHIPP (Alberta) would become a DSP. Both managers also decided the DSP concept would benefit all parks and protected areas in Alberta because it addressed a previously unrecognized part of their mandate to preserve nature and the environment! Given this good outcome, Calgary LPAC contacted the Saskatchewan LPAC to coordinate efforts in both provinces.

The Regina and Saskatchewan Centres had also occasionally suggested to CHIPP staff in Centre Block that there was a need to protect the dark sky for the SSSP. In August 2003, during the SSSP, Darcy Kozoriz (Regina Centre) discussed the potential of creating a Dark-Sky Preserve with the Saskatchewan CHIPP staff and received favourable interest. This led to a formal meeting with senior parks management in Swift Current, SK, in February 2004, at which Darcy Kozoriz, Rick Huziak, and Vance Petriew discussed light-pollution abatement and proposed the idea of a CHIPP DSP. The proposal was greeted with immediate acceptance, as it had been in Alberta.

The Saskatchewan parks management also recognized that the DSP concept fit perfectly within their mandate to preserve nature and the environment. They were very appreciative of the presentation and considered it to be a great "eye-opener" as to the effects of lighting that humans are implementing around the globe.

To convey the idea of a Cypress Hills DSP to a wider audience, and to advance the broader application within the park systems of the two provinces, the park managers arranged for us to attend suitable meetings in Regina and Edmonton. Rick Huziak spoke at the Saskatchewan Eco-tourism Conference in Saskatoon on March 19, 2004. Several park managers and the Saskatchewan Director of Parks were present at the conference. The light-pollution presentation fit well with other visual presentations about the beauty of Saskatchewan's parks. Protecting the night sky was not a hard concept to sell in this atmosphere.

Bob King addressed the "All Area Managers" meeting in Edmonton on April 15, 2004, which was also attended by the Assistant Deputy Minister for Alberta Parks. There was unanimous endorsement of the DSP proposal and strong interest in broad application of responsible lighting in all of Alberta's Parks and Protected Areas. By May it was confirmed: Alberta would support the creation of a DSP in CHIPP.

On June 8, 2004, only six hours after successful, sleep-deprived expeditions to see the transit of Venus , Rick Huziak and Vance Petriew spoke at the Saskatchewan Park Managers' Annual Meeting in Regina. The presentation demonstrated how DSPs would benefit the park environment. The Park Managers unanimously agreed that applying responsible lighting concepts in all parks was an idea that would fit well into their management plans.

With the 2004 Saskatchewan Summer Star Party only two months away, Saskatchewan CHIPP management began work with other Parks administrators and managers to get a commitment from Saskatchewan Environment to proceed with the creation of a Dark-Sky Preserve.

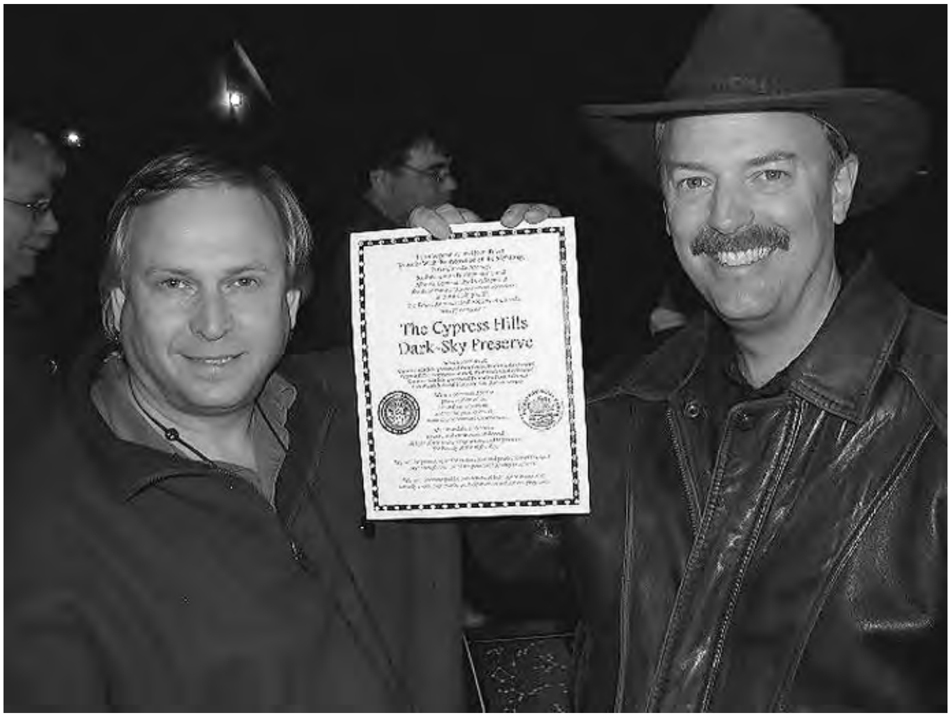


Figure 4 — Richard Huziak (left) and Bob King (right) proudly hold a copy of the Cypress Hills Dark-Sky Preserve declaration. Photo by Vance Petriew.

As a result of this effort, a declaration was signed on August 13, 2004 at the Saskatchewan Summer Star Party making the Cypress Hills (Centre Block) Dark-Sky Park a reality. CHIPP park management was surprised by the roaring ovation given by the crowd, a reaction that, as astronomers, we would have surely expected. The importance and relevance of the DSP was further reinforced.

Plans were moving forward for a bigger announcement — that of the Cypress Hills DSP, comprising all portions of CHIPP. A perfect venue for such a declaration was the upcoming Canadian Parks Council Conference to be held at the CHIPP Centre Block (Saskatchewan side) during the week of September 25. At this conference, park managers from across Canada (and a few from the United States) would be able to witness the Cypress Hills Dark-Sky Preserve declaration as a surprise event; a declaration that was meant to both educate and impress.

As plans progressed, it became apparent that since Fort Walsh National Historical Site was within the CHIPP park boundaries it, too, should be asked to make the same declaration. Fort Walsh management immediately agreed bringing Canada Parks Agency into the partnership.

At an outdoor wrap-up barbecue held at the CHIPP West Block Ranger's Station on September 28, 2004, Rick Huziak and Bob King gave presentations about light pollution and how a Dark-Sky Preserve would benefit the Parks' plans. This was followed by the presentation of the formal declaration and a signing ceremony. Canada Parks Council members across Canada were present to witness the signing of the Cypress Hills Dark-Sky Preserve declaration, which was signed by the Assistant Deputy Ministers for parks in Alberta and Saskatchewan, Canada Parks Agency representatives and Bob King and Rick Huziak representing the RASC. Vance Petriew had the foresight to bring a telescope, and following the ceremony we were able to show off the clear sky and continue our light-pollution lobbying. The full Harvest Moon was a wonderful target for telescopic observations.

One attendee at the declaration ceremony summarized the experience best: "I've been protecting the environment within my park for many years and thought I knew almost everything there is to know about my surroundings. Then you astronomers show up and teach me a new way to look at the world. It's both a humbling and enlightening experience and I am thankful for the new outlook you have shared with me out of your deep appreciation for the Earth and Universe we live in."

Figure 5. Rick Goett (CHIPP Centre Block, left) and Rick Huziak (right) display the commemorative t-shirts handed out at the declaration ceremony. Photo by Vance Petriew.

Next Steps

The signing of the declaration marks just the beginning of the work required. Saskatchewan and Alberta park management want to use our partnership to formulate lighting regulations for the Cypress Hills DSP. Lighting in Elkwater will be retrofitted once budgeted funds are approved. In Centre Block, retrofit plans will be made soon.

Together, we will also create informational signage for CHIPP entrances, pamphlets about the dark-sky concept, and educational programmes that promote awareness of the effects of light on the nocturnal environment. The CHIPP Web site will be updated to discuss the DSP. Interpretive programmes relating to public astronomy and First Nations constellations and mythology are also contemplated. Alberta has also asked for a proposal for an educational observatory.

Conclusions

Proposing dark sky preserves within the parks systems across Canada is a useful place to start. The primary mandate of the parks system is to preserve the natural state of parks, while making them accessible and enjoyable for the visitors. Dark skies are an integral part of the natural environment and one that many parks will be willing to protect once light-pollution issues are properly explained. Both the Alberta and Saskatchewan governments realize this and have suggested applying responsible lighting practices and dark-sky goals throughout their parks and protected areas. While these should be goals everywhere, the parks systems are a good place to start since they are already mandated to protect our environmental treasures.

References

1. Observer's Handbook, The Royal Astronomical Society of Canada, University of Toronto Press, Toronto, 2003.
2. Cinzano, P. et al., The sky-glow figure is adapted from Attilla Danko's Web site (cleardarksky.com). The sky-glow maps Danko uses were created by Cinzano et al., and are used by permission of Blackwell Science with the following credit: P. Cinzano, F. Falchi (University of Padova), and C. D. Elvidge (NOAA National Geophysical Data Center, Boulder). Copyright Royal Astronomical Society. Reproduced from the Monthly Notices of the RAS by permission of Blackwell Science.

Reference URLs

Alberta Community Development Press Release: `www.gov.ab.ca/acn/200410/17199F8DE4BA5-F138-48B2-B2BF1B080BBE4F2D.html`

Saskatchewan Environment Press Release: `www.se.gov.sk.ca/media/Saskatchewan%20Environmentnewsreleases/cypress_dark.htm`

More images of the Declaration: `www.ras.sk.ca/lpc/dsp/dsp.htm`

Calgary Light-Pollution Abatement Web site: `www.syz.com/rasc/lp/frame.html`

Saskatchewan Light-Pollution Abatement Web site: `www.ras.sk.ca/lpc/lpc.htm`

RASC National Light-Pollution Abatement Web site: `www.rasc.ca/light/home.html`

The International Dark-Sky Association: `www.darksky.org/`

Richard Huziak, Past-President of the Saskatoon Centre, has been an active amateur astronomer for 36 years. For his work in research and promotion of astronomy, Richard was awarded the RASC's Chant Medal in 2001, and the Director's Award from the American Association of Variable Star Observers in 2003. In January this year, the name HUZIAK was permanently given to asteroid 4143 by the International Astronomical Union in Cambridge, Massachusetts. To preserve the disappearing night sky for future generations, Richard sits on the Saskatchewan Light-Pollution Abatement Committee.

Vance Petriew is Past-President of the Regina Centre and an active amateur astronomer within the AAVSO. In 2001, Vance discovered Comet P/2001 Q2 Petriew at Cypress Hills Inter-Provincial Park while attending the annual Saskatchewan Summer Star Party. For his discovery he was awarded the Edgar Wilson Award and the RASC Ken Chilton Prize. Vance sits on the Saskatchewan Light-Pollution Abatement Committee.

Bob King has had an interest in astronomy for as long as he can remember and has been a member of the RASC since 1978, serving on council and various committees for Calgary and Edmonton Centres. He particularly enjoys the public education aspects of astronomy. Bob has been involved with light-pollution abatement since 1990 and currently leads the Calgary Centre's Light-Pollution Abatement Committee and serves on the RASC's National Light-Pollution Abatement Committee. He and the Calgary committee have played a significant role in Calgary's EnviroSmart Streetlight Retrofit Project, influenced Calgary's revised roadway lighting standards and its new community standards by-law, built an effective responsible-lighting education programme, and have provided support to light-pollution abatement efforts in several other communities in Canada and the United States.

Life List

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

The sands of time were eroded by
the river of constant change ...

— Peter Gabriel (with Genesis),
Firth of Fifth

"That's another one for the Life List!" is the sort of comment one hears during a memorable observing experience. Of course, such a list is completely subjective. In my own case, it's not so much a "to do" list of objectives to be checked off one-by-one, as a "been there" retrospective of actual observations that have earned their place in the memory bank. By that I mean chiseled into the stone tablets of brain-stem memory; I don't keep an observing log so forgettable doesn't cut it.

For some a Life List might include particular observing sessions, star parties, or favourite deep-sky objects. My own bias is towards dynamic events, mostly close to home in our own Solar System, where one can observe in real time the subtle workings of the constantly changing cosmos. Since these events occur at specific moments in time, my memories organize themselves chronologically:

December 25, 1984: After dropping my parents at the airport around midnight for an overnight flight, Anna and I continue on for our traditional Christmas visit to Red Deer at an un-traditional time. Driving due south on a deserted Highway 2, my attention is grabbed, and held, by the unmistakable figure of Orion the Hunter, framed by the sparkling Winter Hexagon. It is a pleasure making his acquaintance, even at the embarrassingly advanced age of 29.

January 24, 1985: Walking to an Oilers' game, I see a spectacular conjunction of Venus with the crescent Moon. The ice fog that has obscured everything else in the sky frames these two brilliant objects with gorgeous halos.

July, 1985: At a cottage retreat in France, I point out a rising planet to my sister Margaret, not entirely sure if it's Jupiter or Saturn. I bring up my 7 × 50 binoculars for a look, and to my unabashed surprise, I am thrilled to immediately resolve a string of Galilean pearls. I never again mistake Jupiter for anything but the King of Planets.

January, 1986: The combination of dark skies, a rural location, a trusty pair of 7 × 50 binoculars, my Dad's company, and Halley's Comet is a winner.

August, 1986: The summer after joining RASC, I discover the Edmonton Space Sciences Centre's Observatory, and find myself returning frequently. I watch Richard Reid effortlessly sweep up M13 and M57 in the C-14. It appears like magic, but Richard patiently explains: "See that little parallelogram of stars near the bright one…" Although I am scared spitless by the hardware, I begin to think "I could do that!" By the following spring, I am a volunteer.

April 25, 1987: All-night observing session at Waskehegan, which includes a stunning view of the Whirlpool Galaxy in the club scope, a 17.5-inch *Coulter*. Deep into the morning hours, three of us remain, including Mike Noble and a newcomer I have just met, Alister Ling, hoping to see an occulted Venus emerge from behind a late-rising Moon. The *Observer's Handbook* occultation tables give an invisibility code for Edmonton, but the data for other stations suggest that under good conditions we should see the reappearance event a couple of degrees above the northeastern horizon. Conditions are far from good, however. We wander eastward down a cart path to find a clear horizon view, and are rewarded with a binocular glimpse of the slender waning crescent Moon rising through clouds. Suddenly a bright spot appears on the lower right of the unlit limb and rapidly intensifies. Success!

May 1, 1987: A bare week later, I am working a Friday evening shift at my new volunteer gig and have a last look at the now four-day-old crescent Moon before closing. To my surprise, I see it is bearing down on a brightish star, so Richard and I stick around for the inevitable occultation. In the *Zeiss* refractor, the Earth-lit limb of the Moon inexorably advances toward the star as I, a freshly-minted "expert," speak confidently about how instantaneous its disappearance should be. I am shocked that the star blurs and fades briefly before winking out. Only later do I read about step occultations involving double stars, and later still that this particular object, 136 Tauri, is suspected to be double from a lone observation made decades before. I submit my observation to the International Occultation Timing Association.

August 27, 1988: Partial eclipse of the Moon at 3 a.m. Alan Dyer, Russ Sampson, Alister, and I open the observatory for the occasion, but public interest is, shall we say, limited. We have a great time anyway, as an array of Solar System objects spans the sky at roughly 30-degree intervals: Saturn, the eclipsed Moon, Mars a month before its perihelic opposition, Jupiter, and finally Venus. A double-shadow transit on Jupiter mimics the happenings within the Earth-Moon system. Just before we close the roof, a bright object appears unannounced in the southeast. Sweeping it up in the C-14, we are delighted to resolve a research balloon, an iridescent gossamer teardrop with its payload hanging at a comical angle in the eyepiece.

April 30-May 1, 1989: I go to Waskehegan on consecutive nights to observe, and then confirm, Pluto during the year of its perihelion. On the second night, it has moved ever so slightly against the background star field. Unexpectedly, it has also dimmed a couple of tenths of a magnitude. After the fact, I read I have observed an event of the rare occultation series involving Pluto's moon Charon. I am awarded a Pluto certificate by the observing group. Later that year, Edmonton Centre hosts a talk by the planet's discoverer, Clyde Tombaugh. Clyde graciously agrees (after I have purchased his book) to sign my certificate.

July 2, 1989: Occultation of a sixth-magnitude star, 28 Sagittarii, by Saturn. The ringed wonder is at opposition that very night, low in the summer sky but with rings at maximum tilt. Seven of us share six telescopes at the observatory for unforgettable views of the star disappearing behind the A ring, reappearing in Cassini's Division, then undergoing a spectacular series of fluctuations as it passes through the Crêpe Ring before briefly being "captured" between the ring and ball of the planet. An unforgettable sight, perhaps the first on the list that warrants a perfect score of 10 out of 10.

August 24, 1989: *Voyager 2* encounters the then-outermost planet. A largish crowd gathers in the Space Sciences Centre to watch spectacular images of Neptune and Triton materialize from the depths of space as if by magic. The crisply focused photos show a veritable wealth of detail never before imagined, let alone imaged. After we've had our fill, I invite the stragglers outside to see Neptune with their own eyes. Even in our largest scope, the C-14, this gorgeous world is reduced to a pale blue dot, mute testimony to the immensity of the void that humankind has navigated.

April 1, 1990: April Fool's Day Graze Expedition. Weeks of planning and a midnight excursion are foiled by a single cigar-shaped cloud at the most inopportune moment. In the middle of the line, Larry Wood sees the star when all around him see nothing. Larry is credited with discovering the first known hole in the Moon.

January, 1991: I put my newly-acquired 8-inch f/8 Cave mirror Newtonian to the test observing an all-night series of mutual events involving all four moons of Jupiter. At –33° C, the winter air is crisp, but so are the optics.

July 11, 1991: Total eclipse of the Sun, seen from Goat Beach near Mazatlan, Mexico. Circumstances are perfect, as Sun and Moon come together at the zenith in the sky's ultimate centerpiece. It's an exceptionally long eclipse at nearly seven minutes, and it needs to be because there's so much to see: brilliant pink prominences; extensive coronal streamers, the bright star delta Geminorum hiding in their veils; four planets strung out to the east. In the rainforest toward the eastern horizon, a lightning storm is underway. 11 out of 10.

July, 1991: The ash of the Mount Pinatubo volcanic eruption girdles the tropics, largely obscuring our view of the deep southern sky theoretically accessible from the Tropic of Cancer. In return we are rewarded with a series of spectacularly vivid sunsets featuring the four planets and the now-waxing Moon undergoing weird colour transitions as each prepares to splash down in the Pacific.

March 8, 1993: Extreme close perigee of Moon with exceptional northern libration leads to all-night observing session that ultimately kick-starts a new project: to observe every named feature on the lunar nearside. First phase of project is completed nine years later.

August 23, 1993: As the last stragglers from Mount Kobau Star Party, Alister and I awaken after overnight rains to transparent skies. Limiting magnitude is near 7.5; I feel like I'm in space. Without any optical aid, we count dozens of unrecognized stars within the usually-vacant Great Square of Pegasus, easily sight the Pinwheel Galaxy, and spot dark lanes and rifts through the Milky Way including the rarely-seen "Super Polaris Highway." 10 out of 10.

November 29, 1993: The Fort Nelson Graze Expedition. I am one of 15 Edmonton Centre members who are conducting Actual Scientific Research, trying to measure the polar diameter of the Moon. This involves two teams of observers simultaneously measuring the opposing poles of the Moon grazing the same star; for sufficiently accurate observations both limbs must be dark, so this is only possible during a total lunar eclipse. Despite heavy cloud, which almost totally ruins the eclipse itself, our group miraculously makes successful measurements. Alas, the other expedition in Baja California records a null result, so our scientific efforts are ultimately in vain. The kind people of Fort Nelson treat us like visiting royalty.

July 16-22, 1994: Planetary bombardment in real-time. The fragmented Kamikaze Comet, Shoemaker-Levy 9, is obliterated by mighty Jupiter like mosquitoes on a windshield. Unforgettable. 10 out of 10.

August 12, 1994: Kobau again. Watching meteors on the sweetest nights of the year. A circle of Edmonton Centre members observes the peak nights of the Perseids under ideal conditions, shortly after the passage of the parent Comet Swift-Tuttle. I personally count over 700 Perseids in 15 hours over 4 nights.

March 26, 1996: Comet Hyakutake passes Polaris. From a dark site, seven freezing amateurs observe its spectacular 60+ degree tail.

April 3, 1996: Two of my favourite binocular star fields are simultaneously adorned with bright visitors. Venus passes by the Pleiades, while Hyakutake cruises through the alpha Persei stellar association.

April 9, 1997: An amazing naked-eye tripleheader. Yellow and blue Comet Hale-Bopp continues to grace the skies from dusk onwards; the crescent Moon occults ruddy Aldebaran; minutes later, a dazzling aurora explodes onto the scene, displaying a variety of saturated greens, violets, reds, and more colours than I can name. 30 out of 10.

October 20, 1997: Grazing occultation of Aldebaran, observed by 30 amateurs near Morningside, AB. Harris Christian and I draw the lucky seventh station in the middle of the graze line, and are rewarded with six disappearance/reappearance pairs in under a minute, plus an unforgettable seventh event: a fade where Aldebaran diminishes to a tiny, faint dot but never goes out. Incredibly, we have resolved the disc of this nearby orange giant. 10 out of 10.

August 24-26, 1998: Cause and effect. Observe a Class X-3 solar flare from beginning to end through the hydrogen-alpha scope at the observatory. Two nights later, observe the resultant all-night, all-sky aurora.

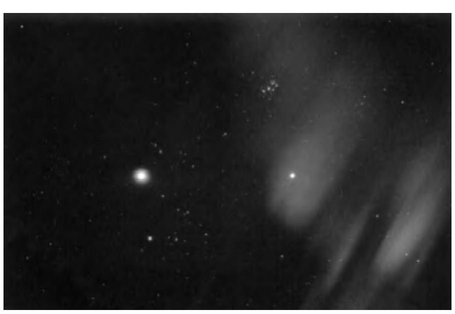
November 22, 1998: Independently predict and observe a partial eclipse of Jupiter's outermost satellite, Callisto. The giant moon fades by several magnitudes but is faintly visible throughout.

February 26, 1999: Bittersweet. A vanful of bereaved local astronomers makes its way to Calgary to join a huge throng of admirers paying last respects to Father Lucian Kemble. Appropriately, the planets are massing also. Venus and Jupiter are in a spectacular close conjunction, Saturn hovers a short distance away. The fourth member of the planetary quartet, shy Mercury, eludes our gaze until we make our final turn westward towards the church. Suddenly the Winged Messenger appears in the deepening twilight, low on the due west horizon and directly outside the open doors of the sanctuary… Later we are drawn almost magnetically to the Lamplighter's old observatory in Cochrane, where we take a lingering look at Kemble's Cascade.

January 18, 2000: Thanks to a timely heads-up from Mike Hoskinson, spot a bizarre cloud in the early evening twilight in the general direction of Banff. Experts later argue whether it should be called a noctilucent or a nacreous cloud, but all agree it is the aftermath of the Tagish Lake fireball, ten hours after the meteorite fall and a thousand kilometres downrange.

July 30, 31, August 1, 2000: On consecutive days at the observatory, see the Moon occult the three innermost bodies of the Solar System, Mercury, the Sun (a partial eclipse), then Venus.

August 12, 2000: Rain clouds clear off very late, but in time for an unforgettable hour. The sky is alive with a spectacular aurora, a handful of bright Perseids, a minimum of Algol, and my first sighting of the "Millennium Diamond," a temporary asterism of the Hyades, Pleiades, Jupiter, and Saturn. The most dynamic night sky I've ever seen.



Millennium Diamond: Jupiter, Saturn, the Hyades and the Pleiades form a diamond in the sky against a backdrop of aurora.
Photo courtesy of Sherry Campbell.

November 20, 2000: An exciting day for an occultation enthusiast. David Dunham, probably the world's leading expert on the subject, flies to Edmonton specifically because he feels we have the best chance to see a rare occultation of a bright star (mu Geminorum) by an asteroid (752 Sulamitis). Not only that, he's plotted exactly where we should go… how can we go wrong? My first expedition to Fort McMurray yields reasonably good sky conditions, preparation, anticipation, and… nothing. Nothing but crushing disappointment. Sharing a prime station, Murray Paulson and I need each other to corroborate that we didn't blink and miss it. My lifetime batting average for asteroid occultations falls to 1 for 7. Even the expert calculations of Dr. Dunham are not always a match for the extremely slippery science of asteroid astrometry.

November 18, 2001: Leonid meteor storm puts on a once-in-a-lifetime show. I see over 1500 meteors overnight, including 655 during the peak hour. These numbers are conservative, the meteors are simply too plentiful to accurately count. 10 out of 10.

January 1, 2002: Observe a shadowless transit of Ganymede in front of Jupiter. During this time, an imaginary observer on Ganymede or Jupiter could see a transit of Earth against the Sun. To me, looking the opposite way from inside the light cone, Ganymede covers its own shadow.

November 19, 2002: Another Leonid storm, this time all but beyond our visual reach due to clouds, snow, bright moonlight. However, the shower is successfully observed by car radio, and by four radio telescopes in the fledgling Sky Scan Array. Our results are later used by a leading international meteor scientist.

August 28, 2003: Closest approach of Mars in almost 60,000 years. On the actual night itself, clouds have driven away the madding crowds and the hardworking volunteers. Only Kevin Jeske and I remain at the observatory, stubbornly holding out for a look at Mars at its closest. Mere minutes before closest approach at 3:52 a.m., the clouds magically part in the narrowest of sucker holes. The view isn't great, but it *is* a view at just the right moment. The hole closes even more rapidly than it opened. Kevin and I shake hands, glad of the company and of the corroborating witness that we have indeed experienced a minor miracle, or at least a moral victory.

June 8, 2004: An expedition of Edmonton astronomers gathers on Wood Bison Lookout north of Fort McMurray to see the rarest of astronomical spectacles: a transit of Venus. We need clear skies down to the horizon to catch the very end of the event. At the appointed time (4:35 a.m.!) the Sun rises, wobbles unsteadily for a time, and grudgingly reveals the black planet captured just within its limb. The silhouetted Venus moves slowly but inexorably toward the nearest exit in a surreal undulating spectacle of light, colour, and absence thereof. This is *much* more interesting than the black dot on white disc I had anticipated; to my surprise I give it 10 out of 10.

As Venus disappears off the Sun's lower-right limb just a couple of degrees above the northeastern horizon, I suddenly realize I'm seeing what amounts to a photonegative of my first significant observation, the lunar occultation of Venus that Alister, Mike, and I witnessed 17 years previously. What goes around comes around.

Christmas, 2004: Mining the motherlode of memories has again sparked the thrill of discovery and innate joy in nature's beauty. Luckily, my passion is astronomy, where the sky's the limit and it is impossible to have "seen it all." If I remain fortunate, and alert to opportunity, the upcoming decades will yield many more wonderful celestial moments to add to the Life List.

A contributing editor to JRASC *since 2000, Bruce McCurdy has been inspired to write about astronomy for the past two decades, having submitted over a hundred articles to* Stardust, *the Edmonton Centre newsletter. The foregoing retrospective was written for the 50th anniversary special edition of* Stardust *published November, 2004 (Sherry Campbell, Editor).*

Dr. Alison Sills

by Philip Mozel, Toronto Centre (philip.mozel@osc.on.ca)

Growing up in Toronto is not conducive to astronomy given the level of light pollution. Nonetheless, Dr. Alison Sills' enthusiasm was never dampened. Her fascination with the subject, dating from a young age, was nurtured by her father, an RASC member, who exposed his daughter to the splendour of dark skies on family camping trips. She accompanied him to the public star nights at the David Dunlap Observatory in Richmond Hill, where, along with other RASC members, they toured the public through the Universe with their telescope. Dad and daughter also attended Toronto Centre meetings at the McLaughlin Planetarium where she particularly remembers the lectures of Dr. Tom Bolton of the University of Toronto.

While attending high school, Dr. Sills applied to, and was accepted by, the Ontario Science Centre's Science School. Here she spent a semester and had a "fabulous experience that made me think I wanted to go into science." Galvanizing her further about this time was an event that occurred thousands of light years away. A Canadian, Ian Shelton, discovered the closest supernova visible on Earth in centuries: SN1987A.

Her path was now set. Finishing undergraduate work at the University of Western Ontario, Dr. Sills moved on to Yale for her Ph.D. and did postdoctoral work at Ohio State and the Theoretical Astrophysics Group at the University of Leicester. In 2001 she joined the Department of Physics and Astronomy at McMaster University in Hamilton where she is now an assistant professor.

Dr. Sills' current research is largely theoretical (and therefore largely free of light pollution!) and looks at stellar dynamics and hydrodynamics and the evolution of stars. Questions are also asked about the structure of low-mass stars when mass is lost to a binary companion. She also studies stars that are found in unusual places such as globular clusters where the relatively high stellar-population densities result in a greater-than-normal collision rate. Study of the collision products not only tells us something about the individual stars involved but also about the history of the clusters' formation.

Then there are blue stragglers. Blue stragglers are hot, blue, and seemingly young stars. But what are young stars doing in globular clusters (which are very old)? This apparent age difference presents astronomers with a quandary since one would expect all the stars in the cluster to have formed at the same time. What is the secret of the stragglers? Thanks in part to the work of Dr. Sills, we think we know.

Consider the interior of a globular cluster where stars are densely packed. (When asked what the night sky would be like on a planet in such a cluster, Dr. Sills responds, "What night!?"). Stellar collisions will be frequent. And the result? That depends on many factors such as the relative masses of the two stars and the speed of the collision, typically 10 km s^{-1} in the globular cluster environment (or 200 km s^{-1} in the galactic core!). The stars may have come from widely separated locations in the cluster or may have once formed a binary system. In either case, they may merge thereby rejuvenating themselves as a single, "new" star. It is now generally believed that blue stragglers result from the merger of smaller, yellow (*i.e.* sun-like) stars. The mass of the now-single star is greater than either one of the precursors. The increased mass exerts greater pressure on the core, the temperature increases, and the star becomes bluer. The merger also increases the spin rate (which may have an effect on the abundances of the elements we see due to the resulting churning). Voila! A blue straggler. (The term blue straggler is not meant to suggest that these stars are straggling through space. Rather, it refers to their position toward the blue side of a colour-luminosity, or Hertzsprung-Russell, diagram of the host cluster).

The magnetic fields of the stars also "collide." They may cancel each other out or make themselves stronger or…who knows. This field of investigation is wide open and beckoning investigators like Dr. Sills.

Major stellar smashups are not the only events that have caught Dr. Sills' eye. She is also curious about smaller fender-benders. It turns out that some stars with planets seem to be metal-rich (*i.e.* have a high abundance of elements heavier than helium). Such metalicity seems to be the fingerprint of solar systems. The mystery here is the source of these elements. Do they originate with the star itself or perhaps with a planet that has collided with the star? Once again, Dr. Sills is on the crash scene and we may shortly have an answer.

The cosmic CSI goes on as Dr. Sills continues to investigate bumper-car stars and things that go bump in the night.

Philip Mozel is a past National Librarian of the Society and was the Producer/Educator at the McLaughlin Planetarium. He is currently an Educator at the Ontario Science Centre.

The Skies Over Canada

Observing Committee News

by Christopher Fleming (observing@rasc.ca)

Observational astronomy offers many avenues of opportunity, and for those who have a keen interest in this great hobby there are a wealth of resources available. Professional astronomy is largely funded by tax dollars and therefore the results of that research are, in many cases, available to everyone and can be used by hobbyists. In the early years of the Internet, before the World Wide Web was established about 12 years ago, astronomy had a significant presence via several universities. This gave it a jumpstart in the realm of the Internet and since then the amount of data posted by educational institutions, as well as by talented individuals, is quite significant and a boon to all those who have joined the computer revolution.

This is not to say that books have become less important because I have purchased more of them since I bought my first computer than I did previously. Perhaps you could say that the Internet sparks an enthusiasm for learning and is a wonderful guide to what is available on a global basis. It has been said that astronomy is a perfect way to use the Internet and, with resources like the amazing *Hubble Space Telescope* images available to us (they are public domain funded by tax dollars) at the click of a mouse, I would have to agree.

The Observing Committee would like to support those who have established Web sites that offer tutorials, images, or information about astronomy in general. We plan to post links to these sites with priority given to RASC members, but not exclusively. They will be featured in two categories, one for recreational astronomy and the other for scientific pursuits, although perhaps some could be listed in both categories. We invite you to send a link to your site via our committee email address at `observing@rasc.ca` and we would appreciate some description of the contents in order to save us from having to search and read the entire site.

Another major project we have been working on for some time is nearing completion and should be ready for launch in the spring of 2005. It is a comprehensive new lunar observing certificate program that will be named in honour of Isabel K. Williamson, who was a legendary amateur astronomer from the Montreal Centre. Denis Grey has been coordinating the development of the program along with other committee members and several lunar observers (dubbed "lunatics") from across the RASC. Many thanks to Denis and company for a job well done — it will be available for download from the Observing area of the RASC site and via the online eStore in booklet form.

The Explore the Universe Certificate program continues to be popular and we encourage all Centres to participate in this important new observing program. It was designed for new observers but everyone can benefit from the great variety of objects listed there, many of which are not available on our other two certificate programs. You will also find an optional supplementary list of variable stars included with the ETU program that will challenge even the most demanding observer. There have been three Explore the Universe Certificates awarded since our last report and they are listed in Table 1.

Our flagship Messier program has been sailing right along and I am glad to report that there have been seven new Messier Certificates awarded since our last report and they are listed in Table 2.

The Finest NGC list features many outstanding deep sky objects that are well worth checking out as well as some very challenging targets that require polished observing skills to locate and see. We have awarded one new Finest NGC Certificate since our last report and you find that skilled observer listed in Table 3.

Congratulations to all of the new certificate recipients; their names have been added to the recipients' list on the Web site for each program.

The Asteroids Section continues to be updated with information and finder charts covering asteroids that will be visible from Canadian latitudes and that will be brighter than magnitude 10. You will also find an inclusive history of the origin of asteroids, a chronology of their discovery, their composition, sizes, and distances. Also included is a list of frequently asked questions, an observing-skills page, printable observing forms, images, recommended books, and links to several key minor-planet Internet sites. In addition you will find a link to Peter Jedicke's list of Asteroids with Canadian Connections and an overview of suggested projects that you may find interesting.

The Variable Stars Section features direct links to official American Association of Variable Stars Observer's (AAVSO) magnitude estimate charts for Mira-type Long Period Variables that will reach maxima in 2005 and that will be brighter than magnitude 8. You will find them on the Sample Charts 1 page; we also have direct links to charts for several other variable-star types that you can find on the Sample Charts 2 page. Many of the most interesting variable stars in the night sky are listed there as well as the

Table 1. Explore the Universe Certificate Recipients.

Name	Centre	Date Awarded
Curtis E. McEwan	Toronto, Ont.	September 2004
Ralph A. Croning	Winnipeg, Man.	September 2004
F. Lindsay Price	Winnipeg, Man.	September 2004

Table 2. Messier Certificate Recipients.

Name	Centre	Date Awarded
Chris Teron	Ottawa, Ont.	August 2004
Larry Scott	Saskatoon, Sask.	August 2004
Christopher Novak	Montreal, Que.	September 2004
George Charpentier	Saskatoon, Sask.	September 2004
Charles Doucet	Moncton, N.B.	September 2004
Emma MacPhee	Moncton, N.B.	September 2004
Christopher Mulders	Calgary, Alta.	September 2004

Table 3. Finest NGC Certificate Recipient.

Name	Centre	Date Awarded
Tenho Tuomi	Saskatoon, Sask.	September 2004

positions of possible nova outbursts. In addition the Variable Star Section has detailed information about how to observe variable stars and a complete tutorial written Dr. Bob Nelson of the Prince George Centre.

The Special Projects Section features specific information about upcoming events such as eclipses, transits, notable planetary conjunctions, and more. Recently we posted a page for the October 27, 2004 total lunar eclipse and we are planning more content as outlined toward the beginning of this article. We would welcome additional content for this section so, if you have a scientific project underway that you would like to share with fellow RASCals, please let us know.

A new Comets Section was nearing completion at the time of this writing and should be posted in the Observing Sections area of the RASC Web site by the time this article reaches you. I extend a sincere thank you to David Levy and Michael K. Holzer for contributing content to it; the address is `www.rasc.ca/observing/comets`.

Clear Skies.

Christopher Fleming is Chair of the RASC Observing Committee and Observer's Chair in the London Centre. He enjoys all types of observing especially Deep-Sky, Lunar, Double Stars, and Variable Stars. Chris is also a musician and Webmaster of the London Jazz Society's Web site.

WEB ACCESS TO FEBRUARY 2005 ISSUE

The February 2005 issue of the *Journal* can be accessed from the RASC Web site at `www.rasc.ca/currentjrasc`
This issue will be posted immediately after the final production version is complete (approximately February 10, 2005) and removed from the Web once the issue begins arriving by mail.

DEPARTMENTS

Across The RASC

Columns

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Astrocryptic

by Curt Nason, Moncton Centre

We present the solution to last month's puzzle

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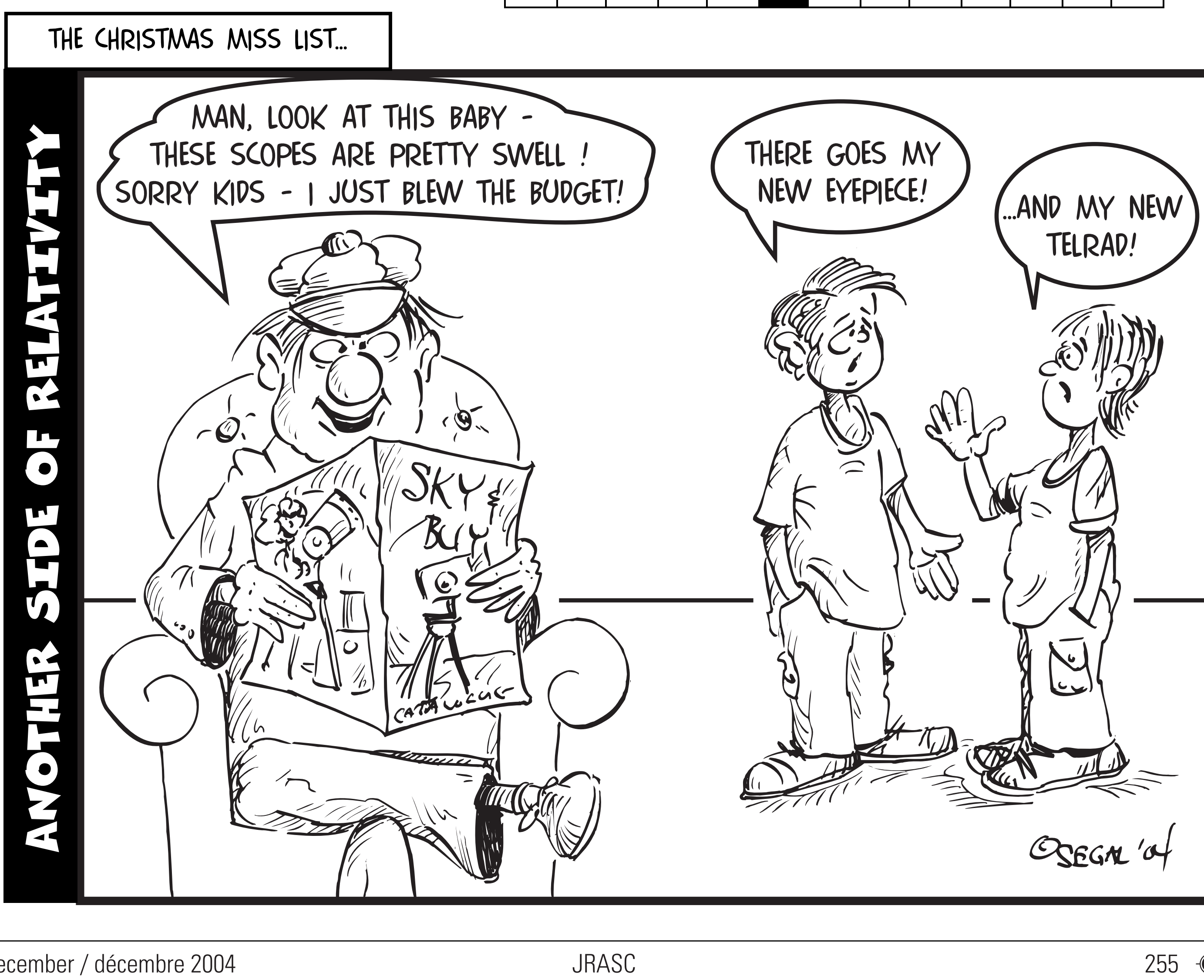

Great Images

The Propitious Pleiades
The poet Milton describes the Sisters as “shedding sweet influence.” One of the nearest open star clusters, the Pleiades’ young hot blue stars and painterly blue reflection nebulae seem to float in front of the cooler yellow background stars, yielding a three-dimensional effect. Merope, Maia, and Alcyone have starring roles in the nebulosity.
— Digital composite of photos by Rajiv Gupta from the December page of *Observer’s Calendar 2001*

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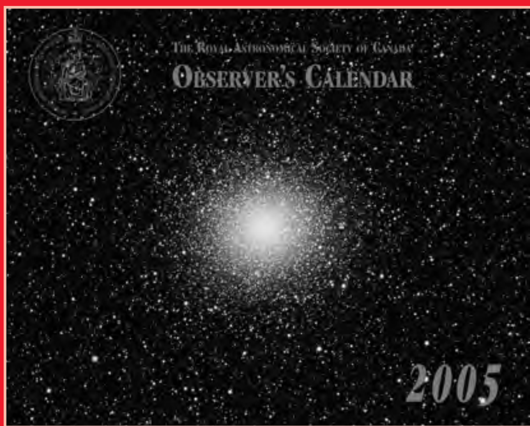

Observer's Calendar — 2005

The award-winning RASC Observer's Calendar is your annual guide

Created by the Royal Astronomical Society of Canada and richly illustrated by photographs from leading amateur astronomers, the calendar pages are packed with detailed information including major lunar and planetary conjunctions, meteor showers, eclipses, lunar phases, and daily Moonrise and Moonset times. Canadian and US holidays are highlighted. Perfect for home, office, or observatory.

Individual Order Prices:
$16.95 Cdn/ $13.95 US
RASC members receive a $3.00 discount
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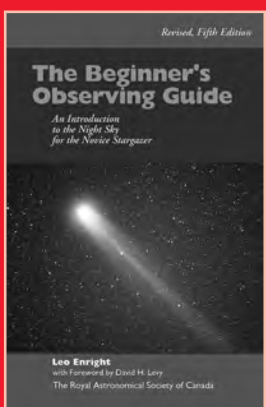

The Beginner's Observing Guide

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

Written by astronomy author and educator, Leo Enright; 200 pages, 6 colour star maps, 16 photographs, otabinding.

Price: $19.95 plus shipping & handling.

Skyways: Astronomy Handbook for Teachers

Teaching Astronomy? Skyways Makes it Easy!

Written by a Canadian for Canadian teachers and astronomy educators, Skyways is Canadian curriculum-specific; pre-tested by Canadian teachers; hands-on; interactive; geared for upper elementary, middle school, and junior-high grades; fun and easy to use; cost-effective.

Skyways is complete with conceptual background; teacher information; student worksheets; resource lists; Canadian contributions to astronomy section FAQ's; and more. Written by Canadian author and RASC member, Mary Lou Whitehorne.

Price: $16.95 Cdn (members); $19.95 Cdn (non-members)
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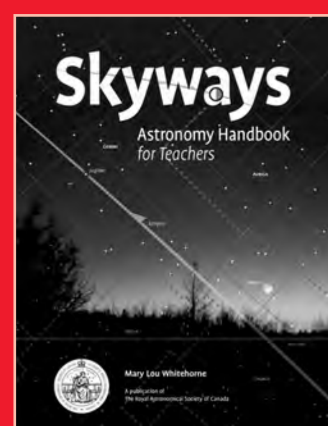

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