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Building for the International Year of Astronomy (IYA2009)

February / février 2008

Journal

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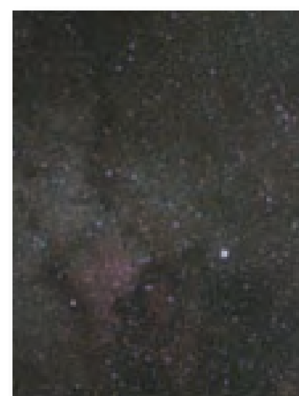

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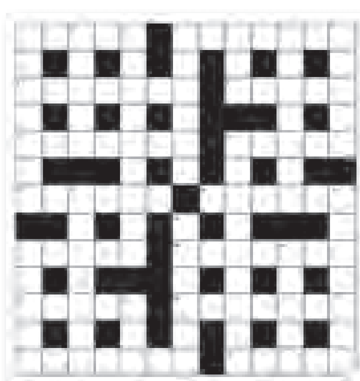

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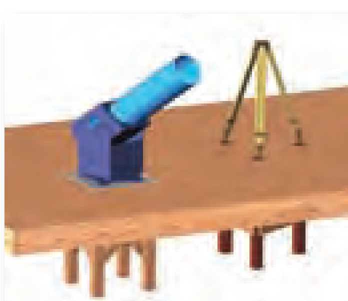

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ROYAL ASTRONOMICAL SOCIETY OF CANADA

SOCIÉTÉ ROYALE D'ASTRONOMIE DU CANADA

DEPARTMENTS

Cover photo:
The dome of the 1.6-m Mont-Mégantic Observatory under moonlight. The observatory is the largest on the east coast and is administered by the Université de Montréal, Université Laval, and McGill University. Photo courtesy Robert Dick, using a Canon Rebel XT, with a 18-70-mm zoom lens, 30-second exposure at f/4, ISO 1600.
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COLUMNS

Editorial

Lost — Canadian Astronomy

by Jay Anderson

This fall, we learned that the David Dunlap Observatory north of Toronto is likely to be turned into another boring subdivision full of snout houses. Though the process has a whiff of subterfuge and hidden agenda, it merely marks the continuation of a process that has being going on for a decade or more and it shows no sign of abeyance. Canadian astronomy is lost.

We are told that Canadian astronomers have one of the highest publication records in the world (a distinction also claimed by the British and the Americans). We know of some of the discoveries, recognize the acronym CFHT when it appears in the news, and can probably name at least one Canadian astronomer. Can the same be said of those outside our Society?

Our astronomers have a deserved reputation for innovation — just think of the CFHT, *MOST,* and the exquisite Galactic Plane Survey at the DRAO. There is a camera on the CFHT called *MegaPrime* that leads the way in wide-area deep-sky observing. *MOST* set the scene for a generation of new satellites, doing cheaply what the Americans and Europeans are now doing with their billions. We have time on Chile's telescopes (built for them by the Europeans), and some time on U.S. telescopes. It's not such a bad idea, the sharing of costs and ideas with the rest of the world, but that, and neglect by Canadian astronomers themselves, has made astronomy invisible to the man and woman on the street.

The CFHT with its magnificent *MegaPrime* should have a dynamite Web page. Its images should grace the covers of magazines. Planetaria around the country should sell CFHT posters of the Universe's trophies. Indeed, the CFHT Web page does show off some spectacular images — exactly 12 of them each year, scarfed from the pages of an Italian calendar manufacturer and overlaid with the manufacturer's logo. Just a picture — no description, no attempt to pass on a little science, not even a particularly good job at image processing. The Gemini telescope next door, in which the University of Toronto participates through AURA (the Association of Universities for Research in Astronomy), has a more lively public presence, and celebrates their achievements (not the U of T's) with more imagery and an electronic journal.

The public invisibility of Canadian astronomy goes beyond a few Web-page adjustments. There was a time when Canadian astronomers wanted to reach the Canadian public — the former pages of this *Journal* are a testament to that. Canadian astronomers once had the status now enjoyed by Canadian astronauts. Helen Sawyer Hogg and C.A. Chant understood their

Journal

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

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connections to the country, and probably considered it a duty to keep us informed. Today, Terence Dickinson and Al Dyer are the modern HSHs.

This country needs some serious in-house astronomy. It needs astronomical institutions that communicate and it needs astronomers who reach out to the public. Bickering, poor planning, government cutbacks, and the cost of playing with the Big Boys has ruined several chances to build other at-home observatories or observing projects. We tried once, in the not-very-suitable mountains of B.C., but the DAO, DDO, and Mégantic prove that you don't have to be on a mountain-top to be a hit. The Cypress Hills of Alberta or Saskatchewan, the sunniest part of Canada, are tailor-made for a Canadian version of AURA. We have huge strengths in radio astronomy that are being frittered away by parochial views of how and where astronomy should be done. But more than anything else, we have professional astronomers who can't sell the Universe.

International Year of Astronomy is coming. How about a Canadian Year of Astronomy?

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ONE HUNDRED EDITIONS OF THE *OBSERVER'S HANDBOOK*

by Roy Bishop, Halifax Centre

Abstract: The 2008 *Observer's Handbook* is the 100th edition of this venerable annual guide to the sky. Created by C.A. Chant, sustained and expanded by seven editors and assistant editors, fine-tuned by an editorial team, and supported by more than one hundred contributors over the years, the *Observer's Handbook* is one of the best-known facets of Candian astronomy throughout the world, and provides significant financial support for The Royal Astronomical Society of Canada.

Résumé: L'édition de 2008 de la publication *Observer's Handbook* est la centième de ce guide annuel du ciel. Rédigé par C.A. Chant, maintenu et élargi par sept rédacteurs et rédacteurs adjoints, peaufiné par une équipe de redaction et appuyé par plus d'une centaine de collaborateurs durant ces cent ans, la revue *Observer's Handbook* est une des composantes de l'astronomie canadienne les mieux connues à travers le monde. Elle fournie aussi un appui financier important à la Société royale d'astronomie du Canada.

Introduction

The *Observer's Handbook* of The Royal Astronomical Society of Canada (RASC) is one of our country's oldest scientific publications. The *Canadian Almanac* (since 1847) contains some astronomical information, but astronomy forms only a minor part of this non-technical sourcebook on life in Canada. A few scientific publications such as the *Transactions of the Royal Canadian Institute* (published from 1852 until 1969 by Canada's oldest scientific society), the *Proceedings of the Nova Scotian Institute of Science* (since 1863), and the *Proceedings and Transactions of the Royal Society of Canada* (since 1883) also pre-date the *Observer's Handbook;* however, these serve as forums for the presentation of reviews and research in various fields. The *Observer's Handbook* was the first comprehensive guide to the sky, the first annual astronomical almanac, to be published in Canada.

The first edition of the *Observer's Handbook,* then titled *The Canadian Astronomical Handbook,* covered the year 1907. A second edition appeared for 1908, but for the following two years most of the information that would have appeared was published instead in installments in the *Journal of the Royal Astronomical Society of Canada.* The Council of the Society decided to return to a separate publication for 1911 with the name the *Observer's Handbook,* and it has been published annually ever since. The *Observer's Handbook* for 2008 is the 100th edition.

Annual Astronomical Almanacs

The world standard for annual astronomical data is the *Astronomical Almanac,* published jointly by the Nautical Almanac Office of the United States Naval Observatory and Her Majesty's Nautical Almanac Office in the United Kingdom. The RASC is indebted to these organizations for much of the Solar System data that appear in the *Observer's Handbook.* Although the *Observer's Handbook* relies on the *Astronomical Almanac* for some of its material, there is little overlap in the two publications. The *Observer's Handbook* is intended for a wider audience and contains a broader spectrum of topics.

Annual astronomical handbooks are published in several countries: for example the *Handbook of the British Astronomical Association* in the United Kingdom (since 1922); Ottewell's *Astronomical Calendar* in the United States (since 1974); and the *New Zealand Astronomical Yearbook*. Canada's *Observer's Handbook* is unusual in that it is distributed to many countries and is found in most professional observatories in both North and South America. Its wide use is due to the quantity, quality, and variety of information it contains.

The Creator of the *Observer's Handbook:* C.A. Chant

Born in 1865 near Toronto, Clarence Augustus Chant graduated B.A. in physics and mathematics from the University of Toronto in 1890, and in 1901 received a Ph.D. in physics from Harvard University. He joined the physics faculty at Toronto in 1891 and the RASC (then The Astronomical and Physical Society of Toronto) a year later. When Chant joined the Society in 1892, who could have guessed that 15 years later he would create both the *Journal* and the *Observer's Handbook* and be their editor for half a century!

On 1893 April 18, Chant addressed the Society for the first time. His title was "The Polarization of Light."

> *[Chant's] paper concerned the nature of light, but little did he realize that to hundreds of future members of our Society, and to future astronomers in Canada, he was to become the guiding light. Through his devotion and un-*

tiring efforts directed both to professional and amateur astronomy he would earn for himself the title of the century in our land — The Father of Canadian Astronomy. (Kemp 1968)

Figure 1 — Clarence Augustus Chant (1865-1956), the creator and first Editor of the *Observer's Handbook* (1907-1956) and the "Father of Canadian Astronomy." Photo from the JRASC, 11, 62 (1917).

It was on Chant's urging that, in 1904, the University of Toronto put an astronomy option in its mathematics and physics program. A year later, during his four-year presidency of the RASC (1904-1907), Chant's daughter Etta designed the official seal of the Society, an updated version of which graces the title page of the current *Observer's Handbook.* The seal shows the figure of Urania, the mythological Greek muse of astronomy, and the motto *Quo Ducit Urania* — literally *Whither Leads Urania,* or as long-time RASC member and musician Franklyn Shinn (1911-1997) preferred: *Whithersoever thou mayest lead us, O Goddess of the Universe* (Shinn 1989).

In 1905, Chant also established the Gold Medal of the RASC as an award for the top student graduating with first-class honours from the undergraduate astronomy and physics course at the University of Toronto. Among the recipients of the Gold Medal are several who went on to make major contributions to the *Observer's Handbook:* Frank Hogg (1926 medalist), Peter Millman (1929), Ian Halliday (1949), John Percy (1962), and Anthony Moffat (1965).

In 1906, Chant began to make the RASC truly national by instituting the system of Centres, beginning with the Ottawa Centre. Today there are 29 Centres, from St. John's to Victoria. That same year, with an increased annual grant from the Ontario government and a new federal annual grant obtained as a result of a meeting with the Prime Minister, Sir Wilfred Laurier, (Broughton 1994), Chant launched *The Canadian Astronomical Handbook for 1907,* and the bi-monthly *Journal of the Royal Astronomical Society of Canada (*the *Journal* had been preceded by the annual *Transactions* of the Society).

Chant's preface to the 1907 Handbook is reproduced in the 1997 edition. One sentence from that preface gives the purpose of the *Observer's Handbook* (Chant 1906): "The object has been to produce a companion which the observer would wish always to have in his pocket or on the table before him."

In addition, the opening lines of Chant's introduction to Volume 1, Number 1 of the *Journal* give the raison d'être of the RASC in words that are as accurate today as they were a century ago (Chant 1907):

The object of The Royal Astronomical Society of Canada is to extend and popularize the study of Astronomy, Astrophysics and related branches of science. It hopes to be a bond uniting workers in this field of knowledge in all parts of the land, whether professionals or amateurs.

As a result of Chant's efforts, the University of Toronto established a separate Department of Astronomy in 1918, although Chant was the only astronomer on the faculty until 1925. Five of Chant's students became directors of observatories. He was the co-author of textbooks and the author of *Our Wonderful Universe,* a popular account of astronomy that went through several editions and was translated into five other languages. Chant officially retired in 1935 after 44 years of service, the year when another of his major accomplishments was completed — the David Dunlap Observatory of the University of Toronto, still the largest optical telescope in Canada. In 1940, on the 50th anniversary of its incorporation, the RASC established its highest award, the Chant Medal, in his honour. Chant kept an office at the observatory until his death in 1956. For more information regarding Chant and his impact on Canadian astronomy, see Heard (1957) and Jarrell (1988).

The Handbook's Contributors

The success of the *Observer's Handbook* owes much to contributors, who provide many of the sections. Along with the Editor, Editor's Essistant, Copy Editor, and Proofreaders, the contributors give freely of their time and expertise. It is remarkable that for a century the *Observer's Handbook* has been produced by volunteers, to the benefit of astronomy both in Canada and in many other countries.

One of the contributors to the first edition of the *Observer's Handbook* was Andrew Elvins (1823-1918). Elvins was the guiding spirit of Canada's first astronomical society, The Toronto Astronomical Club, which began in 1868. The club became The Toronto Astronomical Society in 1869 and was incorporated in the province of Ontario as The Astronomical and Physical Society of Toronto in 1890. With the approval of King Edward VII, the name became The Royal Astronomical Society of Canada in 1903. On the semicentennial of the incorporated society, Chant (1940) remarked "Everyone looked upon [Elvins] as the leader of the little band of students of the heavens for thirty years (1860-1890) and the true father of the incorporated society."

Through Elvins, a contributor to the 1907 edition, the 2008 *Observer's Handbook* has a link going back 140 years to the origin of the RASC. Hogg (1989) gives a brief account of both Elvins and Chant, together with the first century of the incorporated society. For a description of Elvins and other

Figure 2 — Andrew Elvins (1823-1918), "the true father of the incorporated society." Photo from the JRASC, 13, 98 (1919).

prominent members of the Society in its early years, see Watson (1917). For reminiscences of Elvins by Chant and five other members of the RASC, see Chant (1919).

In the preface to the first edition of the *Observer's Handbook,* Chant mentions five individuals (in addition to himself) who assisted with its preparation. Since then, more than one hundred people have contributed. The centennial edition represents the work of 51 individuals (48 contributors plus the editorial team), a few of whom have helped with the *Observer's Handbook* for three decades or more: Alan Batten (40 years), Terence Dickinson (41 years), Brian Marsden (35 years), and John Percy (39 years). Former contributors with a comparable record include Clarence Chant (48 years), John Heard (37 years), Janet Mattei (30 years), Peter Millman (49 years), Ruth Northcott (35 years), and Charles Worley (33 years). All but one of these long-serving individuals are/were professional astronomers. Terence Dickinson, the one amateur astronomer in the group, is Canada's preeminent astronomy science writer.

The Growth of the *Observer's Handbook*

Our understanding of the Universe has changed dramatically since the first *Observer's Handbook* was published. In 1907, no one knew what made the stars shine. Atomic spectra were a mystery, as were the periodic table of the chemical elements and the structure of the atom. There was no Hertzsprung-Russell diagram. An anomaly in the motion of Mercury was ascribed to an unseen planet, Vulcan. Lunar craters were generally believed to be of volcanic origin. Galaxies were not part of cosmology. Radio astronomy was decades away. White dwarfs, supernovae, neutrinos, neutron stars, pulsars, quasars, and black holes were unknown. The Big Bang and the cosmic microwave background were unheard of, and space travel was barely entering the realm of science fiction. Computers were carbon-based *Homo sapiens,* not silicon-based machines.

As Peter Broughton points out in *Looking Up,* his marvellous history of the RASC, several factors have been responsible for the expansion of the *Observer's Handbook* during the past 40 years:

1. The tremendous advances in physical theory, technology, and the space program are reflected in some new or expanded sections;
2. The ever-increasing breadth and depth of observing interests;
3. Efforts to make the Handbook more readable and instructive without sacrificing tabular data;
4. Material has been modified and expanded to make the Handbook more useful in other countries.

Exclusive of pages devoted to a list of officers and bylaws of the RASC, the 1907 edition had 100 pages. All editions from 1908 through 1967 had less than 100 pages, not including those devoted to advertisements (advertisements appeared in editions 1948 through 1975). The 1918 and 1919 editions had the fewest pages, 32, a consequence of financial stringency imposed by World War I. During Ruth Northcott's tenure as editor, the page count again reached 100 (for the 1968 edition), during John Percy's, 144 (1981), Roy Bishop's, 288 (1999), and Rajiv Gupta's, 304 (2003). After six decades of relatively little change, the number of pages has tripled in the past four. In the same period, the number of sections has more than doubled. The variety of topics covered ranges from Alexander's Dark Band to the zodiacal light. Under Patrick Kelly's editorship, the centennial 2008 *Observer's Handbook* is the largest yet at 324 pages and is an invaluable resource for anyone interested in astronomy — beginner or expert, amateur or professional, student or teacher. Its blend of numerical data and concise, explanatory text is unique. For an overview of the enhancements to the centennial edition, see the Editor's Comments (Kelly 2007).

The *Observer's Handbook* is unusual amongst astronomical publications in that it is widely used both in professional observatories and as either a required text or a resource book in universities and schools. One of its sections, "Teaching and the *Observer's Handbook*" by John Percy, is intended to introduce instructors to the valuable role the *Observer's Handbook* can play in science education at any level.

For the first half of its existence, virtually no profit was realized from the *Observer's Handbook.* In the early years, the RASC relied upon grants from the Ontario and Federal governments to cover the costs of its publications. From 1912 through 1948, the retail price of the Handbook was 25¢ (20¢ for orders of ten or more). Not until the 1960s did the Handbook begin to show a small profit, and it was not until a decade later, under

John Percy's editorship, that the Handbook provided an annual net income for the Society exceeding $10,000. With the 1999 edition, the figure rose above $80,000. With inflation factored in, the growth in Handbook profit was not as dramatic as these figures indicate. However, for more than 30 years it has been a major income generator in the RASC's financial statements. There are two reasons for the growth in Handbook net income — an increasing retail price (from $1.50 for the 1971 edition to $25.95 for the 2008), and a substantial decrease in production cost per page resulting from the gradual implementation of digital technology during those years.

Yet things change. Recent Handbook revenue has fallen primarily because the rising Canadian dollar has reduced the revenue from sales in other countries. However, with the support of its editors, editorial team, and contributors, the Handbook may well survive a second century. Despite the rapid advance of digital technology, the Handbook possesses several advantages over an electronic almanac. The *Observer's Handbook:*

- Is smaller and lighter than a laptop computer
- Requires no AC power or battery
- Has no switches to operate or wires to connect
- Can be accessed in a few seconds
- Works at −30 °C
- Easily survives a 2-metre fall onto concrete
- Has no hard disk to crash or memory chip to fail
- Is not attractive to the average thief
- Can easily be recycled
- Is still readable 100 years later. (Will today's digital files be accessible a decade from now, let alone a century?)

The Editors of the *Observer's Handbook*

Editor	Editions	RASC President
C.A. Chant	1907-1957	1903-1907
Ruth Northcott	1958-1970	1962-1964
John Percy	1971-1981	1978-1980
Roy Bishop	1982-2000	1984-1986
Rajiv Gupta	2001-2006	2002-2004
Patrick Kelly	2007-	

Although Chant was the Editor of both the Handbook and the *Journal* for half a century, from the late 1930s the main workload fell to the Assistant Editor — Frank Hogg until 1951 and then Ruth Northcott. Frank Hogg, a native of Preston, Ontario, was one of Chant's students, and an RASC Gold Medalist, who obtained the first Ph.D. granted in astronomy by Harvard University. He joined the faculty of the University of Toronto in 1934 and served as President of the RASC during 1941 and 1942. He was Director of the David Dunlap Observatory from

Figure 3 — Frank Scott Hogg (1904-1951), the first Assistant Editor of the *Observer's Handbook* (1939-1951). Photo from the JRASC, 45, 1 (1951).

1946 until his premature death in 1951 (Chant 1951).

Ruth Northcott, also an astronomy graduate of the University of Toronto, joined the staff of the David Dunlap Obser-

Figure 4 — Ruth Josephine Northcott (1913-1969), the second Assistant Editor (editions 1952-1957) and the second Editor of the *Observer's Handbook* (editions 1958-1970).

vatory when it opened in 1935 and became a member of the university faculty in 1944. She succeeded Chant as Editor of both the Handbook and the *Journal* in 1956 and continued until her own untimely death in 1969 (Heard 1969).

After Northcott, the Handbook and the *Journal* were assigned separate editors. In 1970, John Percy, also a graduate of the University of Toronto and a member of its faculty since 1967, became Handbook Editor. Ian Halliday, another Toronto graduate and at that time, on the staff of the Dominion Observatory in Ottawa, became Editor of the *Journal*. Both Percy and Halliday had received the RASC Gold Medal for their outstanding undergraduate records. In addition, they established a desirable precedent, being the first editors of the RASC to retire from that position!

In 1981, a drastic change occurred when the editorship of the Handbook passed from professional astronomers at the University of Toronto to the author of this article, a resident of rural Nova Scotia who had never taken a course in astronomy. Somehow, the Handbook survived, doubling in size to 288 pages and producing a net income of approximately $1 million for the RASC during the Saros of his tenure as Editor.

Figure 5 — Left-to-right, John Percy, Roy Bishop and Rajiv Gupta, respectively the third (1971-1981), fourth (1982-2000), and fifth (2001-2006) editors of the *Observer's Handbook*. Photo by Clair Perry at the RASC General Assembly in Montreal, 2002 May 17.

Production of the 1982 *Observer's Handbook* involved corresponding with contributors via Canada Post, assembling a manuscript, reviewing the manuscript with the University of Toronto Press, retyping of the manuscript by the press, followed by two successive sets of proofs to be inspected letter-by-letter, number-by-number, and annotated with proofreader's marks. For some pages, hot-metal monotype was involved (shades of Gutenberg). By the 2000 edition, the production had evolved to communicating primarily by email, computer-produced camera-ready copy, a single set of proofs requiring much less time to examine, and film typesetting.

In 2000, the editorship went from the Atlantic to the Pacific when Rajiv Gupta, a mathematics professor at the University of British Columbia, accepted the position. Rajiv had already made notable contributions to the RASC. He initiated the Society's award-winning *Observer's Calendar* and edited it for 15 years (1992-2006), served as Treasurer, and contributed to the Handbook for several years. Like the previous Handbook editors, while Editor (and while also looking after the *Observer's Calendar!*), he served a term as President of the Society. Gupta made the production of the Handbook fully digital and assembled an editorial team composed of a Copy Editor (Betty Robinson), an Editor's Assistant and Proofreader (James Edgar), and a Proofreader (Bruce McCurdy).

Figure 6 — Patrick Kelly, the sixth Editor of the *Observer's Handbook* (2007-). Photo by Roy Bishop at Cape Split, Nova Scotia, 2007 May 27.

In 2006, the *Observer's Handbook* returned to Nova Scotia when Patrick Kelly, an instructor and Director of Computer Facilities, Faculty of Architecture and Planning at Halifax's Dalhousie University, became Editor. Patrick brings many talents to his new position, including formidable expertise with digital technology, boundless energy, and (highly desirable for a Handbook Editor) an unflappable, genial personality.

Like his five predecessors, Pat Kelly has devoted countless hours to the RASC, both at the national and Centre levels. He has served as Editor of the *Bulletin* (1991-1996), as Associate Editor of the *Journal* (1997-2000), and as an assistant editor of the *Journal* (2000-). His contributions to the Society's Halifax Centre are legendary, and include being President, Secretary, and Editor of the newsletter *Nova Notes*. Currently Patrick is Centre Treasurer and Centre Representative on National Council. He also takes time to be "Cookie Chairman" (in charge of refreshments at monthly meetings of the Centre)! Patrick's volunteer activities extend beyond astronomy. He is a Director and Chair of the Program Committee of the Blomidon Naturalists Society, Atlantic Canada's largest natural history organization. He is on the Board of the Federation of Nova Scotia Naturalists, and is a Regional Coordinator for the five-year *Maritimes Breeding Bird Atlas* project (2006-2010). Pat Kelly is an example of the maxim: *If you want something done, ask a busy person.*

All former editors of the *Observer's Handbook* have also served as President of the RASC, and all have been immortalized in the asteroid belt: 3315 Chant, 3670 Northcott, 32208 Johnpercy, 6901 Roybishop, and 14654 Rajivgupta. Also noteworthy is that in 100 years, there have been only six editors, possibly a publication record.

Through the Handbook editors, four universities have made a significant contribution to Canada's scientific heritage and the dissemination of astronomical knowledge:

- The University of Toronto — Chant, (Hogg), Northcott, Percy
- Acadia University — Bishop
- University of British Columbia — Gupta
- Dalhousie University — Kelly

Comments Regarding the *Observer's Handbook*

Among the pleasant moments that I experienced while Editor, was to receive unsolicited comments regarding the Handbook. I quote a few of them here — for posterity before my Handbook files are no more — for the inspiration of the contributors to the current Handbook and the Editor's three assistants, and to give Patrick Kelly strength to carry on when he needs it most. Several of the authors of the following quotes I knew. Some were amateur astronomers, some professional. Others I did not know, particularly those from other countries, yet they took the trouble to write. If you recognize your own words, I hope you do not mind being anonymous.

"This is a fantastic book!"

"My hands shake each time a new edition arrives."

"The *Observer's Handbook* is an indispensable treasure trove for anyone interested in astronomy, and I do mean ANYONE."

"The RASC Handbook is the best book of its kind anywhere, and has an international reputation for quality."

"The single most useful book for naked-eye, binocular, and telescope observers."

"I carry the Handbook in my backpack everywhere."

"A very complex document that is so readily understandable."

"The standard North American reference for sky data."

"The *Observer's Handbook* is beautifully and concisely written, and it contains all the essential information for observers."

"The real strength of the *Observer's Handbook* is in the in-depth articles."

"I enjoy the high density of information, which is a refreshing change from the expansive style of *Astronomy* and *Sky & Telescope* articles."

"There is no article, graph, diagram, or list with a quality less than superb."

"During our tour of the Naval Observatory, co-publisher of the *Astronomical Almanac,* I saw the RASC *Observer's Handbook* on the control stand of the 26-inch refractor but I did not see a copy of the *Astronomical Almanac.* When I asked why, the astronomer who was showing us the telescope replied that he preferred it."

"Truly a magnificent resource, and so reliably authoritative that I must express appreciation."

"Originally the Handbook did a superb job of telling us what was happening in the sky, but more and more, it now motivates us as well. It is now a book with exciting articles, easily understood directions, and almost unlimited information. A child of Grade 6 can benefit from the *Observer's Handbook* and copies are used in most professional observatories. You can't say that about many books."

"I have been led to join your organization by the excellent quality and practicality of your *Observer's Handbook,* which I shall treasure as an amateur astronomer and teacher of college physics and astronomy courses."

"I spent much of last night unable to put the latest Handbook down. Anyone, from beginner to hardcore, can drool over it for hours!"

"Thank you very much for this superb publication."

Conclusion

In her address as retiring President of the RASC at the Society's 1964 General Assembly in Ottawa, Ruth Northcott said (Northcott 1964):

> *We believe that the Observer's Handbook is a truly significant contribution that Canadian astronomy in general and our Society in particular has been making to the dissemination of astronomical knowledge for half a century. I trust that it will still occupy the same position of respect after the first hundred years.*

Since her tenure as Editor, the number of Handbook pages has more than tripled and its distribution has expanded worldwide. The subsequent four Editors, the members of the editorial team, and the many contributors to the *Observer's Handbook* have vindicated Ruth Northcott's trust.

Acknowledgments

Many years ago, Peter Millman (1906-1990) gave me copies of publications relevant to highlights in the history of the Royal Astronomical Society of Canada. Also, while editor of the *Ob-*

server's Handbook, I had many conversations with Helen Sawyer Hogg (1905-1993), who provided several forewords for the Handbook concerning the early history of the RASC. More recently, Canada's pioneer radio astronomer, Arthur Covington (1914-2001), left me his complete, bound set of the RASC *Journal* and many early editions of the *Observer's Handbook*. Information from all three of these remarkable members of The Royal Astronomical Society of Canada has been incorporated into this article. In addition, I thank Peter Broughton, Rajiv Gupta, Patrick Kelly, and John Percy who reviewed a preliminary draft of this article and made several helpful suggestions. Special thanks also to Peter Broughton and Bonnie Bird for providing Figure 4, and to Clair Perry of the RASC Charlottetown Centre for Figure 5.

References

Broughton, R.P. 1994, *Looking Up: A History of the Royal Astronomical Society of Canada* (Dundurn Press: Toronto)

Chant, C.A. 1906, *The Canadian Astronomical Handbook for 1907* (Royal Astronomical Society of Canada: Toronto), 6

Chant, C.A. 1907, JRASC, 1, 1

Chant, C.A. 1919, JRASC, 13, 98

Chant, C.A. 1940, JRASC, 34, 273

Chant, C.A. 1951, JRASC, 45, 1

Heard, J.F. 1957, JRASC, 51, 1

Heard, J.F. 1969, JRASC, 63, 225

Hogg, H.S. 1989, in the *Observer's Handbook 1990,* ed. R. Bishop (University of Toronto Press: Toronto), 1

Jarrell, R.A. 1988, *The Cold Light of Dawn: A History of Canadian Astronomy* (University of Toronto Press: Toronto)

Kelly, P. 2007, *Observer's Handbook 2008,* ed. P. Kelly (Thistle Printing Ltd., Toronto), 8

Kemp, J. 1968, *'Scope, the Newsletter of the Toronto Centre,* Centennial Edition, 12

Northcott, R.J. 1964, JRASC, 58, 99

Percy, J.R. 1982, JRASC, 76, 392

Shinn, F. 1989, Newsletter RASC, 1, 39

Watson, A.D. 1917, JRASC, 11, 47

Roy Bishop is an Honorary Research Associate in the Physics Department at Nova Scotia's Acadia University where he was a professor and Head of the Department for many years. He is a recipient of the Service Medal and the Chant Medal of the RASC, and past Honorary President of the Society. Currently he is Honorary President of the Society's Halifax Centre. For relaxation, he divides his time between his observatory under magnitude-6 skies at his home beside the Bay of Fundy, and sailing his yawl along the Atlantic coast of Nova Scotia.

MONT-MÉGANTIC DARK-SKY RESERVE CONFERENCE 2007 SEPTEMBER 19-21

Robert Dick[1], Yvan Dutil[2], Dan Taylor[3]

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[2]*ASTROLab du Mont-Mégantic, RASC-LPAC)*
[3]*RASC-LPAC*

Abstract: A conference of the International Dark-Sky Association (IDA), hosted by the ASTROLab du Mont-Mégantic, was held at the observatory (Cover photo), 60 km east of Sherbrooke, Québec. Speakers were invited from across North America and Europe. There were 85 registrants and 10 visitors at the meeting. The three-day event was held to celebrate the recognition by the IDA of dark-sky status for the Observatory and its surroundings.

During the meeting, the Mont-Mégantic Observatory and the region around the site were declared an International Dark-Sky Reserve, and those who lead the campaign received the RASC LPA Award in recognition of their work and accomplishment. This report summarizes the presentations at the Conference and comments on the sky quality at the Observatory.

Résumé: Une conférence de l'association International Dark-Sky (IDA), organisée par l'ASTROLab du Mont-Mégantic, a eu lieu à l'observatoire (Photo de couverture), à 60 km à l'est de Sherbrooke, Québec. Les conférenciers invités venaient de l'Amérique du nord et de l'Europe. Quatre-vingt cinq participants inscrits et 10 visiteurs ont assisté à la réunion. Cet événement de trois jours a eu lieu pour célébrer la reconnaissance par la IDA de l'état de la noirceur du ciel à l'observatoire et dans ces environs.

Durant la conférence, l'observatoire du Mont-Mégantic et la région adjacente ont été proclamés une réserve de l'International Dark Sky, et ceux qui ont mené la campagne ont été décerné le prix LPA de la SRAC en reconnaissance de leur efforts et du projet réalisé. Le rapport résume les présentations à la conférence et les commentaires sur la qualité du ciel à l'observatoire.

Cover photo — Dome of the 1.6-m Mont-Mégantic Observatory under moonlight.

The Conference

The Conference was held in the modern and spacious ASTROLab facilities (Figure 2); the meeting room had all the necessary amenities — computerized console, digital projector, sound system, and real-time French–English translation. Light-pollution activists, lighting industry representatives, astronomers, and National Park representatives from Canada and the United States were among the speakers. The inclusion of so many points of view allowed people from varied backgrounds to learn about and appreciate different LPA aspects.

Figure 2 — ASTROLab Building

Three themes to the presentations were:

1. The impact of light pollution on the nocturnal environment (astronomical and biological),
2. Progress being made by the lighting industry, and
3. The efforts being made to reduce light pollution.

Dr. Richard Wainscoat, representing the International Astronomical Union, gave an astronomical viewpoint. Using images from the American Department of Defense's meteorological satellites (DMSP), he showed time-lapse images of the steady degradation of even the best astronomical sites around the world. He noted in particular that Hawaii, the Canary Islands, and the observatories of Chile are threatened by light from urban development.

Dr. Martin Aubé of the CÉGEP du Sherbrooke had developed a sky spectrograph that not only monitored light-pollution levels, but also identified different light sources, including auroral emissions. Dr Aubé had already employed the portable instrument at several sites in the U.S. A permanent light-pollution observatory, using this instrument, is planned at Mont-Mégantic to follow the long-term evolution of the site.

Astronomers do not have the only word on the night sky — wildlife is impacted by artificial lighting as well. Carina Poulin, a student at the University of Sherbrooke, discussed the effect of lighting and sky glow on the nocturnal environment.

Dr. Mario Motta, a physician from Boston, discussed the physiology of night vision, bringing attention to the limitations of current lighting standards and the impact on persons with cataracts. Cataracts in aging eyes develop from the centre of the lens outward. The crystalline material of the cataract is not as transparent to light and not capable of focussing as sharply as the less-affected periphery of the lens. The constriction of the iris in high-light environments thus results in much less light getting to the retina in the afflicted eye than generally realized, and the visual image is significantly degraded.

The Illumination Engineering Society, represented by its President, Kimberly Szinger of Calgary, noted that the lighting industry is becoming much more sensitive to demands for efficient and effective lighting. Yannick Vaillancourt of the Corporations of Electricians of Quebec and Eric Ladouceur, a lighting engineer, explained how lighting fixtures are actually selected to satisfy a given requirement. However, the question-and-answer session that followed raised the subject of the collateral impact of those levels, not how the levels were calculated.

It was quite apparent to the authors of this paper that, though the engineers were meeting the illumination requirements, it was the requirements themselves that may be the source of the light-pollution problem. Those who define the lighting requirements must become more aware of the effect of glare, light trespass, and sky glow. As citizens and consumers of illumination, we should have the last word on what lighting is installed. The public has only recently begun to voice their preferences.

The RASC Light-Pollution Abatement Program has evolved to track, if not lead, this evolution. Robert Dick outlined the evolution of the RASC LPA Program from its beginnings in 1976 and 1977 articles in this *Journal,* to the National LP Committee of 1991, the LPA Program of 2000, and up to the present. There is now clear evidence for a changing perception by city managers; more municipalities are listening to their citizens and adopting efficient lighting practices rather than maintaining a policy of just adding more light.

To advance their lighting policies, city managers have to hear about and understand what should be improved. Dan Taylor has worked with the City of Windsor to develop and introduce their lighting policy — the result is the city's Lighting Intensity Standards (LIS). Although the building industry's LEED program (Leadership in Energy and Environmental Design) for energy-efficient construction includes a Green Building Rating System, very little consideration is given to lighting. Windsor's LIS addresses that oversight and provides for much more control over municipal lighting.

The main sources of sky glow come from urban areas, but fortunately, some cities are taking advantage of technology to save energy and reduce light pollution. One is the use of full-cut-off fixtures to reduce glare. Jean Rochette of Quebec City described "smart" light controls that dim lighting when it is not needed. The controls can reduce the illumination levels to only 30% of the installed levels during low-traffic periods. Quebec City has also reduced wattage in many fixtures to reduce glare. Managers are able to command strings of lights to power down by sending high-frequency control signals through the power lines. The technology has not degraded the colour of the lights or reduced their life.

One of the most useful displays used in educating municipal officials is the sky-glow maps generated from night-time imagery from the U.S. Defense Department's Defense Meteorological Satellite Program (DMSP) satellites in 1997. The DMSP instruments are more sensitive than most weather satellites but because they are intended for meteorological use, do not provide the resolution or sensitivity needed for light-pollution studies. Dr. Yvan Dutil of Mont-Mégantic Observatory suggested that a dedicated satellite be developed to monitor light pollution. The growing importance of energy usage and the growing realization of the impact of artificial lighting on the environment make this a good time to begin such studies. He is in consultation with Dr. Pierantonio Cinzano (`www.light-pollution.it/indexen.html`) and the European Space Agency to promote interest in the project. The suggested instrument has very modest requirements — a low-cost microsatellite might suffice.

American and Canadian park authorities are also interested in the impact of light pollution. Their goal is to sensitize the public to the problem and to promote interest in, and respect for, the nocturnal environment.

Chad Moore of the U.S. National Park Service introduced their sky-monitoring program. A CCD-based instrument is carried to parks where it is used to take images of the night sky with a fish-eye lens, which are then analyzed for atmospheric clarity and sky glow. Since their equipment can easily detect the Gegenschein along the ecliptic band, it is more than adequate to assess the quality of the skies. At the conference, the instrument was used to quantify the MMO site. Moore's insight and that of his colleague, Dan Durisco, have helped the RASC in our development of criteria to assess Dark-Sky Preserves.

Parks Canada is also very sensitive to the preservation of the nocturnal environment. Dr. David Welch presented their position regarding light pollution. The development of Canadian parks as Dark-Sky Preserves may be more fruitful than south of the border because of the more limited development within Canadian parks and sparser population beyond the park borders. Parks Canada is developing an agency-wide outdoor-lighting protocol that, when implemented, will significantly restrict lighting within parks.

The final speaker was Paul Blu, the president of the French Association for Nighttime Protection (ANPCN). Though all earlier presentations at the conference outlined problems with outdoor lighting in North America, Mr. Blu's talk showed us that we are actually quite fortunate. The U.S. and Canada have discovered the impacts of artificial outdoor lighting early enough to correct most of the problem. In France, the problem is so bad that even successful LPA programs have very little effect. Light pollution seems so widespread and ingrained in society that the delegates were impressed by the persistence of the ANPCN.

Mr. Blu's talk was followed by a debate about the rationale of lighting for cultural aesthetics versus restricted lighting to preserve the night sky. The discussion became somewhat animated with lighting designers, engineers, astronomers, and researchers weighing in with their individual perspectives.

The International Dark-Sky Association Certification

The RASC has been recognizing Dark-Sky Preserves for seven years, since the creation of the Torrance Barrens DSP on 2000 October 14. Canada now has the largest number of certified Dark-Sky Preserves in the world (six), with the USA a close second at four. Hungary, with one, is the only other country with a Dark-Sky Reserve. Mont-Mégantic is the only Dark-Sky Preserve in Canada to be recognized also as a Dark-Sky Reserve by the IDA.

The staff at the Mont-Mégantic Observatory ASTROLab (their public outreach and interpretation centre), led by Chloé Legris (Figure 3), have reached out to neighbouring municipalities as far as Sherbrooke, 60 km to the west. Their efforts have encouraged local municipalities to convert to lower-level illumination and shielded fixtures.

In recognition of this effort, the RASC has awarded the Observatory and surrounding communities the RASC Light-Pollution Abatement Award. The Certificate was presented by Robert Dick (Chair, RASC-LPAC) to M. Bernard Malenfant, the President and founder of ASTROLab du Mont-Mégantic.

The IDA certifies Dark-Sky sites using three levels: Gold, Silver, and Bronze. A site evaluation of the MMO was done by Chad Moore of the U.S. National Park Service, a very experi-

Figure 3 — Chloé Legris

enced naked-eye observer. (He said he had once seen M82 naked eye!) Based on his experience, the Mont-Mégantic sky was Bortle Class 1 or 2, which is essentially pristine and would normally be worth a Gold classification. He found that the light dome of Sherbrooke affected his dark adaptation (Figure 4) however, and so the site was rated at the Silver level. We were lucky to have a clear night during the conference that enabled us to appreciate the dark skies at Mont-Mégantic for ourselves.

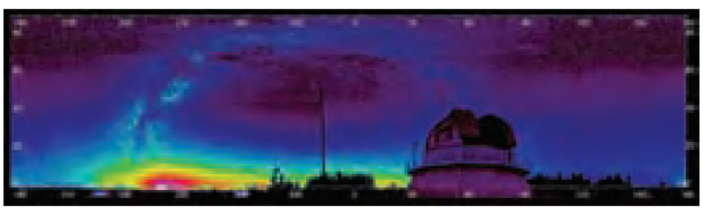

Figure 4 — MMO Panorama by Chad Moore (US National Park Service), Sept. 2007

Though some areas of the park are shielded from Sherbrooke's light dome, we found that the red ASTROLab building illumination was too bright for astronomy. The Park Director agreed that the lights should be replaced. A site re-evaluation is planned after five years and the results may lift the preserve to the Gold level. We were also impressed by phosporescent plastic pucks used to mark roadways and pathways. They are very effective, need no electricity, and do not affect night vision. While specially created for the Mont-Mégantic park, we think their use should be promoted for use everywhere.

The establishment of this Dark-Sky Preserve proves that good lighting practice can reduce light pollution and energy consumption. The director of the observatory, Dr. Robert Lamontagne, likened the improvement to turning down the light pollution to that of 30 years ago (Figure 5). The energy saved is equivalent to the annual consumption of a small town of a few hundred inhabitants! Hopefully, this success will be imitated elsewhere.

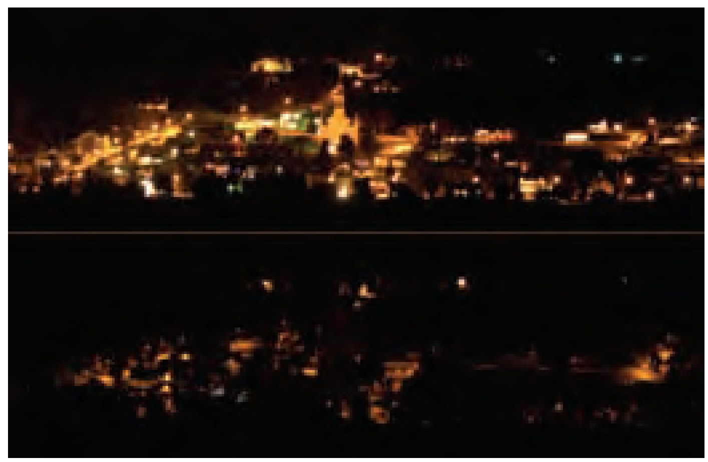

Figure 5 — The town of La Patrie, before and after conversion. Image: G. Poulin – ASTROLab

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www.rasc.ca/discussion

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The RASCals list is a forum for discussion among members of the RASC. The forum encourages communication among members across the country and beyond. It began in November 1995 and currently has about 300 members.

To join the list, send an email to listserv@ap.stmarys.ca with the words "subscribe rascals Your Name (Your Centre)" as the first line of the message. For further information see: www.rasc.ca/computer/rasclist.htm

Feature Articles/
Articles de Fond

In Memory of Gertrude Jean Southam

by Dan Collier, Vancouver Centre

Gertrude Jean Southam died in October at Vancouver. She was the daughter of H.R. MacMillan, a founder of MacMillan-Bloedel, and a philanthropist of renown. H.R.'s donation of $1.5 million enabled the City of Vancouver to add a planetarium to the new centennial museum being built on Kitsilano Point. When the planetarium opened in 1968, it became an important symbol of the scientific, technical, and educational interests of Vancouver's inhabitants. Today, when such subjects are more important than ever, the H.R. MacMillan Planetarium remains such a symbol.

But Jean established her own program of philanthropy. Many local charities and service organizations benefitted from her donations. These were so substantial that she felt embarrassed and sought to keep the full amounts out of general notice.

It is therefore not surprising that her name does not appear on the facility she brought into existence in the aftermath of the tragedy that took the life of her son. As Gordon's grandfather had given us the H.R. MacMillan Planetarium, an observatory was the ideal memorial for Gordon. In due course, one was constructed next door to MacMillan Planetarium and opened in 1980. Like the planetarium, the observatory has principally been an educational facility and a place for night-sky sightseeing. Consideration was given in its design to make it as accessible to the public as possible: a classroom, a library, ramps for wheelchairs, and a generous footprint for the observing floor itself — 30 feet in diameter.

The Gordon MacMillan Southam Observatory was really her legacy. The observatory was originally equipped with a telescope by Zeiss and topped with a dome built by the firm that eventually became AMEC, arguably the foremost builder of observatories in the world. AMEC later provided a new Cassegrain telescope for the Observatory. This, too was made possible through Jean's generosity.

Figure 1 — Mrs. Jean Southam officially opens the Gordon MacMillan Southam Observatory in 1980.

On a typical night, when the city's weather permits, the observatory, its telescope, and the volunteers who staff the facility will bring the Universe closer to 100 visitors. Fortunately, Jean Southam was aware of the success of the observatory, and in turn we shall remember her.

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Duplicity of ZC1042: My First Double-Star Discovery

by Alister Ling, Edmonton Centre (aling@telus.net)

Introduction

One of the things I love about astronomy is that after 30 years of observing it's still possible to be a neophyte in a wide range of subtopics. In that time, I have seen a number of lunar occultations, participated in a handful of lunar grazes, and seen one asteroid occultation. When I joined IOTA (the International Occultation Timing Association) four years ago, I wanted to witness more asteroid events, but I certainly hadn't expected to discover a bright double star in my first year of videotaping! Occultations are easier to do than you might think, and are well suited for the suburban astronomer who wants to do more observing.

Hiding is Revealing

When a Solar System object passes in front of a star, the sudden drop of light is a delight to observe: dynamic events are exciting! Scientifically measured, an occultation might reveal something about the size of the star, possible rings or an atmosphere around the occulting body, its size or limb profile, and if the star is a double. If you're extremely lucky, it is possible to detect a tiny moon of a larger asteroid.

Visual timings of lunar occultations were once used to help refine the orbit of the Moon, but the current predictions are more accurate than the error bars of inconsistent observer reaction times. On the positive side, visual timings of asteroid events are still of value when less than a handful of observers participate.

Off-the-shelf sensitive low-light security video cameras work well for occultations, and produce 30 frames per second. Actually, they take two interlaced exposures (or fields) per frame, allowing a time resolution of 0.017s, which is of value for refining lunar and asteroidal profiles.

Getting Wired

My first step into the realm of measurement was to purchase the video camera. Unfortunately, Webcams are not sensitive enough, so I got the highly recommended PC-164C at about $100, same size as a classic 1.25-inch eyepiece. For double the price, you can get a WATEC unit (WAT902H2ULTIMATE) of similar sensitivity but with exposure control, a useful feature when the Moon's bright limb is nearby. The signal enters the input to an old VCR (remember those? <grin>). If money is no consideration, digital camcorders or recorders with appropriate input jacks will save a processing step.

Originally, I piped WWV into the audio, then used free software to identify the start of a second, and then counted frames until the event. After a couple of months of this laborious data reduction, I sprang $250 for a KIWI-OSD, a black box that inserts GPS time and a field count directly onto each video field. Retrieving times is not much harder than reading numbers.

In short, getting set up for video work sets you back about the price of a decent eyepiece — not bad if you use a longer perspective — so just get over being cheap. Early in the process, I picked up a 1.25-inch focal reducer that screws in front of the PC-164C to produce double the field of view of the normal 5 arcminutes. This is crucial since my scope has no fine-motion controls.

Advice from the IOTA email group saved me considerable frustration, but there are plenty of gremlins to beat back during each observing session. Practice, practice, practice gives you the confidence and calm under pressure to handle cracked cables, blown fuses, and correctly connecting the daisy chain of outputs to inputs. Always carry a backup set of cables, batteries, and fuses!

Fellow Edmonton RASCal Mike Hoskinson was a couple of months ahead of me, and he proved to be the catalyst I needed to get going. Thanks Mike!

Setting up for the Evening

I really like observing. My initial passion for deep sky has waned, partly because of the hiatus between sessions, but mostly because I found I enjoy watching long-period variables change and detecting fresh outbursts from cataclysmic binaries. Through an accidental discovery of a variable star (you know, one of those that turn out to be constant), I discovered the joy of putting eye to eyepiece 10 to 15 times a month, even for a couple of hours under suburban skies.

I let the scope cool in my backyard, put the kids to bed, and then head outside. I figured "Hey, I'm under the stars anyway," so I may as well spice up the observing list and contribute some data along the way.

Almost without exception I watch the occultations on the small black-and-white monitor (Canadian Tire $15) in real time. As much as I personally prefer to have eye to eyepiece, the value is greater with video timings, so I don't begrudgingly stare at the monitor. If the event is bright enough, I watch directly through my 4.5-inch Tasco (yes I still have it!).

The Double

I've yet to see a "step-wise" occultation of a double star at the eyepiece, but my observing buddy Bruce McCurdy tells me the experience can be puzzling and startling. We're trying to confirm his visual discovery of 136 Tauri but we only have a couple more chances before the window closes for 15 years until precession brings the Moon back to the right place.

Not all stars can get occulted by the Moon — in fact, only those within 6° 21´ of the ecliptic are available. The first compilation of these stars was called the Zodiacal Catalogue, or ZC. It is now supplemented by the XZ Catalogue that includes fainter stars. Double or multiple stars scheduled to receive grazes over North America are listed in the RASC *Observer's Handbook,* under "Occultations by the Moon."

When it came time for ZC1042 to disappear behind the Moon's face lit by earthshine on 2007 March 26, it disappeared promptly on cue, with no hint of duplicity. The images sat on my VCR tape for a few months before I had time to digitize the clip and retrieve the data.

I had long known that double stars are routinely discovered via lunar occultations, but I figured that all the bright ones would be known by now. I'm quite surprised that such a bright one (a Zodiacal Catalogue star!) lay in wait. As to the event itself: Spring was a busy time — a fair number of asteroid and lunar events was committed to VHS-tape, but family life, work, and variable stars took precedence over data analysis. Given the choice of sitting in front of a computer or being at the eyepiece, I'll always take the real thing. As well, at Edmonton's latitude of 53.5 degrees, "perpetual twilight" was rushing headlong towards me (between May 15 and August 1, the Sun is never below 18 degrees below the horizon); I knew that I'd have time for data reduction over the summer. Yet I did not submit my report until the end of August! Who said summer wasn't busy?

Data analysis

With the free software LiMovie, I am able to step frame by frame through the video in order to isolate the disappearance or reappearance. Here are two frames (all 10 are available at `www3.telus.net/public/aling/double_discovery/Double_Discovery.html`) showing the 0.09 second "hang time" before the secondary disappeared.

Because this was unequivocally a double star, I didn't know what to do or how to report it. Fellow IOTAians pointed me to specialist Henk Bulder (a contributor to the lunar occultation section of the RASC Handbook). He downloaded my video clip and determined the stellar parameters. LiMovie has a number of built-in tools for data analysis, including subtraction of background light from the signal. There is a special horseshoe-shaped aperture to keep the earthshine limb out of measurement. Mr. Bulder stepped me through the methodology of using this tool. Based on the magnitudes of faint stars occulted earlier that evening, I estimate the companion to be about mag 9.8.

Figure 1 — Disappearance of the primary during frames 13965-6.

Figure 2 — Disappearance of the secondary during frames 13971-2.

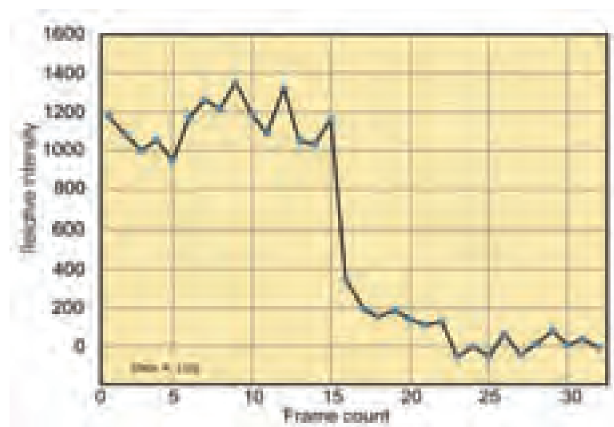


Figure 3 — LiMovie graph demonstrating how the light level drops to the secondary before falling to the background level.

Final results

Star details:
ZC1042 = SAO 78770, mag 6.7 at 6h49m10.2s N27 11' 25" (2000)
Secondary: mag 9.8, separation 0.05" PA 88, calculated by Henk Bulder

By far, it's the tightest double I've ever split!

Conclusion

If you're looking for some spice to insert into your observing sessions, then video occultations may be just the thing. Although it is by no means simple, setting up and collecting data is fairly straightforward. I've also contributed to revising the size of asteroid 17 Fortuna and expect to succeed with many more.

I would like to encourage those with video capability to check their results carefully. Since I'm new to this game, I've only just learned that it is important to rule out previously suspected doubles. Many of them were discovered visually and were subject to less than ideal seeing or diffraction effects. Remember that the lunar orbit precesses, and we've only just passed an extreme. Many of the stars undergoing occultations now have only had a few chances at modern measurement. From the phrasing of this article's title, you can deduce that I expect to find more.

Alister Ling continues to enjoy all aspects of visual astronomy since discovering Jupiter in the mid-1970s with a 4.5-inch Tasco. Slowly but surely he is adding impartial scientific measurement to the mix; the challenge is to do it unattended so he can keep the eye at the eyepiece when it's clear!

References

IOTA Web site: `http://lunar-occultations.com/iota/iotandx.htm`
Here you can find good advice, interesting upcoming events, and a free on-line how-to book.

Seriously Seeking Ceres!

by Rick Stankiewicz, Peterborough Astronomical Association

The planets aligned for me this past month, in a "minor" way. I can credit several events, all happening at once, that allowed me the opportunity to capture the famous minor planet/asteroid (now officially a dwarf planet) Ceres. First off, I finally broke down on November 1 and bought the digital single-lens reflex camera (DSLR) I have been wanting for years (Canon Xti). Second, a talk by Robert Fisher at the November meeting of the Peterborough Astronomical Association about Ceres and how unique it is, got me excited about the possibility of seeing this celestial body. Finally, the November/December issue of *SkyNews* magazine arrived and I noticed a segment in Alan Dyer's "Exploring the Night Sky" on how to find Ceres over the next five months.

Now with my interest piqued and the right equipment at hand, all I needed was clear skies. On November 11, I got my wish — clear skies from my backyard south of Peterborough. Armed with the finder chart from *SkyNews,* I was able to aim my DSLR, which I had piggybacked on an ETX 90 telescope, and start clicking away in the constellation Cetus. Before long, I had captured Earth's closest and smallest (941-km diameter) dwarf planet. By carefully comparing the final image to a detailed sky atlas, I confirmed that the 7.3-magnitude object in the image was indeed Ceres. I had just missed opposition on November 9, but it was still plenty bright enough to record.

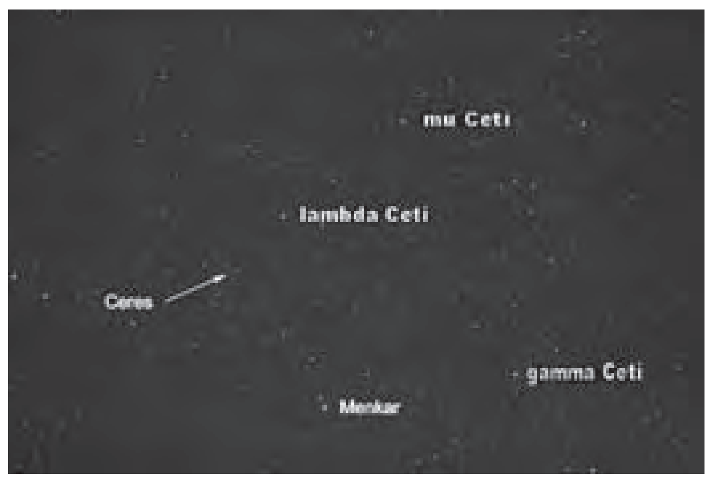


Figure 1 — The author's image of Ceres (arrow).

What a great experience, when the planets do align, even if they are dwarf planets!

A Moment With…

Dr. Richard Cyburt

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

In the film *Powers of 10,* we are seen to be, exponentially, in the middle of everything, *i.e.* between cosmic vastness and subatomic minuteness. However, what might seem to be two solitudes are in fact related: both large and small inform the other. We achieve knowledge of our place via both "atom smasher" and space-borne telescope. Exploring both extremes are scientists such as Dr. Richard Cyburt.

As happened with many scientists who have appeared in this column, Dr. Cyburt had the stars and planets pointed out to him by his father. He remembers Jupiter in particular. As a student, he found he had an aptitude for science as well as math, whose "rhythms" he appreciated. He also enjoyed seeing how things were put together, so a brief job in construction was a natural endeavour. Following interests shared with his father, he studied drafting and architecture in high school. Delving eventually into physics, he went on to study cosmology and astrophysics in graduate school.

Growing up near Chicago, he wasn't very far from Fermilab, the particle physics research centre named for the famous physicist Enrico Fermi. Fermilab is engaged in basic research aimed at understanding the fundamental nature of matter and energy, laying claim to an impressive body of work: discovery of the top and bottom quarks, finding the first direct evidence for the tau neutrino, measurement of the lifetimes of charm quarks, determination of the structure of protons and neutrons, and so on. These feats were accomplished with the aid of the Tevatron, currently the world's most powerful particle accelerator. Besides basic research, Fermilab also opens its doors to interested high-school students, providing lectures and tours on Saturday mornings. Naturally, Dr. Cyburt attended, in part because this afforded an opportunity to see, in a manner of speaking, how we are put together.

After graduating from the University of Illinois, Dr. Cyburt wrestled with what to do — university or some other environment. He cast his job-hunting net widely and snared a position in the theory group at TRIUMF, Canada's National Laboratory for Particle and Nuclear Physics, located on the campus of the University of British Columbia. TRIUMF belongs to an elite group of facilities studying both nuclear physics (*e.g.* the Argonne National Laboratory and the National Superconducting Cyclotron Laboratory (NSCL) in the USA) and particle physics (*e.g.* Fermilab and the European Organization for Nuclear Research (CERN) in France/Switzerland). All are capable of producing intense beams of exotic particles for study. TRIUMF accomplishes this with the world's largest cyclotron (a.k.a. "atom smasher"). Basic research also finds practical application as TRIUMF is, for example, the only facility in Canada using proton therapy to treat eye cancer.

When asked how he would describe his work at TRIUMF, Dr. Cyburt answers, "Exotic." Using particle physics, he not only attempts to determine how we are put together, but how the entire Universe is constructed. He draws on a wide variety of ideas, both large and small. "My field is broad," he says. "My research is in nuclear and particle astrophysics, basically letting the physics of the small tell us about the physics of the large and vice versa." To this end, Dr. Cyburt studies subjects such as the relationships between gravitinos and dark matter, solar neutrinos, big bang nucleosynthesis, and the cosmic microwave background.

It turns out that, of the more than 100 elements known to exist (some rather fleetingly), only hydrogen and helium were produced in any quantity during the Big Bang. Stars came later and cooked up the heavier elements. But then there is the problem of lithium. While the current incarnation of the Big Bang theory has ably predicted the quantities of the two lightest elements, it doesn't do quite so well with lithium. Is this the fault of the theory? Of particle theory? Of current observations? We don't yet know, but scientists are working the problem from both ends. Observations of the Universe continue even as atomic particles whirl around cyclotrons and tevatrons in high-speed experiments. Such tests may tell us where the gap in our understanding lies. It falls to researchers such as Dr. Cyburt to analyze the experimental data and attempt to plug the gaps.

Explaining the small while pondering the large can have interesting philosophical implications as outlined by such thinkers as Albert Einstein, Douglas Adams, and Homer Simpson (see Dr. Cyburt's Web site). By conducting research in nuclear astrophysics, one can investigate why, for example, elements such as carbon and oxygen, the materials of our manufacture, are so abundant. The connection between the stars and us becomes evident. We are indeed star stuff, Dr. Cyburt points out, citing the late Carl Sagan. "This is the nitty gritty of why I do physics."

Dr. Cyburt's work also tries shining a theoretical light onto dark matter. In a pie chart showing the composition of the Universe, normal matter gets a very small slice. About a quarter of the pie is dark matter (the remainder is dark energy). We are still quite literally in the dark about why this should be so. In the next few years, this may change, as new observations by ground- and space-based telescopes are completed and as new experiments by ever-more-powerful particle accelerators reach a conclusion. The latest of the giant accelerators, the Large Hadron Collider at CERN, is nearing completion. It is designed to test theories by creating exotic high-energy particles, probing for antimatter, looking for evidence of extra dimensions, and generally mimicking the energies of the Universe a billionth of a second after the Big Bang. Along the way, it may find evidence for dark matter. It will then fall to scientists such as Dr. Cyburt to provide the theoretical underpinnings for the new observations. The resolution of the dark-matter mystery may very likely come from particle physicists rather than astronomers.

After several years at TRIUMF and several months at the University of Victoria's Physics and Astronomy Department, Dr. Cyburt moved to his current position at NSCL at Michigan State University, a member of the Joint Institute for Nuclear Astrophysics (JINA). The vision statement of JINA states that there is a "desire and need for understanding the cosmos on the femto-scale while interpreting observations and events on the tera-scale...." Dr. Cyburt is firmly lodged in between as he seeks to understand "the big picture" of particles and astrophysics. This involves coming to an understanding of ourselves and our place in the Universe through the tripod of theory, experiment, and observations.

In addition to his other duties, Dr. Cyburt manages the JINA Reaclib Database (a catalogue of nuclear reaction rates that may be searched by scientists interested in astrophysical model calculations) and JINA's Virtual Journal of Nuclear Astrophysics (where articles dealing with neutrinos, anti-magnetars, mergers of binary compact objects, luminous supernovae, neutron star crusts, and so on may be found).

The long and the short (or should we say the large and the small?) of all this is that scientific "diplomats" are trying to arrange a meeting in the middle of the Brobdingnagian and Lilliputian worlds to more fully place our own world in its proper context.

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

Second Light

Lopsided Gamma Rays in the Milky Way

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

For us Canadians, looking at the region of the Galactic Centre in the sky is difficult, but nevertheless, come summer, look southward at Sagittarius and ponder what the gamma rays coming from that direction are telling us. Georg Weidenspointner of the Max Planck Institute for Extraterrestrial Physics and his colleagues have discovered that the gamma-ray emission line at 511 kiloelectron volts (keV) is distributed asymmetrically near the galactic centre (see the January 10 issue of *Nature*). This was unexpected, and distinctly odd, as in astronomy we usually expect symmetry in galaxies because the rotation of material around the centre tends to average things out on timescales of about a billion years (and even faster near the centre). Given that the Milky Way is at least 10 billion years old, in a "steady state," one would expect a high degree of symmetry.

Most readers are familiar with spectral lines — in the optical part of the spectrum, we have the classic Hα line, where a deep red photon is emitted when an electron in the second excited state moves downward to the first. The emission line at 511 keV arises when an electron and its antiparticle — a positron — collide and annihilate each other, converting the entire mass of both particles into energy. It has been known for a long time that such emission is coming from the galactic centre region, but the source of the positrons to feed the annihilation process has been a mystery. In fact, so many explanations have been tried and found not to work that people had actually suggested that the line instead came from the annihilation of some exotic particles that might make up the dark matter. The process of annihilation begins with the production of electrons and positrons.

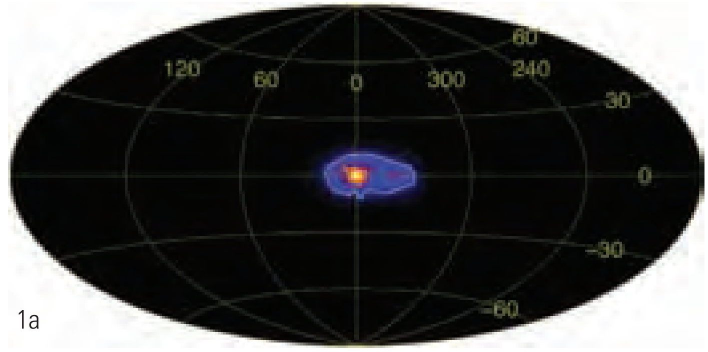
The decay of the radioactive isotope of aluminum (^{26}Al) was expected to provide one source of positrons. (That isotope is associated with supernovae, and is thought to have provided an important source of heat for asteroids as the Solar System was forming.) The gamma rays associated with the decay of ^{26}Al are distributed pretty symmetrically around the galactic centre, and based upon that, Weidenspointner estimated that about 28 percent of the positrons giving rise to the 511-keV line come from ^{26}Al. But what was the source of the others, and why are the sources not symmetric about the centre of the Milky Way?

Weidenspointner shows that the gamma-ray line emission is asymmetric in just the same way as a distribution of binary systems composed of an evolved low-mass star in orbit around a neutron star or black hole ("low-mass X-ray binary"), and the X-rays emitted are particularly energetic. (Low-mass X-ray binaries that emit mainly low-energy X-rays are more symmetrically distributed.) The envelope of the evolved star is falling onto the neutron star or into the black hole through an accretion disk, and as the gas falls, it converts gravitational potential energy into thermal energy, becoming very hot in the process. Just why these stars are distributed asymmetrically is an open question, but having two asymmetries that match strongly suggests that the sources of the positrons have been identified. These X-ray-emitting binaries had in fact been proposed previously as the source of the positrons, in part because they are common near the galactic centre. Theoretical work suggested that such positrons would not move farther than ~100 parsecs from their point of origin, which would give rise to a diffuse background of 511-keV emission.

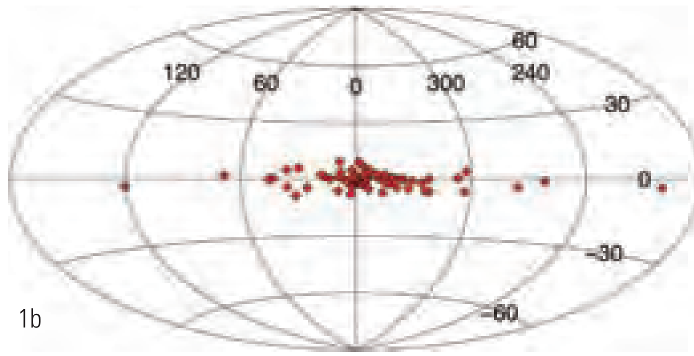
Binary systems in which the star orbiting the neutron star/black hole is more massive (the "high-mass X-ray binaries") do not have an asymmetric distribution. While they too could plausibly generate the required positrons, it appears that they do not do so.

So, while one mystery — the origin of the 511-keV line emission — has probably been solved, it makes another — why are the low-mass X-ray binaries asymmetrically distributed? — more interesting. That's the way things often work in science.

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



1a



1b

Figure 1 — The upper panel shows the distribution of the 511-keV line emission in galactic coordinates, with the centre of the Milky Way at 0,0. [Figure 1a] The lower panel shows the locations of the low-mass X-ray binaries in the same coordinates. [Figure 1b] Both images courtesy of Weidenspointner and *Nature*.

Deep-Sky Contemplations

The Silver Needle Galaxy

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

Many galaxies that can be viewed in amateur telescopes appear as little more that dim smudges to the visual observer. Although the challenge of hunting down faint fuzzies can be rewarding in itself, a welcome respite to such searching is offered by edge-on spiral galaxies, whose appearance in the eyepiece is distinctly different from the more usual dim-fuzzy fare of the deep-sky diet. NGC 4244 [RA = 12^h 17.5^m, DEC = +37° 48´] is one such commonly observed edge-on spiral, being on both the RASC Finest NGC list and the Astronomical League's Herschel II list. Located in Canes Venatici at a distance of 14 million light years, this is a relatively nearby galaxy. Its nearness explains why it is so bright (mag. 10.4) and large (15.9´ × 1.8´) despite its meagre mass of 10 billion Suns, only one-tenth the mass of a typical member of its Sc galaxy type.

The Sc classification for NGC 4244 in the Hubble scheme indicates it is a spiral without a bar and that it has loosely wound arms with knots in its arms. While it now seems difficult to imagine, prior to the 1920s, the division of galaxies by morphology into what we now call elliptical, lenticular, and spiral galaxies was absent. Instead, what existed were purely visual descriptive systems, such as the Dreyer New General Catalogue's descriptor of NGC 4424: pB, vL, eE 43°, vgbM, meaning pretty bright, very large, extremely extended 43 degrees (referring to the direction of its principal axis relative to north), very gradually brighter middle." Of course, the concept that galaxies are separate islands of stars lying outside our galaxy was not proven until the mid-1920s, so the lack of a galaxy classification scheme at that time is perhaps not surprising.

Figure 1 — Position of NGC 4244 in the night sky.

A version of Edwin Hubble's classification system for galaxies was actually suggested by J.H. Reynolds in 1920, six years before Hubble published his now-famous galaxy classification, although Reynolds did not feel such a classification system was adequate, while Hubble did. The common usage of Hubble's scheme, with subsequent modifications, has shown its utility in supplying a common terminology around which rational discussions about galaxies can be based.

The Hubble sequence divides galaxies into ellipticals (E), lenticulars (S0), and two types of spirals: barred spirals (SB) and unbarred spirals (S). Both types of spiral galaxies are further divided into three main types: a, b, and c. Type c spirals, like NGC 4244, have smaller bulges, as well as more-gently spiralling arms that contain more clumps of stars and ionized hydrogen (HII) regions than types a and b do. Hubble mistakenly thought that as a galaxy aged it evolved from E to S0, and if no bar was present, then to Sa to Sc to Sb. This resulted in Sc galaxies being called "late type spirals," and Sa galaxies being referred to as "early type spirals," in supposed deference to their differences in evolution, although such terminology is now opposite to our current understanding. Only about 3% of bright galaxies do not fit into the standard Hubble sequence. These misfits have resulted in extension of the Hubble sequence to include additional later-type classifications (Sm, Sd, and Im), among other subdivisions.

Professional telescopes find that NGC 4244 has a nuclear cluster of stars with a mass of several million solar masses that likely formed *in situ* as gas accreted into the central regions of the galaxy. It has a stellar halo of a few million solar masses

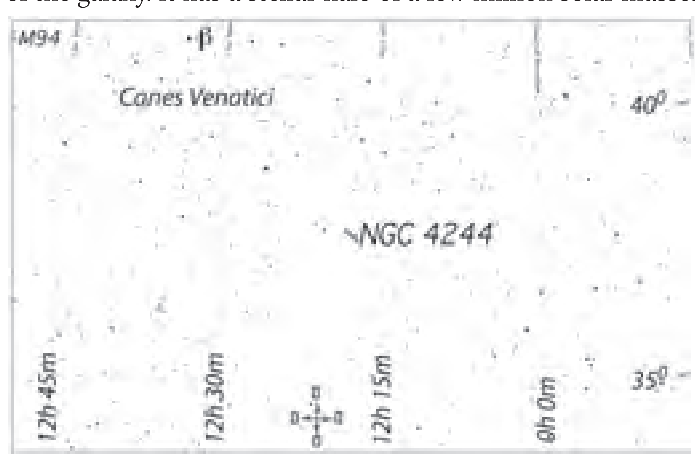


Figure 2 — Finder chart for NGC 4244.

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IC405 (the Flaming Star Nebula) Large and Small

by Stuart Heggie and Wayne Malkin

These images, by two of the RASC's finest astrophotographers, display complementary views of the emission nebulae IC405 (and IC410) in Auriga and inaugurates the beginning of regular colour reproduction in the *Journal*. The upper photo, a wide-angle view by Wayne Malkin, was taken in December 2007 using a Pentax 125 telescope and an SBIG 11000 camera. The image is composed from approximately 40 minutes total of RGB filtration and several hours of H-alpha exposure. The lower photo, of IC405 itself, is by Stuart Heggie, no stranger to these pages. Heggie's photo, taken in December 2006, is composited from 16 × 15-minute exposures in H-alpha, and 8 × 5-minute RGB using a Takahashi FSQ and an SBIG ST-10XME camera.

IC405 and 410 lie at a distance of 2200 light years and have a real size of 19 × 12 and 15 × 13 light-years respectively. The bright blue star in IC405 is known as the "Runaway Star" and originated in the Orion Nebula. This star is passing through the nebulosity, exciting hydrogen gas and causing the typical red emission.

Cool Dogs

by James Edgar

The Sun was just setting on 2007 November 26, (Grey Cup +1!!), when the Sun dogs and spire were just too good to pass up. What doesn't show up in the details is the −19 °C temperature, and a substantial wind that made it feel much colder! The first snowfall of the year made the roads treacherous, but very photogenic. The photo was taken with a Canon 20D and a Sigma 17-mm wide-angle lens at f/16, ISO 200, 1/500 second.

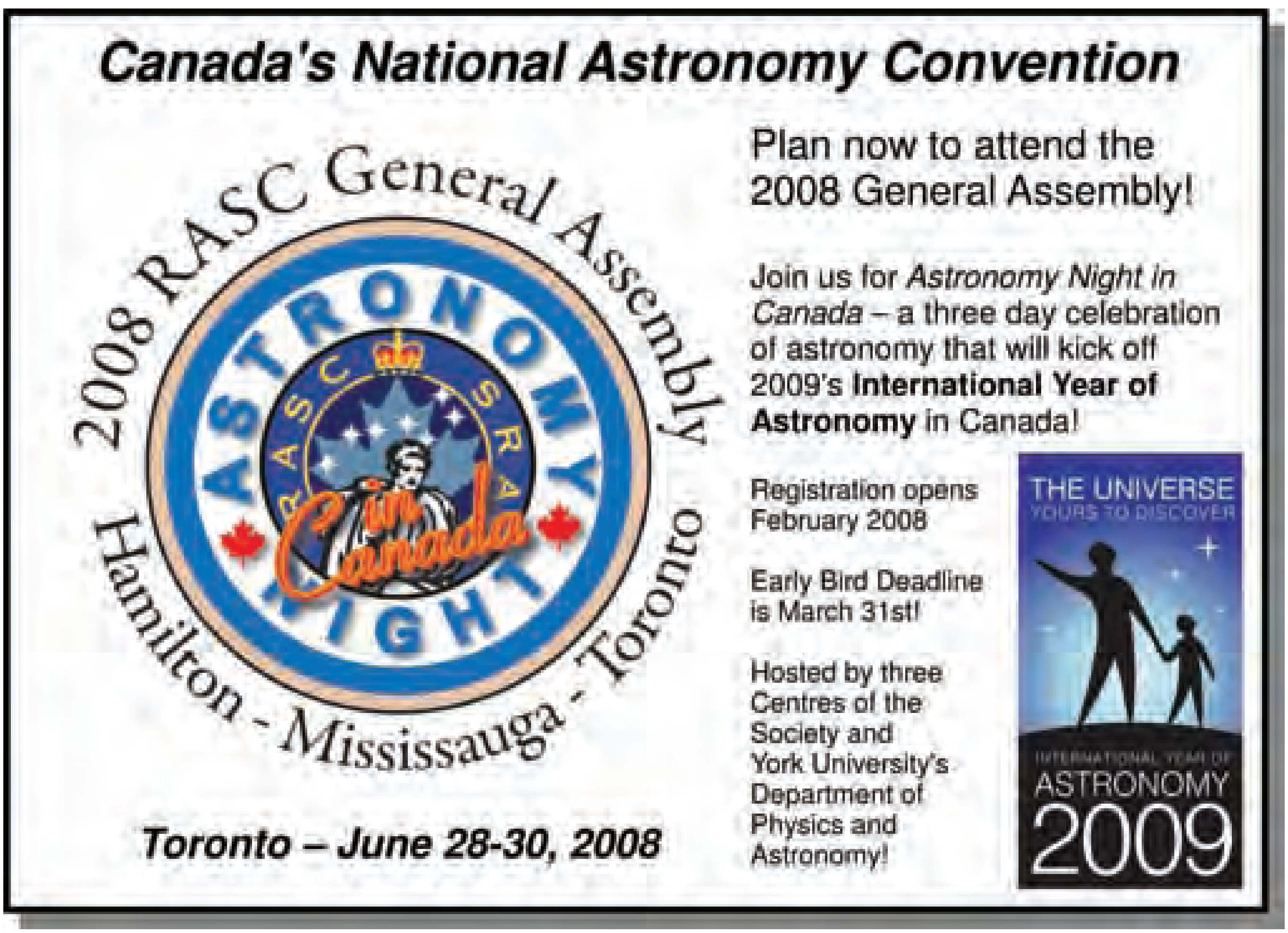

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Figure 3 — 50′ X 50′ POSS image of the field that includes NGC 4244.

that is thought to be the remnants of previous mergers with other galaxies. It is part of the NGC 4631 group of six gravitationally bound galaxies, has a maximum rotational velocity of about 100 km/s, and a diameter of 65,000 light years.

In the eyepiece, its moniker as the "Silver Needle Galaxy"

Figure 4 — Image of NGC 4244 courtesy of John Mirtle, taken with a manually guided 8-inch f/6 Newtonian on hypered Tech Pan film; 45-minute exposure from Wilson Coulee Observatory, Alberta, 1991 April 6.

is apt, but don't take our word for it: have a look at this beauty in the eyepiece and see what your scope shows of this fine object.

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

Through My Eyepiece

Peas in a POD

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

I've always wanted an observatory of my own. Having the use of the Montreal Centre's observatory as a teenager was always a big thrill. After decades of setting up my telescope every night and, worse still, having to tear it down at the end of the evening, I longed to have a permanent setup where I could just walk out, open up, observe, and then shut down in just as short a time when I started to get cold or tired.

I looked into various alternatives over the years, but they were all either too pricey for my pocketbook or too complex for my limited do-it-yourself skills. The one ray of light in all this was in a talk at the Toronto Centre by a fellow named Wayne Parker. Most Canadians perhaps best know Wayne as the bass player in the band Glass Tiger, but he is also an amateur astronomer. His talk was about a company he had recently started to build relatively inexpensive roll-off roof observatories, which he called *SkySheds*. I was particularly impressed by his emphasis on good engineering design and simple, inexpensive technology. From time to time, especially when I moved out of the city, I thought of getting his company to build me a *SkyShed,* but the price was still an obstacle.

Then at the Ottawa General Assembly (GA) last year, I picked up a one-page black-and-white flyer in which he announced a new venture: the *SkyShed POD* — a molded plastic observatory for an unbelievably low price, $1000 US. Knowing the care Wayne put into his *SkySheds,* I was pretty sure this would be a winner, so I signed up for his pre-order list, and joined the *SkyShed POD* Yahoo Group.

Because of Wayne's desire to do things right the first time, it was only around the time of this year's GA that *POD*s actually started to ship. The price had also crept upwards a bit. Wayne was entirely upfront with his potential customers about this, sharing with us the vicissitudes of mold making, hardware shopping, and beta testing. When my *POD* was ready in the second week of July, a friend picked it up from the factory near Owen Sound and delivered it to my farm: ten gigantic plastic moldings and a box of hardware.

Most people apparently can assemble a *POD* in a few hours but, as I mentioned, my DIY skills are severely limited. I'm one of those rare individuals who can read the manual; in fact, I can't really do something *unless* I have a manual. Wayne supplies a wonderful video tutorial on how to assemble the *POD;* unfortunately, I'm almost totally incapable of learning in visual mode. As a result, it took me a few *weeks* rather than hours to get my *POD* assembled, but with a couple of phone calls from Wayne and a little help from family and friends, I finally got it together for first light on July 29.

In this picture, you can see the basic design of the *SkyShed POD:* five wall pieces and a door piece (at left) 1.2-m tall support two nesting half domes atop many roller-skate type wheels. The dome itself is 2.3 m in diameter and 1.1-m high. The whole structure weighs a little over 300 kg.

There are three main limitations of this design: its interior diameter, the height of its walls, and the overlapping dome halves, which block the zenith if the telescope is placed in the exact centre of the *POD*. These combine to put certain limits on the size and configuration of the telescopes you can place in it. Wayne has worked hard to maximize the versatility of the *POD,* but there are some things it just can't do. One of the first things I wanted to do was try a variety of my telescopes in the *POD* to see what would work best.

As you can see in the picture above, it is not terribly well suited for a Dobsonian the size of my 28-cm f/4.3 *Starmaster*. Sitting flat on the floor of the deck, I can't observe anything below about 40° altitude. I experimented with concrete blocks to raise the height of the telescope's base. By raising it 30 cm, I could just see Jupiter over the wall when it was on the meridian; 40 cm was better, but that put the eyepiece 'way too high when observing close to the zenith.

The *POD* works much better with shorter telescopes. Here it is with my Intes 15-cm Maksutov-Newtonian mounted on a Vixen GPDX mount:

This, as you can see, is a much better fit. Almost the entire sky is available for viewing, right down to the horizon. Interestingly, because of the offset east and west of the meridian that you get with a German equatorial mount, the zenith is also accessible with this setup. Similarly, my Orion 10-cm f/9 ED refractor on the same mount worked really well, with a slightly higher pier. However, the real winner was my Celestron *NexStar* 15-cm Schmidt-Cassegrain. By offsetting this a bit to the south of the centre of the dome, I could almost access the zenith, could view down to the horizon in all directions, and could observe anywhere in the sky while seated comfortably. The 15-cm SCT became the regular resident of the *POD*.

Needless to say, I began to feel frustration at not having my usual 28 cm of aperture available to me, so I came to a decision. If a 15-cm SCT worked so well in the *POD,* wouldn't a larger SCT work equally well? I've been extremely pleased with the optics, mechanical solidity, and computer accuracy of my *NexStar,* so an upgrade to a larger SCT made sense. I ordered a Celestron CPC 1100 28-cm SCT, and three weeks later it arrived and was immediately installed in my *POD,* where it is now my main instrument.

The 28-cm is a lot bulkier than the 15-cm, but it doesn't take up that much more floor space. There is still room in the *POD* for my somewhat bulky self, plus an observing table and an adjustable observing chair. Some might call it snug, but I prefer to think of it as cozy, and my scope and I are as comfortable as two peas in a pod — well, actually a *POD!*

What was immediately noticeable with this new setup was that my observing sessions have become longer, even in colder weather, because of the protection of the *POD*. Dew becomes much less of a problem because a lot of the sky is blocked. The accurate GoTo of the CPC 1100 means I can make more variable-star estimates in a given time period, so my productivity has increased. My main loss has been in field of view; the 28-cm SCT maxes out at about 1 degree, so I'm now using AAVSO "d" charts or larger almost exclusively.

I had not anticipated that purchasing a *POD* would lead to buying a new and rather expensive telescope, but the setup seems a really good fit for my current observing interests and situation. So far the *SkyShed POD* has lived up to its promise, and everyone who sees it seems to want to own one. Even my non-astronomer friends see in it a wonderful ice-fishing hut!

Geoff Gaherty is currently celebrating his 50th anniversary as an amateur astronomer. Despite cold in the winter and mosquitoes in the summer, he still manages to pursue a variety of observations, particularly of Jupiter and variable stars. Though technically retired as a computer consultant, he's now getting paid to do astronomy, providing content and technical support for Starry Night Software.

Pixellations 1

by Jennifer West (westjl@cc.umanitoba.ca) and Ian Cameron (icamern@cc.umanitoba.ca), Winnipeg Centre

Digital cameras offer a multitude of often-confusing choices to the user regarding image format, resolution, quality, noise reduction, and ISO speed, among others. In addition, the user can choose to correct images using calibration frames such as darks and flats, or take multiple exposures to combine using a computer. We plan to discuss these options in future articles. To start with, we are going to use a simple scenario. We have obtained a single image of the North America Nebula using a Canon 20Da Digital SLR camera set for a 300-second piggy-back exposure and using a 55-mm lens at f/5.6 and ISO 1600 (Figure 1). Noise reduction was turned off and the file was saved in jpeg format.

Figure 1 — Cropped portion of the original, unprocessed image.

So we have an image. Now what? The first decision to make is which image-processing package you will use. There are many choices available, but for this series, we are going to try to focus on things that can be done with almost any package, so use what you have and what you are comfortable using. For our examples, we will use a combination of *Photoshop CS 2, Photoshop Elements, GIMP,* and *ImageJ*. *Photoshop* is the industry standard image-processing package, however it is very expensive. *Photoshop Elements* is capable of making most of the adjustments we will discuss, is less costly, and is often bundled with many digital cameras. *GIMP* and *ImageJ* are both free, open-source packages that can be downloaded from the Internet. All packages are available for Windows and Mac, while *GIMP* and *ImageJ* are also available for *Linux*. *ImageJ* (West and Cameron 2006) is unique among the above-mentioned packages in that it is designed for analysis and thus is capable of measurements that are more specific. Some operations are much easier to perform in *ImageJ* than in most other packages for this reason.

The first and simplest adjustment that most people perform on a digital image is the brightness/contrast adjustment. But what exactly does it do and how can we make more-intelligent decisions about the settings instead of blindly fiddling with sliders?

First of all, we need to know that a jpeg image uses what is known as 24-bit colour. This means that there are three channels: red, green, and blue. Each of those channels is an 8-bit monochrome image that when combined give us colour. An 8-bit image has 256 levels of grey going from black (= 0) to white (= 255). The "luminance" of an RGB image is a weighted average of the individual R, G, and B values.

A histogram is a plot that indicates the number of pixels that have a particular value. Astronomical images present a challenge since many of the pixels will be very dark or close to black. In addition, we frequently encounter very large dynamic range — *i.e.* some regions of the image will be very bright while others are very dark. Displaying these regions simultaneously is quite challenging.

Many image-processing packages allow us to adjust the minimum and maximum displayed value or the black- and white-points. In *Photoshop, Photoshop Elements,* and *GIMP* this adjustment is called "Levels...." Adjusting these values stretches the display to more closely match the data. For example, Figure 2 shows the histogram of the image in Figure 1. By looking at the histogram, one can see that most of the pixels in the image have values in the bottom half of the histogram. A more quantitative analysis can tell us that most of the pixels have a value between 27 and 127 counts. Thus, if we set our "black-point" to 27 counts and our "white-point" to 127 counts, all of the pixels with a value less than 27 will appear black, and all of the pixels with a count greater than 127 counts will appear white. In addition, since we can still display 256 levels of grey, those levels can now be distributed between 27 and 127 or over 100 counts. We are therefore improving the contrast over that limited range and since there are few pixels above and below, we are not losing a great deal of information in our image. The adjusted image is shown in Figure 3.

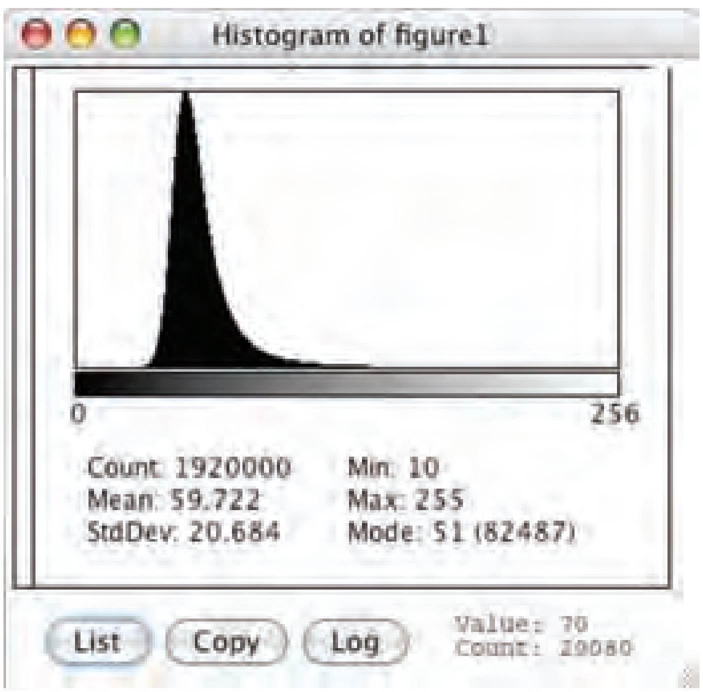

Figure 2 — Histogram of the original image.

We are describing here how to manipulate the "transfer function." The transfer function is a mathematical function that describes how the measured data value is "transferred" or mapped to the displayed value. In this simple case, the function is linear, with a slope equal to 256 (the total number of levels) divided by 100 (127-27).

If instead of adjusting the minimum and maximum values (the black- and white-points) we adjust the "brightness" and "contrast," we can still achieve the same results; however brightness and contrast adjustments are, in our opinion, somewhat more awkward. The brightness adjustment changes the position of the transfer function along the x-axis (*i.e.* the intercept of the function), while the contrast adjustment changes the slope of the function. A slope of zero (horizontal transfer function and minimum contrast) implies that all of the data values will be displayed with the same value and thus the image will appear a uniform grey. An infinite slope (vertical transfer function and maximum contrast) is equivalent to "thresholding" an image. All of the data values above the threshold value will be displayed as white, while all those below will displayed as black. *ImageJ* provides an interactive tool that displays the histogram and the transfer function, and allows the user to manipulate the minimum/maximum values and the brightness/contrast simultaneously (Figure 4). It is an excellent tool for understanding how these values are related and we encourage you to experiment.

Figure 3 — Histogram adjusted image. Minimum (black-point) is set to 27 and maximum (white-point) is set to 127.

The transfer function is not limited to a linear function and, in fact, non-linear functions are often more useful. One of the most useful functions for displaying many astronomical images, especially galaxies, is the log (logarithmic) function.

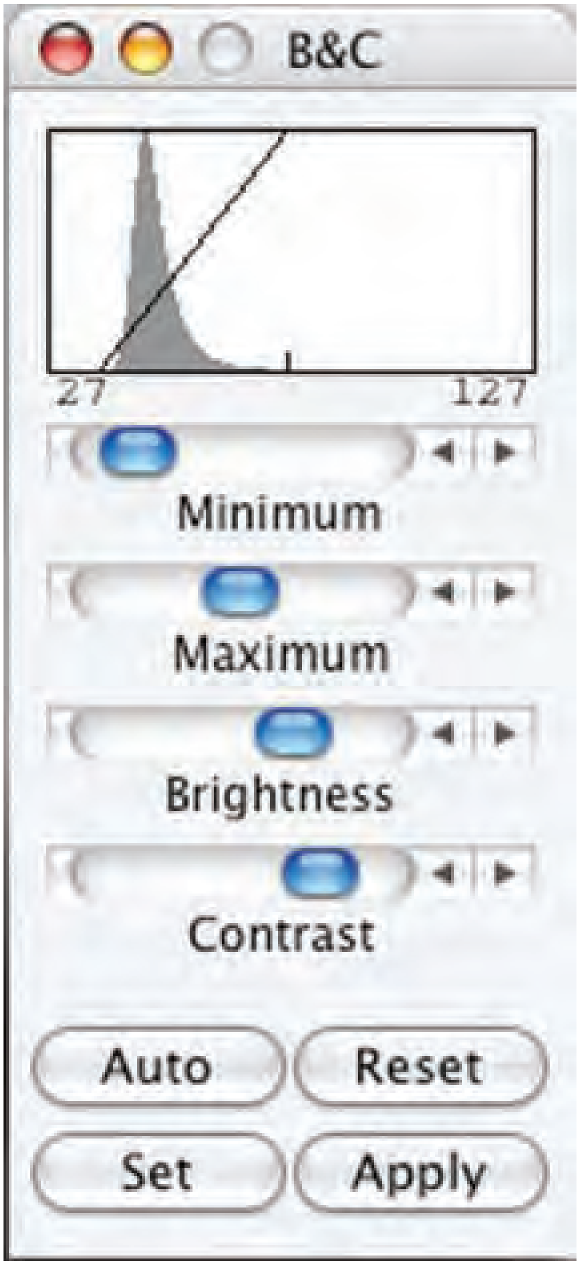

Figure 4 — Brightness and Contrast adjustment tool from *ImageJ*.

The log function rises rapidly at low values and then rises much more slowly for high values. The x-axis of the plot represents the actual values of the data, whereas the y-axis of the plot represents the displayed value. Thus for dark regions, a small change in the actual data value will represent a large change in the displayed brightness. For bright regions, the opposite is true in that a large change in the data value will represent a relatively small change in the displayed brightness. Therefore, the log function works to expand the range of dark regions while at the same time compressing the range of the bright regions. In an object such as a galaxy, this is useful since the darker regions such as the faint arms and knots often contain interesting detail, while the bright regions such as the bright nucleus are often rather featureless.

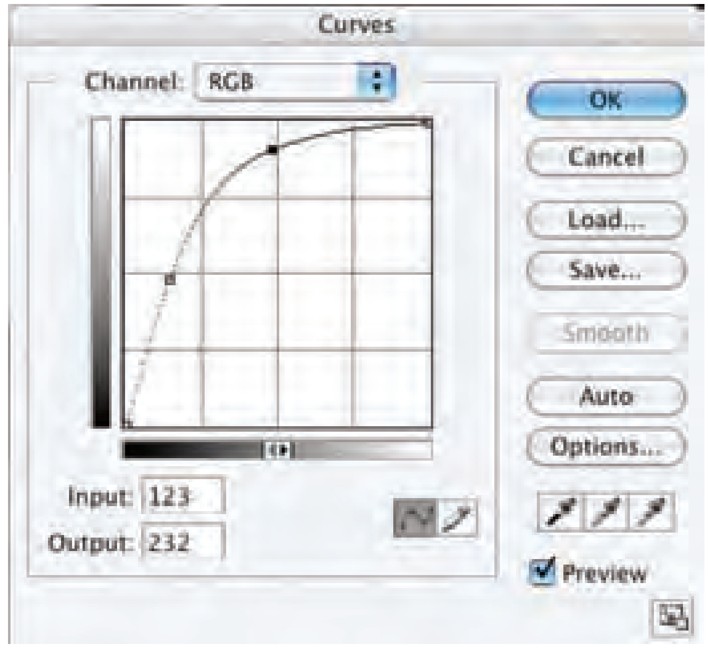

Figure 5 — Curves tool in Photoshop. The transfer function has been manipulated to resemble a mathematical log function.

Photoshop Elements does not have a convenient tool to manipulate the transfer function to display non-linearly. *Photoshop* and *GIMP* both have the "Curves..." tool, which allows the user to arbitrarily manipulate the transfer function and so create one that is similar in character to a mathematically defined function (see Figure 5). *ImageJ* can perform mathematical operations, such as log on the image values itself. *ImageJ* also has "Look-Up Tables" (LUTs) that are used to map the data values to the displayed values. Log and other LUTs are available.

Next time we will discuss image resolution and optimizing your imaging to match your optics.

References

West, J.L. & Cameron, I. 2006, JRASC 100, 242

Ian Cameron has been involved with digital imaging in astronomy for nearly 20 years. He currently manages the observatory at the University of Manitoba.

Jennifer West teaches an observational astronomy course including digital imaging at the University of Manitoba. She has been developing astronomical imaging plugins for ImageJ *for the past seven years.*

Observing on the Deck

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

If your skies and your neighbours' lights permit, the best place to set up your scope is your own backyard, close to the heat and close to the fridge. Best of all is when you can set it up right on the sun deck, but on a wooden deck the stars in your eyepiece do a dance every time you move. If someone else is on the deck you might just as well go in and watch a movie.

Figure 1 — Dob and tripod bases. Both the Dob base and the tripod base can be preassembled. Use braces to stiffen the assembly or, much easier, a plywood skirt.

Every deck is different but if yours has a 2 × 4 or 2 × 6 plank surface, as is common, then this little bit of home renovation might work for you. The idea is to provide an isolated tripod base or Dobsonian platform that is flush with the top of the deck so that it can be walked on and support patio furniture but that will not pick up the vibration of the deck when people move around on it.

The Dob platform can be made of a 24″-square concrete patio paver supported on four braced 4 × 4 posts. Pull up as many of the deck planks as you need to, and frame an opening the size of the paver plus two inches.

If there is a concrete slab under your deck the post assembly can rest directly on it. The posts can be secured with angle brackets and concrete anchors. On rock, you can probably do something similar.

If there is earth below your deck, dig a hole at least two feet deep. Clean out all loose material so that the bottom is clean, undisturbed ground.

Pre-build the post assembly using pressure-treated wood for the posts and exterior plywood for sides to hold them rigid.

Figure 2 — Joists and framing. Use joist hangers and galvanized nails to frame the opening for the Dob base.

Suspend the whole thing over the hole and temporarily support it from the sundeck framing with cleats or clamps. The posts should hang about three inches above the bottom of the hole. Carefully place about six inches of concrete into the hole and consolidate it with a garden rake using an up and down motion, (like mashing potatoes) until it flows completely around and under every post. Finally, fill a glass with whatever tastes

Figure 3 — Finished deck. Without telescopes the deck can still be used for a barbecue. But after the burgers, when the stars come out…

best after you've done something physical.

After the concrete sets (give it 24 hours) remove the cleats or clamps, fill what's left of the hole with whatever came out of it and lay the paver in place on top of the posts. Check the height and cut or shim the posts as required, then fit the deck planks back in. Leave a gap of about ½" completely around the paver.

The tripod base is done similarly, except that the posts are set flush with the top of the deck and the deck planks fitted around them individually.

You'll need some basic construction skills to do this properly. If you are unsure, get advice from a local builder or even have him do it for you. Either way, observing from outside your living room will be very easy to accommodate.

Don and Elizabeth Van Akker did this exact modification to their deck on Salt Spring Island. Then they decided to build the observatory anyway. Don will be glad to help you with this and any other Gizmos project if you email `don@knappett.com`

Concrete for this kind of application is one of the most forgiving materials you can use. You won't use enough of it here to bother with the expense of bringing out a ready-mix truck, so you can mix it yourself in a wheelbarrow. You can buy premixed bags that contain cement and aggregate from a building supply, or you can buy just cement and mix your own. One part cement, two parts sand, and three parts gravel. Or, mix one to five with almost any sandy, gravelly material — even what came out of the hole! Just keep out clay and topsoil and it will set up and be more than adequate for what you are doing here. Add only enough water to turn everything into a creamy paste-like mass (less water is better) and mix thoroughly.

Carpe Umbram

Fifty Years Ago...

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

Remember we'd be up all night
Talking 'til the morning light, yeah
Like the way it used to be
Those simple days
Just you and me, mmmm

Do You Remember by Aaron Carter
© 2002, Aaron Carter

In this case, the "you and me" were a 15-year-old kid named David Dunham and his 60-mm telescope. The memory was of a California night when they went out to watch the Moon occult (pass in front of) the star β2 Capricorni. Last October 29 marked the 50th anniversary of that event, which set David on a lifetime journey into the fascinating world of occultation timing — both lunar and planetary — and eventually gave birth to the International Occultation Timing Association.

On that night, David observed the occultation of β2 Cap near the southern limb of the Moon. But he also watched the brighter star β1 Cap as the Moon slid silently by, leaving it undisturbed. That got him thinking: wouldn't it have been neat if he had set up farther north where β2 could be seen to just graze the Moon, repeatedly flashing off and on as lunar mountains and valleys on the very edge of the Moon passed in front of it? But where exactly would he need to stand? Would it be possible to calculate exactly where on Earth the "graze line" would fall? He set about to find out.

Less than four years later, as a sophomore at the University of California, Berkeley, David noticed in *Sky & Telescope's* Occultation Supplement (which provided predictions for total lunar occultations, but not grazes) that there would be an occultation close to the lunar south pole involving the bright star Aldebaran, not far from his home on that very weekend. By this time David had acquired the mathematical skills needed to calculate the graze path and he set about, with logarithmic and trigonometric tables and a mechanical calculator, to do just that. But the task took longer than he anticipated, with the result that he arrived at the graze limit too late to see the phenomenon. Disappointed, but not discouraged, David continued to work out predictions for lunar grazes and, finally, on 1962 September 18, Leonard Kalish of Los Angeles, using David's predictions, observed a multiple-event graze of the star 5 Tauri. This was probably the first successful observation of a predicted lunar graze seen from the Americas. (Jan Meeus predicted and observed a 6-event graze of λ Geminorum nearly two years earlier in Belgium). Soon David was providing hundreds of graze predictions for scores of observers around the world. By 1974 the number of these "tip sheets" had become too unwieldy and expensive, so *The Occultation Newsletter* was offered at subscription.

Homer Daboll of St. Charles, Illinois became its first editor. Within a year, David founded the International Occultation Timing Association (IOTA). The name and acronym was coined by Dr. Daboll.

It was at about this same time that David Dunham expanded his fascination with occultations to include those by asteroids. This was not a new idea — in 1958 and 1961 occultations by (4) Vesta and (2) Pallas had been observed from Sweden and India, respectively. When David received predictions from Brian Marsden at the Smithsonian Astrophysical Observatory that the asteroid (433) Eros would occult a 3.6-magnitude star as seen from New England, he set to work encouraging observers there to try for the event. (As a researcher at the University of Texas, David was unable to participate.) Six successful chords were obtained that showed Eros to be much smaller than previously thought. It shrank from 65 km × 26 km to 15 km × 7 km.

How wonderfully elegant it is that Eros was the asteroid chosen by NASA to be visited by the *Near Earth Asteroid Rendezvous* mission. The contract was awarded to Johns Hopkins

Figure 1 — A whole-asteroid view of Eros by *NEAR*.

University Applied Physics Laboratory in Laurel, Maryland, where Dr. David Dunham became mission designer. Renamed *NEAR Shoemaker* in honour of Dr. Eugene Shoemaker, the spacecraft not only rendezvoused with the asteroid, it became its satellite for a full year, sending back the most detailed images and other data ever captured of any asteroid, then landed softly on its surface on 2001 February 12, bringing to an end one of the most successful of all of NASA's interplanetary missions.

Now, several hundred amateur and professional astronomers chase thousands of lunar and asteroidal occultations on six continents every year — all because a skinny kid looked up at the Moon more than fifty years ago and wondered how to predict grazing occultations. Thank you, David Dunham! "You da Man!"

Figure 2 — The author with David Dunham (left).

Here is a list of possible occultations over populated parts of Canada for the next two months. For more information on events in your area, visit the IOTA Web site, `www.asteroidoccultation.com`. It is very important that you advise me or another IOTA member if you plan to observe and time an event so we can avoid duplicating chords.

DATE(UT) 2008	ASTEROID #	Name	STAR MAG	Δ-MAG	MAX DUR	PATH
Feb 1	1512	Oulu	11.8	3.8	5.1	swON
Feb 2	713	Luscinia	10.7	4.0	2.5	cON
Feb 2	3447	Burckhalter	8.3	6.9	1.0	eQC
Feb 2	318	Magdalena	11.8	2.9	7.5	sON
Feb 6	1289	Kutaissi	10.1	5.3	2.8	NL-cBC
Feb 6	2837	Griboedov	8.8	7.1	1.2	NS-nMB
Feb 8	2604	Marshak	10.5	6.5	1.4	AB
Feb 10	6306	Nishimura	10.1	5.3	1.2	NL-eQC
Feb 15	380	Fiducia	12.4	1.9	9.7	seSK-neBC
Feb 18	4715	1989 TS1	9.4	7.6	5.8	cQC-swNS
Feb 18	750	Oskar	9.2	5.4	2.7	swAB-nwBC
Feb 19	775	Lumiere	9.7	5.2	6.7	nMB-seBC
Feb 22	191	Kolga	11.4	2.8	12.8	NB-NL
Feb 28	429	Lotis	12.3	2.0	12.1	swSK-neAB
Mar 5	729	Watsonia	11.7	2.5	8.8	seBC-nwSK
Mar 5	227	Philosophia	10.5	4.1	12.1	AB
Mar 9	6255	Kuma	9.8	7.6	2.3	swON-nBC
Mar 10	2054	Gawain	9.8	6.9	4.6	wBC
Mar 11	735	Marghanna	9.0	6.0	7.7	nwMB-seSK
Mar 12	395	Delia	11.2	3.2	5.1	swON, sMB-nBC
Mar 13	175	Andromache	11.8	2.3	7.6	NS-nMB
Mar 14	1284	Latvia	11.8	2.9	4.1	nAB-sMB
Mar 15	1794	Finsen	9.7	5.6	4.0	NB-QC
Mar 16	255	Oppavia	11.1	4.0	5.4	seON-nwON
Mar 18	389	Industria	11.6	0.5	7.7	swON, sMB-neBC

Mar 19	701	Oriola	12.7	1.3	3.6	swON-nSK
Mar 20	27496	2000 GC125	10.5	5.9	1.9	BC
Mar 24	2957	Tatsuo	10.1	5.4	3.4	swBC
Mar 24	769	Tatjana	11.1	2.5	8.0	swBC
Mar 30	733	Mocia	11.2	4.0	3.8	QC
Mar 31	77	Frigga	11.9	1.2	10.1	NS-BC
Mar 31	1094	Siberia	10.4	5.9	2.2	sON-sSK

NOTES:
Mar 05: The paths of two occultations intersect 160 km southeast of Calgary, about 40 minutes apart. Good two-for-one opportunity!
Mar 24: The paths of two occultations intersect at Victoria, about two hours apart. Another good two-for-one opportunity.

Orbital Oddities

Ceres Situation

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

"So tell me, Bruce...any unusual astronomical events happening in 2009?"

I was asked variations of this question at least three different times at the 2007 General Assembly in Calgary. I guess, that after seven years of Orbital Oddities, I do have a reputation for astronomical arcana, but the 2009 focus of the question was due to the International Year of Astronomy recently declared by the United Nations. The occasion will be the 400th anniversary of Galileo's first telescopic observations, although, considering the remarkable accomplishments of 1609, this orbital oddball thinks Kepler's (first two) Laws should share equal billing.

So what's up in IYA2009? My answers were immediate: the longest eclipse of the current century — unfortunately on the other side of the world — and a poorly-timed edge-on (dis)appearance of Saturn's rings. Perhaps the most interesting happenings of the year involve two of the newly designated dwarf planets, Pluto and Ceres.

In the case of Pluto, the action will take place around a boardroom table, as the triennial meeting of the International Astronomical Union is certain to bring the next round of the "Pluto: Planet X or Ex-Planet?" imbroglio. Like it or not, from the public's perspective the Pluto debate is one of the bigger astronomy stories in recent years. People are used to new discoveries adding to the impressive body of knowledge that has been collected at an ever-increasing rate over the centuries, but the simple act of subtraction has raised eyebrows and more than a few hackles. Why should poor little Pluto be demoted?

Some interesting parallels can be made between Pluto and Ceres. The two dwarf planets have much in common, not the least being the difficulties they caused astronomers who were trying to fit them into a categorical box. Each is a prototype for an entire class of objects. Space probes are currently speeding towards both — *Dawn* to Ceres (via Vesta), *New Horizons* to Pluto — with both scheduled to arrive in 2015.

When Ceres was detected by Giuseppe Piazzi on 1801 January 1, it became a telescopic discovery that defined a generation, like Herschel's discovery of Uranus in 1781 or Palitsch's recovery of Halley's Comet in 1758. At the time, it was hailed as spectacular confirmation of the Titius-Bode rule of the spacing of planets, as it nicely filled the gap between Mars and Jupiter. Besides Bode and Piazzi, other famous names involved in the pursuit included Olbers and Schröter, while the mathematical giant J.K.F. Gauss assisted with the orbital calculations that enabled the object's recovery at its next apparition. (Chapman 2001)

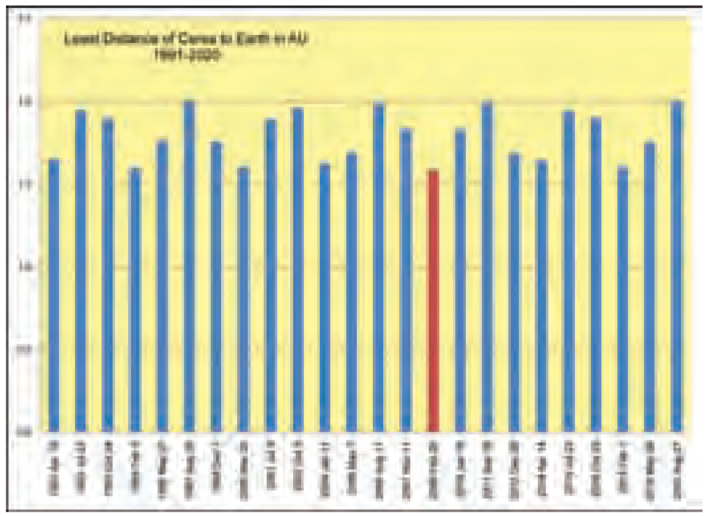

Figure 1 — Least distance of Ceres to Earth, 1991-2020, adapted from Meeus (1983-95). At 2.77 AU, Ceres has an orbital period of just over 4.60 years, completing 5 revolutions of the Sun for 23 of Earth. It therefore has 23 – 5 = 18 apparitions every 23 years, with a mean synodic period of 466 days. Note the strong similarities between the last block of 6 apparitions and the first block 23 years earlier. The 2009 opposition is marked.

However, it quickly became apparent that Ceres was far smaller than the Moon. Though the largest of the main-belt asteroids, it is a shade below 1000 km in diameter. Furthermore, it wasn't alone, as three more asteroids (Pallas, Juno, and Vesta) were discovered by 1807. For a few decades, they remained the

Figure 2 — The path of Ceres in early 2009, from January 1 (lower left of loop) to May 1. Its position in northern Leo near the border of Leo Minor is plotted for the date of closest approach, February 25. At that time it will be 17° north of the ecliptic with an angular speed of ~35 arc seconds per hour. Saturn at lower left will also be in retrograde motion near its opposition March 8.

only known asteroids, and all were considered planets. Then the discovery rate skyrocketed — at one point, asteroids were being discovered at such a prodigious rate that they were dubbed "the Vermin of the Skies." Around mid-century, the whole kit and caboodle were reclassified as "minor planets." In retrospect, this was a great decision, as even My Very Excellent Mother would have a very difficult time cooking up a mnemonic that covered the several hundred thousand denizens of the asteroid belt.

Whatever its official status, Ceres has good timing. Early in 2009, it will make an *exceptionally* close approach to Earth. Mark your IYA2009 calendar for Wednesday, February 25, when at 14h UT, Ceres will be 1.5832 astronomical units from Earth (Figure 1). According to Meeus (1983-95), that will be its closest approach during the period 1980-2060. Spotting this factoid late one night while doing some proofreading for the *Observer's Handbook,* I decided to write to Dr. Jean Meeus, the renowned computational astronomer and RASC honorary member, on this subject, and an interesting correspondence ensued.

Meeus kindly provided some 14 centuries worth of data about close Ceres approaches, listing exactly 100 occasions where it comes within 1.60 astronomical units of Earth (Tables 1-3). It has been closer than the 2009 encounter only once since Piazzi's discovery, in 1857 (around the last time its status was in question, come to think of it!). Furthermore, its approach on February 25 of IYA will be the closest for many thousands of years.

In its way, this is the Mars opposition of 2003 in reverse. While Mars is getting incrementally closer during times of optimum alignment and setting new standards each time, Ceres is in effect receding. What could be causing that?

It is interesting to compare the orbits of the large asteroid with its closest planetary neighbour. Ceres has an eccentricity of 0.077, a shade less than Mars' 0.093, but still significant. The longitude of perihelion for the two is almost 180° opposed, thus perihelic oppositions of Ceres occur in late February as compared to late August for Mars. The argument of perihelion is 73° for Ceres, 287° (effectively, -73°) for Mars. This means that, particularly during close approaches, Ceres is north of the ecliptic and favourable to northern observers, whereas Mars is displaced southward.

Befitting its dwarf status, Ceres is quite steeply inclined to the ecliptic, at 10.6°. From the foreshortened perspective of Earth, aligned between Ceres and the Sun, the asteroid soars 17° above the ecliptic to a declination of nearly 25°, making it extremely well placed for observation through the night (Figure 2).

In terms of its apparent recession from one "good" alignment to the next, Jean Meeus and I discussed several factors that could be at play, such as the changing relationship between Ceres' perihelion point and Earth's aphelion and the theoretical closest approach of the two orbits. Another consideration is the latitude of perihelion: the "hypotenuse effect" of Earth's placement far off the Sun-Ceres plane, especially as the argument of perihelion approaches 90° and Ceres at its closest is maximally removed from the ecliptic plane. Both effects are measurable: the first has currently the effect of making future Ceres approaches *closer;* the second makes them marginally more distant for the next few centuries but then closer again after that. However, they are secondary terms in the bigger equation.

Not surprisingly, it was Jean who hit on the answer. (Let's just say I'm very sympathetic to the plight of dwarfs!) In his private correspondence of 2007 July 31, he wrote:

> *It appears that Ceres' semimajor axis (a) doesn't show a secular variation (at least between 1800 and 3000), only rather small periodic variations. On the contrary, the eccentricity gradually decreases (again besides periodic fluctuations), from 0.078 about 1800 to 0.073 in 3000. And consequently, the perihelion distance gradually increases. Its smallest value (in the period 1800-3000) was 2.5415, in 1863. But after 1946 it never becomes smaller than 2.544, and after 2563 never smaller than 2.552. So I suspect that it is this variation that explains why Ceres will not come closer to the Earth than in 2009, for many centuries.*

An unusual aspect about the apparition of 2009 is that even though Ceres will be exceptionally close, it won't be exceptionally bright. At magnitude 6.9 it will certainly be one of the brighter oppositions, but those of 2004 and 2012 are slightly brighter. Because Ceres stands so high above the ecliptic, it also has a lower phase angle. In essence, Ceres will not be full, but gibbous (Table 4). It's losing the argument of perihelion!

But no matter, Ceres won't wow people at the eyepiece with its brightness at any time. Neither will Pluto, or near-Earth asteroids, or many other subjects that are nonetheless of interest to the public. People just need a reason to look, something current and unusual.

RASC Centres looking to stage public events in IYA2009 might do well to consider a "Dwarf Planet Night" in late February, featuring observation of Ceres at its very closest, and perhaps a public lecture about how the discovery of all three prototype dwarfs changed the way we comprehend and compartmentalize the Solar System.

Just make sure you say "Pluto" a lot in your press releases.

References

Chapman, D. 2001, JRASC 95, 135

Meeus, J. 1983-95, *Astronomical Tables of the Sun, Moon and Planets* (Willmann-Bell Inc.: Richmond), 17, 50

Bruce McCurdy has been involved in public outreach in astronomy for over twenty years. He greatly looks forward to the opportunities that will be provided by International Year of Astronomy to share our skies with all who care to look, and our Universe with all who care to think.

Table 1.

Years	Number of approaches <1.60	<1.59	closest (year)
1601-1800	18	12	1.5740 (1636)
1801-2000	18	10	1.5815 (1857)
2001-2200	17	3	1.5832 (2009)
2201-2400	12	4	1.5846 (2253)
2401-2600	13	0	1.5905 (2557)

Table 1: Distribution of close approaches of Ceres, 1601-2600. The gradual recession of Ceres is apparent. There were three passes of <1.58 AU in 1613-36-59, none since. Since its discovery in 1801, there has been only one approach of Ceres closer than that of 2009. Data courtesy Jean Meeus.

Table 2.

Date	Distance
1894 Mar. 07	1.5970
1917 Mar. 06	1.5894
1940 Mar. 04	1.5867
1963 Mar. 02	1.5885
1986 Feb. 28	1.5872
2009 Feb. 25	**1.5832**
2032 Feb. 24	1.5848
2055 Feb. 22	1.5906
2078 Feb. 19	1.5943
2101 Feb. 18	1.5962
2124 Feb. 16	1.5965
2147 Feb. 13	1.5923
2170 Feb. 11	1.5886
2193 Feb. 09	1.5931

Table 2: Least distances of Ceres at intervals of 23 years minus ~2 days. In the above "Ceres series" there are 14 approaches within 1.60 AU, including the minimum of 2009 as well as a secondary minimum (due to periodic variations) in 2170.

Table 3.

D	C	B	A
		1811	1820
		1834	1843
		1857	1866
		1880	1889
	1894	1903	
	1917	1926	
	1940	1949	
	1963	1972	
	1986	1995	
	2009		
2023	2032		
2046	2055		
2069	2078		
2092	2101		
2115	2124		
2138	2147		
2161	2170		
2184	2193		

Table 3: "Ceres series" of approaches to Earth of <1.60 AU, 1800-2200. Approaches closer than 1.59 AU are shown in italics. The major period within each series is 23 years and the minor period from one series to the next is 14 years. Every event shown occurs between January 20 and March 21. These series are gradually growing shorter as Ceres' orbit becomes less eccentric and approaches close than 1.6 AU become less frequent.

Table 4.

Date	UT	*i*	*k*	Dist.	Mag.
2004 Jan. 09	14h	3.03868	0.99930	1.6258	6.8
2009 Feb. 25	14h	6.42108	0.99686	**1.5832**	6.9
2012 Dec. 18	09h	**0.69060**	**0.99996**	1.6843	**6.7**

Table 4: Three bright apparitions of Ceres. While that of 2009 is the closest of the three, it occurs some 17° north of the ecliptic, resulting in a gibbous phase and significant shadowing. The more distant approach of 2012 December 18 occurs within 2° of the ecliptic, thus Ceres is a much more efficient reflector, flaring with the "opposition effect." This can be seen in the low phase angle *i*, or the very large illuminated fraction *k* (or my preference, 1 – *k*).

Gerry's Meanderings

2007 – A Space Oddity

by Gerry Smerchanski, Winnipeg Centre (smerch@mts.net)

October 2007, out beyond Mars, high above the plane of the Solar System, with the asteroid belt below. Comet 17P/Holmes drifts serenely along in its orbit — quiet, dim, virtually unknown since it faded from view after its discovery in 1892. Edwin Holmes had detected it on November 6 of that year after it appeared rather suddenly near the Andromeda Galaxy, on which he had been conducting regular observations. In his 32-cm telescope, the comet had a bright nucleus and a 5 arc-minute coma. Holmes received the Donohoe Comet Medal of the Astronomical Society of the Pacific for the discovery.

Observers watched it fade slowly from naked-eye brightness over the course of several weeks, only to have it flare up again to naked-eye visibility in January 1893. It was observed uneventfully during close approach for two more orbits, in 1899 and 1906, and then it was lost until 1964. It has been observed ever since, proving to be a sedate and unremarkable comet swinging up and down through the plane of the Solar System between Mars and Jupiter. With an orbital period of less than 7 years, Comet Holmes had made 17 orbits without incident or even much variation in brightness — not unexpected for a comet that never gets as close to the Sun as Mars. Its only noteworthy characteristics since discovery were the perturbations to its orbit from encounters with Jupiter, one of the factors that caused it to be lost for most of the 20th century.

But all this was about to change. In March 2007, Holmes passed through the plane of the Solar System and in May through perihelion. An unassuming comet, Holmes attracted little attention from the third planet during that time. The few on Earth who bothered to locate it near perihelion and estimate its brightness saw the comet as a dim 15th-magnitude star-like dot. By early October, it had dimmed to magnitude 17. Observers expected it to continue to slowly grow dimmer and fade into obscurity once more.

But on October 23/24, something unusual happened. Comet Holmes underwent an explosion of material that quickly formed a bright and rapidly growing coma of dust and gases. Earth-bound observers in Spain and the Canary Islands quickly detected this sudden brightening, spreading the word electronically around the world. As darkness fell in each time zone, ready observers were treated to one of the oddest sights in the nighttime sky. Holmes had gone from invisibly dim to being an easy object with the unaided eye. The slightest increase in magnification, from even modest binoculars, showed a bright circle of orangey-yellow light with a brighter central region. Visually, there was no tail to be seen. Even if there were one, any tail streaming out away from the comet would have stretched out behind the coma because of the perspective of the observers, with the Earth almost directly between the Sun and Holmes. But what a show it put on! For the first few nights, the expanding coma held its brightness, presenting itself as a very large and very bright "planetary nebula." Before long, it grew to the size of the nearby Full Moon as dust rushed out from the nucleus at 500 m/s (1800 km/h). The rapid expansion had observers scrambling to find low-power eyepieces and larger telescopes to try to frame the entire object.

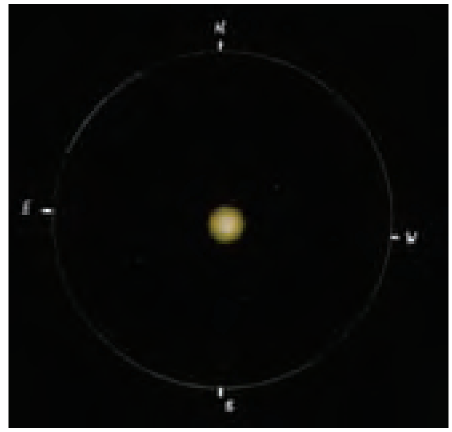

Figure 1 — This sketch is based on my observations on the night of October 24 at around 10:45 p.m. CDT (3:45 UT on 2007 October 25).

Earth's large telescopes were also brought to bear on the event. Even *Hubble* was taken off its busy schedule to complement the other large eyes watching the spectacle. For experienced and novice astronomers, Holmes was exceptional. Here is an excerpt from *Astronomy Sketch of the Day* for 2007 October 29:

> *Many veteran comet observers regard the outburst of Comet Holmes (17P) as one of the oddest sights they have seen. Not only was the sudden brightening unprecedented in modern times, but the perspective we have of this distant comet gave it an appearance all its own. From night to night, you can see it growing in size and yet, due to the dimming of the expanding coma, it maintains a fairly constant brightness when viewed naked eye.*

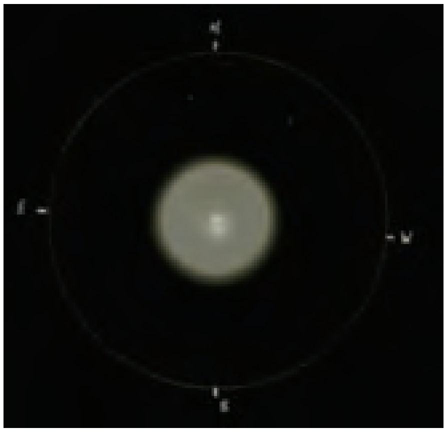

Figure 2 — This sketch was done on October 27 at 11 p.m. CDT (4:00 UT on 2007 October 28). Note the two 11th-magnitude stars that could be seen shining through a relatively colourless coma (bottom/south part of the coma about 1/4 the way in). Since the same equipment was used for both this and Figure 1, the images can be compared directly for size, giving an idea of just how quickly this comet grew. Holmes must be one of the oddest events in comet watching.

Surprised and delighted, observers were left wondering what could have caused this outburst that resulted in a half-million-fold increase in brightness. Estimates of maximum brightness for the outburst ranged as high as magnitude 2.5. What was unusual is that comets seldom flare up or otherwise misbehave so far past their perihelion and at such a great distance from the Sun. The appearance was amazing — it looked like nothing else up there and no other comet in recent times. Over the first week, observers watched it grow in size until it was physically larger than the Sun. The striking yellow/orange colour was quickly lost and, once the Moon left the sky, a fainter, outer greenish-blue halo could be seen. By the second and third days, the coma had a donut appearance, with a slightly brighter outer ring enclosing a dimmer interior — in effect, a giant Ring Nebula. Observers strained to make out detail in the pseudo-nucleus, watching keenly for any signs of disintegration that would yield clues as to what had transpired. But the comet kept its secrets well, though it didn't take away from the view. Report after report mentioned the surprise and amazement of observers all over the planet.

A Comet for All Optics

One of the most rewarding aspects of the outburst of Comet Holmes was that most of the instruments that astronomers use could be effectively applied to reveal a different aspect of the comet. On the first couple of nights after the outburst began, binoculars showed a definite circle of misty coma, while the unaided eye was limited to a bright, slightly fuzzy star. During the first day, a few even thought that they were witnessing a supernova. In the early days of the outburst, the circular yellowy coma had a defined edge and little sign of any of the usual cometary features. During that first night, I would repeatedly stare at the comet with unaided eyes, surprised by how different the view was through binoculars.

Many people leave their binoculars behind once they obtain larger telescopic instruments, but this object was a shining example of why binoculars should always remain in a sky-observer's arsenal. As the comet grew in size, to beyond the apparent diameter of the Sun and Moon, binoculars provided one of the best-framed views. Binoculars also provided the most accurate means of making comet-brightness estimates, as binoculars have a field of view wide enough to include stars (suitably defocused) for comparison.

Small-telescope users were perhaps the most pleased. Here was an object that was rendered very well in these apertures. These telescopes were able to present a view of Holmes that would be comparable to the view of planetary nebulae seen through the largest telescopes.

Larger and higher-powered telescopes also provided their own unique view of Holmes. In large telescopes, the faint blue gaseous coma was made visible surrounding the more yellow dust coma. At high magnification, the details of the pseudo nucleus were made apparent. Several varying jets and nascent tails could be discerned.

Comet Holmes as a Classroom

Holmes also provided a splendid incentive to promote astronomical imaging. During the first week, it was a relatively simple matter to capture some sort of acceptable image of the event. Some astrophotographers made sequences showing the relative motion against background stars or the increase in size over this period. Later in the month, as the comet gradually dimmed and expanded, techniques required to capture the comet became more demanding. The image of the comet was now larger than some CCD chips could accommodate, forcing photographers to combine several images into a mosaic or fall back on shorter focal lengths. Others opted for longer exposure times, trying to discern the faint tail that was forming tight against the main body of the comet because of perspective. Budding astro-imagers following the comet as it expanded and dimmed became aware of just what their mounts and optics were capable of recording and what was required to capture this changing scene. The comet was giving real-life lessons better than any lecture.

Another lesson from Holmes was the manner in which an extended object changes brightness. For the first week or so, the brightness to the unaided eye or through the telescope did not vary significantly, despite the extensive growth of the coma during that time. Those trying to estimate the magnitude of this comet found themselves defocusing binoculars further with each passing night until they ran out of focus. Still, the comet remained about the same brightness — dimmer than

Figure 3 — Holmes near Mirfak on November 18 (November 19 UT) showing how it appeared in binoculars. Note how a definite trending and tailing off of the comet has appeared from its earlier images. (Photo: Kevin Black)

alpha Persei (Mirfak) and brighter than delta Persei. From this, one was able to grasp the relationship between size and surface brightness and how they relate to magnitude. After the first week or so, Holmes appeared dimmer to the unaided eye while still presenting an impressive view under magnification. Visual brightness estimates began to diverge significantly from those done under magnification employing defocused stars. This was another lesson in astronomy and the different ways in which we perceive astronomical objects and react to their brightness.

What Holmes didn't tell us is why it did it. The European Space Agency speculates that it could be sudden outgassing or release of particles from the nucleus. The equilibrium temperature at Holmes' distance is about -95 °C — cold, but not so cold that the typical ices of a comet wouldn't sublimate. Collision with another body is also possible, an explanation first advanced by Fred Whipple to explain the 1892 outburst, but it seems pretty incredible, according to Brian Marsden, that it would happen twice to the same comet. Perhaps the collision was a glancing one with its own moon. It has even been suggested that the comet has a convex shape and is acting like an Iridium flare, but anyone who watched this event unfold will not be impressed with that explanation. Moreover, to add to the mystery — the brightening came at the same point in its orbit as during the first outburst. Time for a spacecraft.

Epilogue

Perhaps Holmes' greatest lesson for observers on this third planet has been to make us realize the limits of our understanding of comets. There is, as yet, no explanation for this outburst, in spite of a plethora of spacecraft and our growing knowledge of comet structure. Holmes, however, defies our conventional understanding of how comets behave and may send us off in search of answers and a new understanding of these enigmatic objects. Some observers are still keenly watching the comet as it fades below naked-eye visibility in hopes that it will have a second outburst in much the same way that it did several months after it was originally discovered during an outburst. Whether that occurs or not, observers are left with a lasting image of a rather unique and mysterious object. And that leaves some (well, me) to speculate on how impressive this would have looked to an observer on the much closer Mars.

Gerry Smerchanski's interest in astronomy extends at least as far back as his second spoken word, which was "moon," but it took a leap forward when he obtained his first department store telescope in 1969. Gerry is a scope-aholic and suffers from "ocularosis," which is defined as the inability to ignore eyepieces and other optical equipment.

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Society News

by James Edgar, Secretary (jamesedgar@sasktel.net)

The recent National Council meeting was record setting, in a way. It is possibly the first such meeting conducted entirely by teleconference. As a cost-saving measure, it no doubt works, but having people sit around a table, reading the body language, discussing items during a meal or a break and afterwards over a brew (or whatever), can't be done over the phone. So the next meetings of the Board Pilot Committee and National Council, on 2008 March 29 and 30, will be in person.

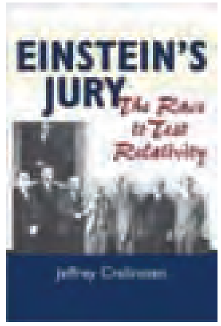
The meeting last November 24 has invoked the $4 membership fee increase that was passed over 18 months ago – we've managed successfully to stave off the red ink until now, but the weakening U.S. dollar, as well as reduced publications revenue, means we have to take other measures. The new fees are effective as of the first of the year, so people who renewed their membership before January 1 won't be affected for some months.

Two very active leaders in our Society, Denis Grey and Randy Attwood, of the Toronto and Mississauga Centres, respectively, have taken steps to create a future for the David Dunlap Observatory (other than sell it to the highest real-estate bidder!). Take a look at their Web site `www.observatorypark.ca`, and find out what the concept of the proposed Observatory Park is all about. Or even better yet, make a donation to add to those already pledged by the Society.

Congratulations are due to the leaders and members at large of the newest Centre in the Society. Welcome aboard Sunshine Coast Centre — now we're 29 strong! If anybody east of the Alberta border is wondering exactly where the Sunshine Coast is, let the old B.C. born and bred Secretary tell you. It's the stretch of the watery passage of fiords and islands between Vancouver Island and the mainland, from Howe Sound in the south to Desolation Sound in the north. It encompasses the communities of Gambier Island, Gibsons, Sechelt, Pender Harbour, Earl's Cove, Powell River, and Texada Island, to name a few. Check out a map available here: `www.bigpacific.com/about/maps.html`.

Late-breaking news! RASC President Scott Young and his wife, Jocylyn, are the proud parents of a new baby girl, Annabel Katherine Chorney Young, born 2007 December 17.

Reviews
Critiques



Einstein's Jury: The Race to Test Relativity, by Jeffrey Crelinsten, pages xxx + 398; 16 cm × 24 cm, Princeton University Press, 2006. Price $35 US hardcover (ISBN-13: 978-0-691-12310-3).

Scholars who struggled to "explain relativity" to the general public during the 2005 centennial of Albert Einstein's *annus mirabilis* would likely have welcomed this new book, Jeffrey Crelinsten's contribution to the vast and still growing Einstein literature. Some, like me, found Crelinsten's lengthy 1983 article in *Historical Studies of the Physical Sciences* helpful. That paper, which was based on part of his dissertation, described William Wallace Campbell's solar eclipse expeditions to measure the gravitational bending of star light passing close to the Sun's limb. The present book covers not only the solar eclipse expeditions but also several other astronomical tests of Einstein's general theory of relativity.

The basic thesis of this book is that, while Einstein's general theory of relativity represents a culmination of 19th-century theoretical physics in Europe, the acceptance of general relativity was clinched by 20th-century observational astronomers, primarily those from the mountaintop observatories in western North America. The book is organized in four chronological sections: 1905–1911, 1911–1919, 1920–1925, and 1925–1930. Each section includes two to four coherent subject chapters describing developments in one of several parallel attacks on the problem of testing general relativity during each time period. The book closes with an epilogue and Crelinsten's final reflections. The index is sufficiently detailed to be useful for research purposes.

One of the parallel cases starts with Crelinsten's recounting of the tragic case of the German astronomer Erwin Freundlich. Though he was the first to see that observational astronomy offered the most direct means of confirming general relativity, Freundlich was unable to convince his superiors of that fact or of its importance. As a result, the later confirmation of general relativity added much lustre to the reputation of British and especially American observational astronomy. Crelinsten makes the case that this sequence of events played an important role in shifting the centre of gravity for observational astronomy from Europe to North America.

Measurement of the deflection of starlight as it passes the limb of a totally eclipsed Sun was one of the observational tests, and Freundlich was among the first to attempt such measurements. He was, unfortunately, clouded out at a site in Russia during the August 1914 total eclipse. The vagaries of weather proved to be only one of the many obstacles that had to be overcome to make such difficult measurements. Arthur Stanley Eddington is generally credited with making the first successful light-deflection measurements at the total eclipse of May 1919. Eddington's positive results were widely reported and caused an overnight shift in public opinion as a result of the publicity given to a report that he presented to a joint meeting of the Royal Society and the Royal Astronomical Society in London. As Crelinsten properly notes, however, professional astronomers were only too aware of the problems involved in both making the observations and in reducing the data. Thus, it was only after a very successful solar-eclipse expedition to Australia in 1922 by Campbell and staff from the Lick Observatory in California that the balance of scientific opinion gradually began to shift. As late as 1960, astronomers were still attempting to repeat the measurements at total eclipses, with little improvement over the 1922 results. Kluber summarized the entire effort with some skepticism in *Vistas in Astronomy* (1960, Vol. 3, 47-77).

Like Freundlich, many other figures in Crelinsten's book lie on the margins of the history of science. Crelinsten makes a valuable contribution by bringing their involvement into clear focus in two related but independent cases. He provides a good discussion of the contest between John Evershed at the Kodaikanal Observatory in India and Charles St. John at the prestigious Mount Wilson Observatory in California. Crelinsten also describes the interesting case of Heber Doust Curtis and his unsuccessful attempts to discredit general relativity.

Based on his observations of iron lines in the solar spectrum, Evershed was the first astronomer to gather experimental evidence that pointed toward a gravitational redshift in the solar spectrum as predicted by Einstein. Evershed's work is emblematic of astronomers working successfully with marginal apparatus requiring excruciatingly careful control of experimental conditions. St. John, on the other hand, a general-relativity skeptic as well as a distinguished spectroscopist, worked with what was arguably the world's finest apparatus for solar spectroscopy. St. John was at first convinced that the cyanogen lines, and not the iron lines, in the solar spectrum offered the best opportunity to measure the gravitational redshift. By persistently refining his observations, and especially the manner in which the data were reduced to eliminate pressure effects on line widths, Doppler velocity effects, and other variables, St. John eventually concluded that indeed it was possible to find a gravitational redshift in the solar spectrum that almost exactly matched that predicted by Einstein.

Curtis' intellectual journey with respect to general relativity is even more interesting. As one of the few American astronomers able to deal with the mathematics of general relativity, Curtis understood the stakes involved in the theory's experimental confirmation. After his unsuccessful attempt to measure the gravitational deflection of star light during a total solar eclipse in 1918, Curtis went on to become an antirelativity skeptic. Appointed Director of the Allegheny Observatory with more limited resources than those that had been available to him at Lick Observatory, Curtis continued to work on the solar eclipse experiments and also devoted attention to the gravitational redshift in the spectrum of the Sun. Crelinsten describes Curtis' collaboration with Charles Lane Poor, a skeptical theoretician, in attempting further light-bending measurements during solar eclipses. Curtis also assigned astronomer Keivin Burns to work with the spectroscopist William Frederick Meggers of the National Bureau of Standards on the gravitational redshift in the solar spectrum. Both efforts failed to discredit general relativity. Crelinsten points out that Curtis and Poor, as well as many other antirelativity advocates, were motivated to some degree by anti-German and anti-Semitic attitudes in addition to their scientific doubts. Such prejudices were not uncommon in the astronomical community at that time. Curtis, at least, completed his otherwise successful career as Director of Astronomical Observatories at the University of Michigan.

My intent in highlighting the above cases is to emphasize the breadth of Crelinsten's approach to the subject and its resulting value to historians of astronomy. Short but useful discussions of other astronomical confirmations of general relativity are provided as well, including the advance of Mercury's perihelion and Walter Sydney Adams' attempts to measure the gravitational redshift in light from Sirius B. Crelinsten is effective in describing not only the observational approaches, but also the gradually changing attitudes of American astronomers towards general relativity. In contrast to British astronomers, in the thrall of Eddington's enthusiastic embrace of general relativity, American astronomers, who admitted candidly they did not understand general relativity, were at first skeptical. Crelinsten makes it clear that the American observatory directors, based on fairly conclusive evidence in support of general relativity developed by their own staffs, became reluctant defenders of the theory they otherwise could not understand.

Crelinsten is thorough; his effort is well documented and is articulately written. He makes a special effort to illustrate how science works, especially at the interface between theory and observation. His description of how the general theory of relativity changed over time as Einstein refined his work is interesting. So, too, is Crelinsten's description of Arthur Stanley Eddington's struggle to understand and explain general relativity. Eddington's naiveté and his waffling on the exact amount of deflection to be expected before leaving for the solar eclipse in 1919 are particularly enlightening. Crelinsten wisely avoided the post-modern traps of over-interpretation and mythology into which some historians and sociologists have lately descended on the subject. His confidence in the science involved has recently been reinforced by Daniel Kennefick's refreshing re-examination of the 1919 eclipse results in *Proceedings of the 7th Conference on the History of General Relativity,* Tenerife, 2005 (in press).

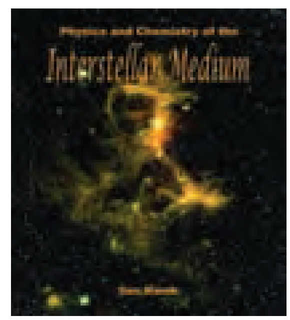
Einstein's Jury is a welcome addition to the literature on general relativity and especially to the history of astronomy. Crelinsten's articulate narrative sheds light on the rapid escalation of the reputation of the California observatories in this period, and shows how these difficult observations helped establish that reputation through the rigour of the scientific effort involved.

An easy read, Crelinsten's excellent book is well suited for the non-specialist reader as well as for historians of astronomy. It is highly recommended for anyone interested in the early acceptance of Einstein's general theory of relativity.

Thomas R. Williams

Tom Williams studied the history of astronomy after a full career as a chemist and manager in the petrochemical industry. He is currently writing a centennial history of the AAVSO, which fits with his longer-term interest in the institutional history of astronomy, its observatories and organizations, including the history of amateurs in astronomy.

Physics and Chemistry of the Interstellar Medium, by Sun Kwok, pages 569 + xiii; 19.5 cm × 24 cm, University Science Books, 2007. Price $84.50 US hardcover (ISBN 978-1-891389-46-7).



The history of astrophysics is marked by regular milestones, where known physical and chemical processes have been applied in novel situations where they have allowed us to gain a new understanding of the Universe around us, including our knowledge of relatively nearby stars, the interstellar medium, and the distant Universe. Research into the nature of the interstellar medium is one of the more recent success areas that resulted from a greatly increased observational capability for spectral line observations, both with ground-based (radio and optical) and space-based (far infrared, ultraviolet, and X-ray) observatories.

Physics and Chemistry of the Interstellar Medium begins with a broad description of the nature of the interstellar medium, including interactions with stars, its chemical nature, and the different states of the interstellar medium: radiation, reflection nebulae, dark clouds, molecular clouds, diffuse clouds, and the hot coronal medium. The basis of the book is a set of class notes created by Dr. Kwok for instructing graduate and advanced undergraduate students. Its goal is to provide readers with a fundamental background in physical and chemical processes that will allow them to apply such knowledge to astronomical observations.

The first few chapters explain the physics fundamentals needed for understanding the interstellar medium: the properties of radiation (Chapter 2); how astronomers measure radiation, including a discussion of interferometry (Chapter 3); how atoms and radiation interact, including electronic configurations of atoms as well as the ionization structure and radiative recombination lines of a nebula (Chapters 4 and 5); and processes for producing continuum radiation (Chapter 6). The approach taken provides a good understanding of the physics at all stages. For example, specific intensity and flux are clearly defined with supporting diagrams, the difference between observed flux and emitted surface flux is explained, and the equation of radiative transfer is developed, and then solved, for cases that arise repeatedly during discussions of radiation, such as the case of plane-parallel geometry.

Interstellar molecules are a major component of the interstellar medium, and their physical properties, including their vibrational and rotational transitions, are described in Chapter 7. Radiation from polyatomic molecules is discussed in Chapter 8, while Chapter 9 explains how we deduce the presence of molecules in the interstellar medium, and their states of excitation.

Interstellar grains — also known as interstellar dust — are a major coolant for the interstellar medium as well as the largest source of opacity for optical radiation. The vast influence of interstellar grains on optical observations is described in Chapter 10. The chemical composition of the interstellar medium, for both organic and inorganic grains, is presented in Chapter 11, followed by the observed spectral features of organic grains in Chapter 12. Our current understanding of the formation of dust is explained in Chapter 13, while chemical reactions in the interstellar medium, which in some cases occur in the gas phase and in others on the surfaces of grains, are reviewed in Chapter 14.

Interstellar gas is set in motion as a result of energy input from stars, including stellar winds and supernova explosions. In turn, the formation of stars is governed by the processes that form density inhomogeneities in the interstellar medium large enough to spawn free-fall collapse. Chapters 16 and 17 of *Physics and Chemistry of the Interstellar Medium* are devoted to those topics. The book ends with a discussion of the interstellar medium in the context of the interaction between all of the different energy and mass inputs and sinks for the interstellar medium in the galaxy, and also a discussion of how such ideas apply to external galaxies.

Each chapter includes relevant exercises that can be solved using the concepts presented, ensuring that students of the subject will obtain a practical understanding of the ideas. Solutions to selected exercises are given at the end of the book to help those who do not have an expert on hand for consultation. A list of references is provided at the end of the book for those wishing to explore some of the topics more deeply or to read the original sources.

In summary, *Physics and Chemistry of the Interstellar Medium* provides a valuable reference for all aspects of the interstellar medium, with many topics described in terms of basic physics. The broad coverage is unique, and includes a collection of many topics relevant to studies of the interstellar medium that are otherwise difficult to find in one source, such as the extensive discussion of molecular properties and radiation, the various aspects of interstellar grains, and the different processes occurring in the interstellar medium. The book appears at an opportune time, when studies of the interstellar medium are making great advances as a result of powerful observational facilities now becoming operational. Both students and researchers will find the book to be a key reference for astrophysics.

Denis Leahy

Denis Leahy is a professor of physics and astronomy at the University of Calgary with interests in high-energy astrophysics. He has taught numerous physics and astrophysics courses. His research contributions include modeling and observations of X-ray binaries, compact objects, and supernova remnants (Web page www.iras.ucalgary.ca/~leahy*).*

The Sun Kings: The Unexpected Tragedy of Richard Carrington and the Tale of How Modern Astronomy Began, by Stuart Clark, pages 211 + xii; 15 cm × 24 cm, Princeton University Press, 2007. Price $24.95 US hardcover (ISBN-13: 978-0-691-12660-9).

Knowing that I might face a lengthy wait for a clinic appointment, I took along my review copy of *The Sun Kings.* As it turned out, I was in and out of the doctor's office very quickly, and knew after my appointment that I could not wait to read more. I was so enthralled that I could not force myself to go home, but had to sit in the clinic waiting room for well over an hour until I had finished the book. With fewer than 200 pages of actual text split into 15 chapters, the narrative urged me on. The style, though at times verging on journalistic sensationalism, compelled me to continue. And there were just enough new ideas and fresh insights to pique my curiosity without overwhelming me with a compendium of names, dates, and achievements.

The author, Stuart Clark, is well known in Britain but new to me. While his Ph.D. is in astrophysics, he now has a highly successful career as a science writer. He is a former editor of the United Kingdom's popular *Astronomy Now* magazine and has written several books, including *Journey to the Stars* and *Universe in Focus: The Story of the Hubble Telescope* (which has sold 100,000 copies). He is not a historian, and apparently has made little use of archival sources in writing *The Sun Kings,* but he does acknowledge the work of Norman Lindop, who wrote a thesis and a definitive article on Carrington in the *Oxford Dictionary of National Biography.* Though there is a fulsome bibliography of primary and secondary sources arranged by chapters, there are no endnotes and the index is inadequate. But, as an engaging and generally trustworthy account of the development of solar-terrestrial science, the book is very successful.

Clark begins with an up-to-date prologue outlining how solar flares have devastating effects on Earth and space probes. (Coronal mass ejections are more directly responsible for such effects, but they were not observed until the space age, and Clark does not mention them until near the end of the book.) He then focuses on events at the beginning of September 1859 that must have seemed almost supernatural to those who witnessed them. Splendid auroral displays were visible even in the tropics, disastrous current surges on telegraph lines caused fires, and wild fluctuations in magnetic instruments at observatories puzzled scientists around the world. At the same time, the central character of the story, Richard Carrington, observed what we would call a brilliant white flare on the Sun. He noted the coincidence of the solar and terrestrial events, but hesitated to make any physical link between the phenomena.

As the story unfolds, we learn of the scientific and personal difficulties that bedeviled investigators of the Sun and solar-terrestrial connections. On the scientific side, there are Sir William Herschel's attempts to correlate the prevalence of sunspots with the price of wheat, Humboldt's quest for world-wide records of magnetic storms, Carrington's difficulties at the ill-equipped Durham Observatory, and Kelvin's unwillingness to recognize the vast amounts of energy released by regions of the Sun. On the personal front, there are rivalries between Sir John Herschel and the Royal Society that led to the establishment of the British Association for the Advancement of Science, the elitism of the Royal Astronomical Society that led the Maunders to establish the British Astronomical Association, and the marital and mental breakdowns suffered by many of the cast, from Sir William Herschel to George Ellery Hale. The epilogue forms a nice bookend by drawing an analogy between the immense blast of gamma rays that reached Earth on 2004 December 27 with the events of September 1859. Perhaps our knowledge of magnetars, the source of the gamma rays, is still in its infancy, as was an understanding of the Sun 150 years ago.

Clark sketches vivid vignettes of a number of astronomers, but gives centre stage to Richard Carrington. He was a Cambridge-educated, independent astronomer whose star catalogue and solar observations earned him high recognition. After his father died, he was forced grudgingly to divert much of his waking hours to the family brewery business rather than to his astronomical passion. That may be "the unexpected tragedy" of the title, or it may refer to his severe illness, his failure to get an observatory position at Oxford or Cambridge, his ill-fated marriage ending in his wife's suspicious death, or his subsequent drug-induced suicide at age 49. There was no shortage of misery in his life. The other phrase in the title, "How modern astronomy began," implies that those who laboured in the field of solar studies were the parents of the new astronomy. That is largely, but not entirely true; there are many strands in the umbilical cord of astrophysics. Clearly, the brilliant light of the Sun made it the object of the earliest photographic and spectroscopic investigations, but Carrington himself did not use such modern techniques.

For those interested in the history of Canadian astronomy, Clark's book puts our meagre endeavours of the 19th century into context. He discusses the work of Edward Sabine in some detail and mentions the Toronto Observatory as one of the worldwide network of magnetic stations that Sabine was responsible for setting up in 1839. We understand why our Victorian observatories dealt with a mix of meteorological, magnetic, and solar data, and why some of our Society's most prominent early members, Elvins and Harvey, for example, were so caught up in speculations about the interrelationship of those fields. We wonder how different our astronomical history would be if the weather had been reversed in Canada and Europe for the total solar eclipse of 1860 July 18. It was an event that Warren de la Rue first successfully photographed in Spain, while Newcomb struggled with clouds in Manitoba, and which E.D. Ashe (not R.N. Ashe as Clark has it) saw only momentarily from his post at Ungava. The important careers of solar astronomer Edward Maunder and his second wife, Annie, are also of some relevance to our Canadian scene. Her wide-angle photos of the solar corona, taken in India in 1898, hinted hinted at the vast extent of the Sun's atmosphere, so it was exciting for Canadians to include the celebrated duo in the 1905 eclipse expedition to Labrador — an event promoted by our Society. Clark's book frames these isolated Canadian events relative to the evolution of solar-terrestrial physics. It even calls to our attention current topics of great concern, such as the low water levels in the Great Lakes and the Sun's role in global warming.

The publicity on the book's dust jacket includes this encomium from one of our Society's distinguished honorary members, Owen Gingerich: "The Sun Kings is the most gripping and brilliant popular-science history account that I have ever read. It is informative, accurate, and relevant. Clark's ability to write so vividly makes me seethe with jealousy." To which I say "Amen."

Peter Broughton

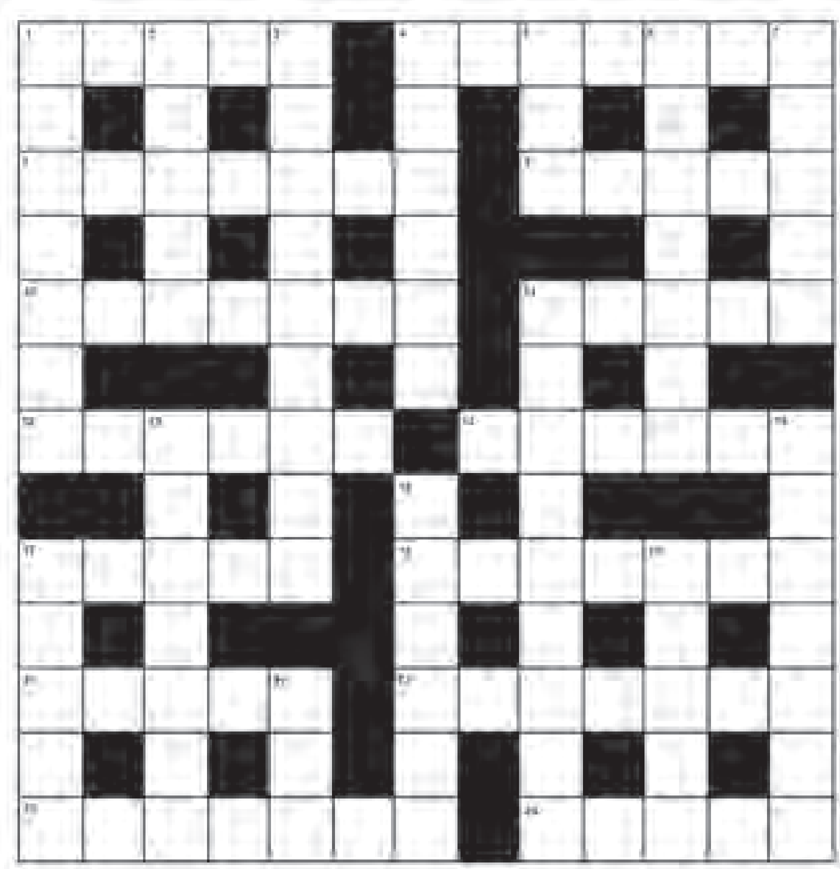
Peter Broughton, a former President of the RASC, has written frequently on various aspects of the history of astronomy, including a foray into solar-terrestrial relationships: Auroral records from Canada 1769-1821.

Astrocryptic

by Curt Nason

ACROSS

1. Diamond given to mother in the Crown (5)
4. French meteorite sparked urge to swim in oil (7)
8. Algol briefly spins rebate about its constellation's head (4,3.)
9. Dwarf starting planetary line up this October (5)
10. Revolutionary period within money earning month (3,4)
11. Sun is reflected from the edge of a lunar mountain (5)
12. Cheats about naming a star in Pegasus (6)
14. Dutch observer rakes poorly around one lunar crater (6)
17. Frequency measure painful to the audience (5)
18. Former program lead angered when RASC membership ran out (7)
20. Dusty mote formed in gravitational precipitation (5)
22. Interferometry method developed by the French following dust particle (7)
23. Acid flashback in Chaney's return to draconic month (7)
24. Help me get around Arend-Roland in a lunar interval (5)



DOWN

1. Grissom kept a pellet in ten during this phase (7)
2. Meteor explodes, losing nothing over this length (5)
3. Somehow alter pH in azimuth heading for Andromeda (9)
4. Planetary model had strange error before Yerkes opened (6)
5. Kirkwood headed our General Assembly program (3)
6. Mr. Runge dizzily follows half the equator for Ptolemaic points (7)
7. Records holding spectacles of magnetic field lines (5)
11. He catalogues nebulae in south Lyra no more (9)
13. Argon permeates high voltage densitometer at Shapley's school (7)
15. Strangely dense RD project to study how light colours by absorption (7)
16. Truman introduced the Spanish astronomer who measured 61 Cygni (6)
17. Dark energy co-discoverer Craig is part of the SOHO gang (5)
19. Leaf gatherer is part of Fleming's moon rocket (5)
21. Northern Index Catalogue started with Copernicus, familiarly (3)

Celestial Typography: Kepler and his Univers

by Brian G. Segal, MGDC

When we were asked to redesign the *Journal* of the Royal Astronomcal Society of Canada about a decade ago, we decided to search around for typefaces that had some historical or cultural relationship to the subject matter of the publication. Just about that time, Adobe began to release a revolutionary kind of digital type called Multiple-Master typefaces. The allure of Multiple-Masters is that the typeface can be altered in a number of ways such that one typeface can fulfill a number of tasks within a publication.

Designers prefer to keep the number of font families in a publication to a minimum. For many, two is the rule of thumb — one for text and another for headers and other special uses such as sidebars, tables, and so on. However, the *Journal* presented a special challenge as we needed a way to differentiate the peer-reviewed articles from the more accessible "popular" content. Many of you will remember that the *Journal* as it evolved was a kind of hybrid of popular articles and serious scientific publication. Initially we did two things: first of all we used a 3-column layout for the "stories" and a 2-column layout for the "science." As well, using the Adobe Multiple-Master font system we could use two different "instances" of the same font and thus differentiate the sections while avoiding breaking the cardinal rule of "keep the font families to a minimum."

We then began searching around for the best combination of font families to accomplish our design, keeping in mind that we would like to have some sort of astronomical reference. It turned out to be relatively easy. For the sans-serif font we chose Univers. Univers is a beautifully designed font with a wide variety of styles, which meant that we could use it for a number of purposes within the magazine. The font was designed by Adrian Frutiger in 1956. It has been used by many organizations and businesses. Its origins are in the very utilitarian tradition of Swiss design.

The search for a "body text" serif font was also rather easy. Just about the time we were looking for the font, Adobe released Kepler Multiple-Master font. It was simply irresistible. Fortunately, Kepler not only has a great name, it is a wonderfully designed typeface — elegant, handsome and capable of great variety through the Multiple-Master technology.

Kepler was designed by the American calligrapher and type designer Robert Slimbach. Slimbach is internationally recognized as one of the best contemporary type designers and has won many awards for his work.

Once we settled on the typefaces, we set to work designing the various Multiple-Master instances of Kepler as well as the variety of styles of the two fonts for all the purposes you see in the magazine. One of the first issues was how to get as much text onto a page as possible without compromising readability. That's where Kepler excelled as we were able to construct an instance of the font that is both economical with space yet maintains easy recognition of the letters. We were able to use an 11-point version of the font. That is a bit larger than your daily newspaper, which usually uses 10-point text. However, due to the tracking and spacing we created, we could fill a page with the same average number of words as 10-point Times, for example, while respecting the eyesight of our readers.

We went on to develop the typefaces used for the original research section, the complex mathematical expressions, tables, captions, headlines, and more. That included deciding on standard sizes for each use, and a host of other considerations, which are probably not that interesting to the average reader, but which are vitally important in the effort to keep you reading the *Journal!*

So as you read this magazine, you will be happy to know that you are accompanied by Kepler and his Univers on your tour of the wonders of the heavens.

Brian G Segal, MGDC is the President of Redgull Incorporated. Brian and his partner Julia Redgrave are the professional production team for the Journal.

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This Issue's Winning Astrophoto!

Cassiopeia Rising Over the Plaskett by Charles Banville, Victoria Centre.

This is a montage of two pictures I took using a Canon 20Da and a Canon EF 17-40mm f/4L lens. The foreground image was acquired at the Dominion Astrophysical Observatory in Victoria on 2007 July 26. That evening the Plaskett Dome was illuminated by a bright 12-day-old Moon. The star trails were created using 87 light frames of 1 minute each taken from Cattle Point on 2007 August 8.

[Editor's Note: The two-member team of Dietmar Kupke and Paul Mortfield of the Toronto Centre selected this late-entry image from among the 30 or so entries to the "Own the Back Cover" contest. Thanks to all the submitters. We welcome further entries, so don't delay – send in yours now! Watch the back cover of the April issue for the next winner.]