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Journal

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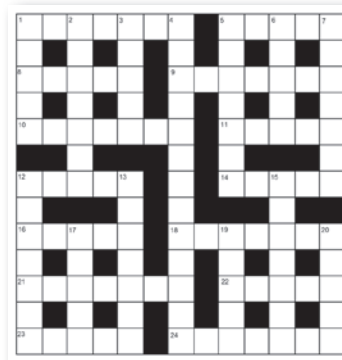
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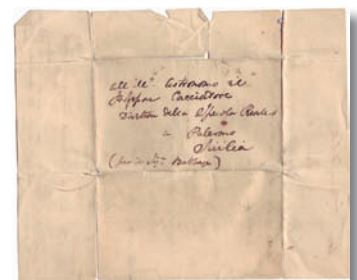
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Front Cover image: Earthshine with a crescent Moon are familiar sights in the spring when snow cover over the Northern Hemisphere greatly adds to the light reflected back to the Moon. This image, by Winnipeg's Stan Runge, perfectly captures the "Old Moon in the new Moon's arms." Stan used a 1-sec exposure at ASA 800 with an f/5.6 300-mm lens on a Canon 20D.

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Executive Perspectives



Mary Lou Whitehorne
1st Vice-President

In my last column, I wrote a little bit about what it means for the RASC to be a federally registered charity. The International Year of Astronomy has really helped to bring the concept of charitable activity into sharp focus for many of us. IYA continues to be a busy year, and as a result, we stand to grow significantly as an organization. What might that mean for the RASC? What are the possible avenues for that growth?

The Society has been around for a long time — 141 years, in fact. But, have we successfully kept pace with the changes in the larger social, economic, and cultural environment? Perhaps not as much as we would like, but IYA is an ideal springboard to expand, strengthen, and improve the RASC to better reflect the modern shape of Canadian society.

In order to grow, we must engage new audiences, work collaboratively with our own members as well as with other organizations, and sustain the engagement of everyone involved. It's a tall order. It is also an achievable goal.

As a volunteer-based Society, we already do a remarkable amount of outreach. Most of this is informal in nature, with a smaller amount of more formal outreach. Outreach is becoming ever more important as our increasingly technological society demands more analytical thinking and decision making of its citizens and its leaders. Scientific literacy is no longer a luxury but a necessity. We are part of the process that works to raise the scientific bar for all Canadians.

We are also experiencing the benefits of collaboration with other organizations. We have been granted formal "associated charities" status with the Canadian Astronomical Society (CASCA) from the Canada Revenue Agency. As a result of IYA we are working closely with the Fédération des Astronomes Amateurs du Québec (FAAQ), CASCA, the National Research Council (NRC), and others. This can only be a good thing as we move toward the future.

One of the challenges we face as an organization is that our membership does not adequately reflect the population of Canada. RASC membership leans heavily toward a single demographic: the middle-aged white male. Less than ten percent of us are female, youth is under-represented, and ethnic and cultural minorities are almost nowhere to be found in our membership. If we are to grow and truly represent Canada's interest in, and commitment to, astronomy, we must find a way to welcome and engage all demographics within the RASC family.

The newly appointed chair of our membership and

Journal

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promotion (MAP) committee, Randall Rosenfeld, has been giving these issues a great deal of consideration. He has written a thoughtful and detailed paper on the subject titled, **“Opportunities for growth: the RASC in the wake of IYA 2009.”** This paper can be found on our Web site here: www.rasc.ca/private/manual.shtml

I encourage everyone to read it and begin the dialogue that will ultimately shape the future success of our Society. Among the growth opportunities described in Randall’s paper, you will find informative discussions and rationale for a number of worthy initiatives, such as:

- An enhanced Web site
- Cultural astronomy
- Education in the schools
- Gender equality, gender representation, bias, and minorities
- Recruitment through real science

- Astronomy tourism
- New media
- Media strategy and contacts
- Grants
- Interns
- Astronomical outreach to the disadvantaged
- Volunteer incentives and volunteer contracts
- Youth involvement

Granted, we will not be able to do all of this at once. But, we ought to be able to establish some priorities and plan a course of action that will capitalize on our past success and ensure steady progress toward a new position of strength and vitality for the RASC in the wake of the International Year of Astronomy.

Quo ducit Urania! ●

News Notes

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

Canadian Space Agency — Astronaut Finalists

The Canadian Space Agency announced 16 finalists in March 2009, each hoping to be one of two Canadians chosen to fly as astronauts. The candidates include two medical doctors, scientists in zoology, physics, and microbiology, a host of military pilots, and a former Olympic kayaker.

Of the total, 15 are men and 1 is a woman. The finalists were chosen from more than 5300 applications sent to the Space Agency in 2008. The two successful astronauts will be chosen in May of this year.

The finalists are:

- Matthew Bamsey from Burlington and Guelph, Ontario, now in Saint-Bruno-de-Montarville, Québec;
- Desmond Brophy from Regina, Saskatchewan, now in Edwards, California, USA;
- Jeremy Hansen from Ailsa Craig, Ontario, now in Cold Lake, Alberta;
- Ryan Hunter from Mississauga, Ontario, now in Boston, Massachusetts, USA;
- Jameel Janjua from Calgary, Alberta, now in Alouette (Bagotville), Québec;

- Mark McCullins, an Irish-born Canadian from Winnipeg, Manitoba, now in Brighton, Ontario;
- David Saint-Jacques from Québec City and St-Lambert, Québec, now in Montréal and Puvirnituk, Québec;
- Geoffrey Steeves from Halifax, Nova Scotia, and Edmonton, Alberta, now in Victoria, British Columbia;
- Keith Wilson from Winnipeg, Manitoba;
- Bruce Woodley from Richmond, British Columbia, now living in Palo Alto, California, USA;
- Stuart Rogerson, a British-born Canadian from Powell River, British Columbia, now living in Cold Lake, Alberta;
- Peter Giles from Lake Echo, Nova Scotia;
- Allyson Hindle of Winnipeg, Manitoba;
- Christopher Denny of Toronto, Ontario;
- Kenneth Welch, of Cardston, Alberta; and
- Joshua Kutryk, from Fort Saskatchewan, Alberta.

Plutoid — Official Name for Trans-Neptunian Dwarf Planets

Dwarf planets like Pluto are now officially known as a “plutoids.” The Executive Committee of the International Astronomical Union (IAU) made the decision in mid-2008 at a meeting in Oslo, Norway, with the naming convention announced in press

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

circular IAU0804. The English term “plutoid” will be spelled “plutoïde” in French and “plutoide” in Spanish. The term refers specifically to trans-Neptunian dwarf planets similar to Pluto.

Members of the IAU Committee on Small Body Nomenclature proposed the name plutoid, which was accepted by the Board of Division III and by the IAU Working Group for Planetary System Nomenclature. The name plutoid was then approved by the IAU Executive Committee in June 2008.



Figure 1 — Members of the IAU Planet Definition Committee from upper left: André Brahic, Iwan Williams, Junichi Watanabe, Richard Binzel, Catherine Cesarsky, Dava Sobel, and Owen Gingerich. Photo: International Astronomical Union

The IAU defines plutoids as celestial bodies in orbit around the Sun:

- with a semimajor axis greater than that of Neptune,
- that have sufficient mass for their self-gravity to overcome rigid body forces so that they assume a hydrostatic equilibrium (near-spherical) shape, and
- that have not cleared the neighbourhood around their orbit.

For naming purposes, the IAU agreed that trans-Neptunian objects with an absolute magnitude brighter than $H = +1$ would be assumed to be plutoids. (The absolute magnitude H for planets, dwarf planets, comets, and asteroids allows astronomers to compare the brightness of objects as if they all sat one astronomical unit from the Sun and the Earth at a phase angle of zero degrees.)

The issue of the definition of a planet came up for a vote at the second session of the 2006 IAU General Assembly in Prague after the conclusion of two years’ work defining the difference between planets and the smaller Solar System bodies such as comets and asteroids.

Astronomer Owen Gingerich, Professor Emeritus

of Astronomy and History of Science at the Harvard-Smithsonian Center for Astrophysics, chaired the IAU Planet Definition Committee that initiated the work. (Gingerich is an Honorary Member of The Royal Astronomical Society of Canada.) Other committee members included Professor André Brahic of Université Denis Diderot (Paris VII); Iwan Williams of Queen Mary University of London; Associate Professor Junichi Watanabe of the National Astronomical Observatory of Japan (also Director of its Public Outreach Office); Professor Richard Binzel of the Department of Earth, Atmospheric and Planetary Science at the Massachusetts Institute of Technology; Catherine Cesarsky, Director General of the European Organisation for Astronomical Research in the Southern Hemisphere and the current President of the IAU; and Dava Sobel, a historian of science and astronomy and author of such books as *Longitude*, *The Planets*, and *Galileo’s Daughter*.

The IAU is an international astronomical organization that brings together almost 10,000 astronomers from all nations of the world. Its mission is to promote and safeguard the science of astronomy in all its aspects through international cooperation. The IAU also serves as the internationally recognized authority for assigning designations to celestial bodies and their surface features.

Currently, the family of plutoids has four members: Pluto, Haumea, Eris, and Makemake. The dwarf planet Ceres — which used to be considered an asteroid — has similar characteristics but is not considered a plutoid as its orbit is inside that of Neptune.

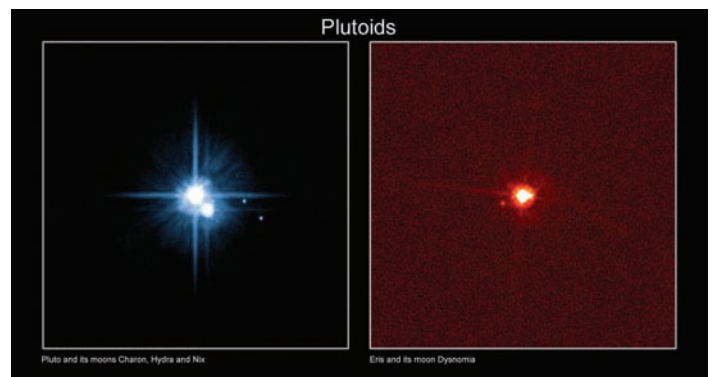


Figure 2 — Two known plutoids: Pluto (left) and Eris (right). Photos credit IAU, NASA/ESA *Hubble Space Telescope*, H. Weaver (JHU/APL), A. Stern (SwRI), the *HST* Pluto Companion Search Team, and M. Brown

CASCA to Recognize Mid-Career Achievements

The Canadian Astronomical Society / Société Canadienne d’Astronomie has established an award, known as the Peter G. Martin Award for Mid-Career Achievement, to be given to a Canadian astronomer, or astronomer working

in Canada, in recognition of significant contributions to astronomical research. The Martin Award will be considered every second year, in odd-numbered years.

Eligible candidates are those who are currently within ten to twenty years of receipt of his or her Ph.D. degree. The award was established in 2009 thanks to a gift by CASCA Past President, Professor Peter G. Martin of the University of Toronto. The first award will be presented at the 2009 CASCA Annual General Meeting at the University of Toronto, May 26-29. The winner will be invited to address the Society.

Martin is currently serving as CASCA Past President

(2008-10) after serving as President (2006-08), Vice President (2003-06), and a Director (1986-89). He is now completing his second term as Chair of the Department of Astronomy and Astrophysics at the University of Toronto. A Fellow of the Royal Society of Canada, Martin received his Ph.D. in 1972 from Cambridge University. His research interests include galactic ecology (the Canadian Galactic Plane Survey), collisions of molecular hydrogen, and gaseous nebulae. ●

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

Feature Articles

Heart of the Crab: Variable to the Extreme

by Michael Attas, Unattached Member (attasm@aecl.ca)

The massive *Hubble* portrait of the Crab Nebula, my favourite deep-sky object, has decorated my computer desktop since 2005. Recently, I stumbled across some amazing historical tidbits about the Crab on the World Wide Web. The highlight was a you-are-there Web site describing the thrilling discovery of the neutron star at the Crab's core. Thinking about the advance of observing technology over the years covered by the Web sites leads me to pose an observing challenge to those among you who track the pulsations of variable stars.

In many ways, the first item on Monsieur Charles Messier's list of fuzzy non-comets is the most peculiar. His 1774 compilation includes many galaxies, globular clusters, and planetary nebulae, but M1 is none of these. The smudge in Taurus received the nickname "Crab Nebula" a century later from Lord Rosse, who saw filaments like crab's legs extending from the central mass. It looked strange enough, but how strange it actually *was* became apparent only in the 20th century.

With the gradual understanding of the mechanism of supernovae came the concept of a supernova remnant, or SNR. The debris remaining after a star explodes can take many forms, and naturally it changes over time. Changes in the Crab's shape were evident over a few decades, with the filaments appearing to expand from the centre. Based on the expansion rate, astronomers estimated that the supernova occurred almost a millennium ago. Old Chinese records indicate that the Crab Nebula is the remnant of a star that exploded in 1054 — or at least that's when the light from the



Figure 1: Doug George captured this spectacular image of the Crab Nebula with his brand-new Ceravolo 300 Astrograph. Doug used the astrograph in its f/9 configuration with an Apogee U9 camera and Astrodon filters. Exposure was 2 hours total in LRGB.

explosion reached Earth. Since then, the puff left behind has been expanding and evolving.

Our understanding of SNRs has also been evolving, thanks to both theoretical advances (especially general relativity) and observations at wavelengths outside the visible range. Observations made using early radio telescopes linked the Crab to a bright radio source. Both X-ray and gamma-ray imaging confirmed that there was a compact, energetic enigma there. The hot, bluish, 16th-magnitude star named Baade's

Star, or CM Tauri, at the heart of the Crab was found to have a peculiar light spectrum, but seemed too faint to be the source of all the electromagnetic energy observed. Then, not long after the announcement in early 1968 of the accidental discovery of pulsars, the compact source was found to emit radio pulses at a rate of thirty times a second. That was convincing evidence that the core of the Crab Nebula is a rapidly rotating neutron star, a bizarre object as massive as the Sun, but only a dozen kilometres in diameter. As it rotates, emissions from its magnetic poles sweep across the sky, with the radio waves flashing past the Earth like a searchlight beam.

Astronomers immediately wondered if the visible light from the neutron star at the Crab's core was also flashing. The discovery of the optical pulsations of CM Tauri is an exciting chapter in 1960's astronomy, and one that's extremely well documented. Thanks to the physicist Philip Morrison and the American Institute of Physics, the Web site www.aip.org/history/mod/pulsar/pulsar1/01.html contains descriptions, interviews, images, and audio from the very moment of discovery. It is a fascinating look at how real science advances, by a combination of enthusiasm, knowledge, risk-taking, and a sense of adventure. John Cocks and Michael Disney, two young theoretical astronomers, found themselves at the University of Arizona's Steward Observatory on Kitt Peak late in 1968. They needed experience at actually using a telescope, and somehow realized that they could put together all the pieces they needed to attempt this challenging observation. Variable stars don't get much more variable than this. How do you detect a star flashing 30 times a second? You need fast imaging instrumentation, plus electronics to compile data in special ways over an extended period, plus a decent-sized telescope, of course. (The one they used was a 36-incher.)

With electronics expert Don Taylor and night assistant Bob McCallister, the astronomers booked a few nights on the scope and set up to collect data. Even pointing the telescope was a challenge, since the target star was too faint to observe visually. Three nights of observations produced no pulsations, and then cloudy nights scrubbed the next sessions. After some head scratching, they realized they had miscalculated the expected pulse period: they had used the wrong formula to correct for the Doppler effect caused by the Earth's revolution around the Sun. A last-minute cancellation on 1969 January 15 gave them access to the telescope once again. The Web site puts us right in the room with them as they began their observing run that night. What makes the setting so real is that they had a tape recorder running while making their observations, so they could keep track of the data they were collecting. Their voices on the tape reveal a mix of frustration,

delight, incredulity, and finally the flash of success as they saw a clear signal rising out of the electronic noise. After the initial thrill, they knew they had to prove to themselves (and others) that the pulse was real. In order to do this, they demonstrated that it disappeared when they changed the target frequency, and also when they moved the telescope off the target star. The Web site also puts this moment of discovery in context, with transcripts and audio of several recent interviews, and a variety of images and background information. Their observation was quickly confirmed by another group using another telescope; the papers announcing the results and confirmation appeared in *Nature* the following month.

Now, a challenge. We're in 2009, almost half a century after this discovery. Telescopes, even large ones, are much more accessible to amateurs, and modern electronic imaging brings the power of 1960's professional observatories to our own back yards. Can we detect the flashing of that distant neutron star? What would it take to succeed? I picture a clever amateur using some fast pixel shuffling on a sensitive CCD chip attached to a high-end scope to do the trick. Simpler techniques, involving a slotted disk spinning in front of the detector at 30 rpm, might also work. Seeing the outcome, say as a pair of images with the neutron star "on" and "off," would make for an awesome Galileo moment for 2009's International Year of Astronomy. Let me know if you are up to the challenge. ●

Your Associate Editor (General) Mike Attas works as an analytical chemist at Atomic Energy of Canada's Whiteshell Laboratories in Pinawa, Manitoba. He's managed to blur the lines between work and play with editorial duties at the JRASC, lots of all-weather Web surfing, and all-too-few nighttime imaging activities.

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The *Apollo 11* Landing and How It Nearly Didn't Happen

by J. Randy Attwood, Mississauga Centre (jrandy_attwood@rogers.com)

July 2009 marks the 40th anniversary of the *Apollo 11* landing. On that Sunday afternoon, astronauts Neil Armstrong and Edwin “Buzz” Aldrin steered a lunar module to the first manned landing on the Moon, while the third *Apollo 11* astronaut, Michael Collins, remained in lunar orbit.

Those who remember that day and recall listening to the landing (there was no live television) may remember that the descent was tense and lasted a little longer than planned. What most people may not realize is that many factors nearly prevented a successful landing. A list of human mistakes, poor design, and just the unknowns of landing in the lunar environment made the 12-minute descent a hair-raising adventure that more than once nearly forced the lunar explorers to call off the landing attempt and return home as footnotes to history.



Figure 1 — The *Apollo 11* Lunar Module “Eagle,” in a landing configuration as photographed in lunar orbit from the Command and Service Modules “Columbia.” Image: NASA

The two astronauts rode in a lunar module (LM, pronounced LEM) to the lunar surface. The LM in turn was carried to the Moon by the *Apollo* mother craft — the Command/Service Module — that provided everything necessary to get the three astronauts to the Moon and back. Once in lunar orbit, two astronauts transferred into the LM and descended

to the surface. Collins remained in lunar orbit waiting for his crewmates and performed a series of observations of the Moon.

Once it was on its own, the LM was designed to descend out of lunar orbit to a specific point on the Moon. It descended in two steps. First, the astronauts fired its engine on the back side of the Moon for 30 s to change its 110-km circular orbit to an elliptical orbit with a low point of 16 km, located some 500 km east of the landing site. It is at this low point that the LM engine would reignite for a 12-min descent to the lunar surface. During most of this descent period, the LM was slowing down, with the engine pointed in the direction of travel. Only during the last few minutes did the LM tilt upright to give the astronauts a look at the landing site.

While the astronauts monitored the systems, the LM computer program controlled the descent out of orbit using height information from radar positioned on the underside of the descent stage near the engine. What the computer could not do was avoid rocks and craters. It was only during the latter stages that an astronaut took over the controls to steer the LM to a safe landing.

As the LM came around from the far side of the Moon, it was flying feet first, windows down. Suddenly, the communication between the LM and Houston began to break up. Mission rules stated that they had to have a good communication link to try a landing. Along with the voices of the astronauts, important information (telemetry) on the health of the spacecraft was transmitted by radio. Houston asked the crew to rotate the LM to provide a better sightline for the antenna with the Earth — the feeling was that the LM structure was partially blocking its view. Communications improved with this maneuver, and they were given a GO for the engine firing, called powered descent initiation (PDI). A few minutes into the burn, the LM rolled from windows down to windows up. This made it easier for the LM to pitch forward later in the descent, thus giving the astronauts their first view of the landing site.

At three minutes into the descent, Armstrong checked their position by watching the craters pass below through his window. Painted on the inner and outer panes of glass were a grid and a series of numbers called the landing point designator (LPD). He would use the LPD a few minutes later, along with information from the computer, to determine where on the surface the LM was heading. Here he was using it to time when craters he had memorized passed by the window, to

check their position. He watched crater Maskelene W pass by his LPD two seconds early. Traveling at 5 km/s, this meant they were going to land significantly long. He knew that as they flew farther west, they would have to deal with rougher terrain, so this might be a problem.

Five minutes into the descent, a warning light flashed on their display panel — a “1202” code on the computer display. Neither astronaut had seen it before in training, so they called Houston for help. An obscure error message, which had been placed in the computer program to monitor its health, “1202” meant “executive overflow” — the computer was being asked to do too much. With its limited memory, it could only perform one task at a time — and that task was scheduled to be the processing of data from the LM’s radar, which was feeding altitude and velocity data every few seconds. For some strange reason, unknown at the time, it was also trying to process information from the LM’s rendezvous radar, which would be used not for landing but for finding the Command Module after the LM returned to lunar orbit for docking. The alarm forced a reboot of the system, which took less than a second, but it was a major concern as the descent continued.

Six minutes into the descent, the astronauts waited for the descent engine to throttle down from 100 percent to 55 percent thrust. Though originally designed to throttle down slowly as the LM lost weight as fuel burned, early tests showed that, at throttle settings between 100 percent and 65 percent, the engine became seriously damaged. The computer software and flight path were reworked to bypass these dangerous throttle settings. Throttle-down on time was an indication to everyone that the system was working well.

Eight minutes into the descent, at just 1.5 km altitude, the LM began to pitch over to 45°. Most of the braking was complete, and the crew could get their first look at the landing site. To avoid additional communication problems, Aldrin had to manually steer the antenna to keep pointing at the Earth as the LM’s attitude changed.

Computer program P64 automatically started, allowing Armstrong to look through his window and use the grid — the LPD — to see where the LM was headed. Aldrin read numbers off the computer display: 43, for example. Armstrong lined up the two 43s on the inner and outer window to see where the LM was taking them. If Armstrong wanted to modify the intended landing site, he could use his hand controller to click left or right to move the landing site to the sides, or forward or back to change the site up-range or down-range. Unfortunately, a design in the LM fuel tanks allowed the remaining fuel to slosh violently. The LM was swaying back and forth several degrees every couple of seconds, and the small reaction-control engines were firing to stabilize the LM’s attitude. It is questionable whether the view through the LPD was all that accurate. It did not matter much, though, because another alarm — a “1201” — appeared on the LM computer display and got the astronauts’ attention.

Houston told them it was the same type of error and to continue, but both astronauts were now reluctant to ask the computer to do any more work than necessary. The computer display was small, and it displayed limited information at a time. To obtain additional information, Aldrin had to explicitly request it by punching buttons and hitting “enter.” He needed the information, but for the rest of the descent, was reluctant to overwork the computer because of the alarms.

With events settling down in the cockpit, Armstrong looked out the window and realized that they were heading directly for a large, blocky crater the size of a football stadium. Ten minutes into the descent, at 150 metres altitude, he took control from the computer. He pitched the LM forward so that it was nearly standing upright. This reduced the braking and allowed him to fly level over the crater. Without television to see what was going on, controllers in Houston were shocked to see from the telemetry that the vertical velocity had levelled off and that the LM was scooting along horizontally at 18 m/s. There was nothing Houston could do now but listen. It was up to the astronauts to put the LM on the surface. They were on their own.

Houston was monitoring the fuel supply, which was getting close to the limit. A low-level indicator in the fuel tanks sent a signal to turn on a light on the control panel when it became uncovered by fuel. This started a 94-s countdown to a point where the astronauts would have a further 20 s to either land or return to orbit, aborting the landing attempt. However, the sloshing fuel triggered this indicator before it should have, and a countdown to fuel depletion began early.

At 11 min into the descent and at an altitude of 50 m, Armstrong chose his landing site, just beyond a 20-m-wide crater. He tilted the LM back to use the engine as a brake and reduce the horizontal velocity. From 60 m altitude, it took nearly 90 s to descend to a landing. Meanwhile, Houston called out “60 seconds” and then “30 seconds” to that 20-s “land or abort now” point, suggesting that this was all the fuel they had left. While some sources say they landed with between 10 s and 20 s of fuel left, they actually landed with around 45 s of fuel in the tanks.

But Houston did not know this, and everyone was holding their breath when long probes sticking below the footpads touched the lunar surface. This caused a blue light the size of a “twonie” to light up on the LM’s display panel, and Aldrin called out “contact light.” Armstrong shut down the LM engine. They had landed.

“Houston, Tranquility Base here, the Eagle has landed.”

With little time to celebrate, the crew went through the procedure to shut down the landing systems and run through a simulated launch countdown just in case they had to leave right away. They vented the fuel tanks to prevent them from heating up, possibly over-pressurizing and exploding.

As they did this, support people in a room beside Mission Control, many from Grumman Aircraft (the company that built

the LM), noticed that the pressure in the fuel lines was going up, not down. The fuel lines were positioned near a line used to vent the helium supply overboard after landing. Helium was used to pressurize the fuel lines and force the fuel to the engine. To save weight, the helium was stored in its liquid form, 270 °C below zero. Now that the super-cold gas was no longer needed, it was causing the fuel to freeze in the fuel line as the helium was being dumped overboard.

There were concerns that, when the heat from the engine soaked back and met the frozen fuel, there would be an explosion. Anxious discussions started, and there was a suggestion that the crew blast off the Moon immediately. Others suggested that they restart or “burp” the engine, clearing out the fuel line. No one had seen this before. Would burping the engine tip the LM over? Would the fuel line explode and harm the crew? Just as they were about to call Mission Control and request an engine burp, the problem went away as quickly as it had arisen. The pressure in the line abruptly fell — either the line cracked or the frozen fuel melted. No one outside the room knew that the danger had existed.

Just over 6 h after landing, Armstrong and Aldrin walked on the lunar surface. Four days later, they landed in the Pacific Ocean, and *Apollo 11* was history. Lessons learned from the first landing made it possible for five more successful expeditions over the next three years.

Epilogue

The problems on *Apollo 11* were quickly fixed. To prevent the LM from landing long in the future, they limited its attitude-control rocket firings after it undocked from the Command Module. The communication problems were solved by ensuring the antenna had a clearer view of the Earth. The 1201 and 1202 alarms were due to a switch being in the wrong position on the LM control panel — a procedural error. The checklist told the astronauts to put it there. Future LM fuel tanks were redesigned with baffles to prevent the slosh. The helium vent lines were moved away from the fuel lines. ●

Pixellations III

Flats



by Jennifer West (westjl@cc.umanitoba.ca) and
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A well-reduced CCD image needs a number of calibrations in order to correct the various artifacts contained within a raw sky image. These calibrations are essential if one wishes to perform measurements on an image, but they can also make a large difference in improving the quality and appearance of “pretty pictures.”

The most commonly applied reduction, and one that is relatively easy, is the dark frame. This is an image taken with the same exposure time as your image but with the shutter closed; the dark frame is then subtracted from the image. Dark frames remove noise that is generated on the chip and correct for hot pixels. Many commercial digital cameras automatically subtract the dark frame from your exposure when the noise-reduction setting is turned on.

Another important reduction, but one that is not as easy to acquire, is the flat field. Flats can correct for a whole assortment of imaging artifacts: vignetting, shadows of dust that might be present on the optical surfaces of your equipment, and the inherent pixel-to-pixel variations in sensitivity on your

CCD chip. Taking a good flat is one of the most challenging aspects of astrophotography.

In theory, a flat is simple to obtain. It is an image of a uniformly illuminated surface. If the optics of your telescope or camera lens and your CCD chip were perfect, then you would have an image that would be uniformly illuminated; every pixel would register the same value. In practice, the image will never appear uniformly illuminated due to all the reasons stated above.

A good flat should meet the following criteria:

- The signal should be reasonably high and not be noise-dominated. As a rule of thumb, we use about 1/3 of the well depth of the chip. So if you have a 16-bit camera, the maximum count would be 65,535 ($2^{16} - 1$) and we would aim to have a count of about 20,000 for our flats. Higher or lower counts are also fine as long as you are not in the non-linear regime of the CCD’s response curve (*i.e.* at very

low or very high signal, approaching saturation).

- The illumination should come from a light source that is as similar as possible to the illumination of your data. This is because a CCD chip has a non-uniform response to light at different wavelengths; *i.e.* a CCD chip is more sensitive at some wavelengths than at others. In addition, if your data are filtered, make sure your flats are filtered too!
- One must obtain flats using exactly the same optical train that you used for your images. The job of the flat is to correct for vignetting and dust along your optical path as much as pixel-to-pixel variations in sensitivity. Do not change the position of any piece of equipment between taking your data and taking your flats.
- Flats should be obtained during the same observing session as your data and with the telescope as close to the same position in the sky as your data. Dust can settle on your equipment over time, and a single grain of dust on a surface near the sensor can appear as a significantly sized “dust donut.” Additionally, small shifts in the position of your equipment can make a difference on your flat.

There are two main types of flats: sky flats and artificial flats.

Sky Flats

As their name suggests, sky flats are obtained by taking an image of the sky. There are several ways to do this. The twilight sky is commonly used, but the dark sky can also be used if some processing is done to remove the stars that will inevitably be present on the image. A third way, useful if the sky clouds over during an observing session, is to take an image of a uniformly cloud-covered sky.

Twilight flats

Twilight flats should be taken soon after sunset, 180° away from the point where the Sun set and at an altitude of about 25°. This part of the sky has the most uniform illumination, and avoids the steep gradients present in the direction of the sunset point. The exposure time for twilight flats is quite short, typically less than a second to a few seconds (depending on the amount of time that has passed since sunset), to achieve the desired illumination on your image (about 1/3 of the full-well depth). Dark frames of the corresponding exposure time should also be obtained and the flats should be dark-subtracted.

Dark-sky flats

Dark-sky flats require a greater investment of time, but, in our experience, they are by far the superior type of flat, providing

the best correction. Dark-sky flats are obtained by moving the telescope slightly off target though still approximately in the same location (see Figure 1). **At least five** images are obtained with the same exposure time as the data frames (it is not strictly necessary that the exposure times be the same, but if they are the same, then the dark frames can be used for both sets of images). More frames may be necessary if the region of the sky is particularly crowded with stars.

We will typically acquire a total of at least five minutes of dark-sky data (five 1-minute exposures), but the more data that are obtained, the better the quality (higher signal) your dark-sky flat will have. Between each image, the telescope should be moved slightly so that the stars will appear in different locations on each image. This is an essential point, as the stars will later be removed by combining the images; this cannot be accomplished if the stars appear in the same spot on each frame. For the dark-sky flats, it does not matter if the telescope is perfectly focused or that it is tracking perfectly. Indeed, the telescope drive does not even have to be on for this data, as the star trails will disappear in the final combination.

Dark-sky flats have several advantages over other types:

- They are taken in nearly the same location of the sky, so the conditions match nearly perfectly. Any reflections or unevenness due to the Moon or other light sources can be processed out of your data.
- The spectral characteristics will match nearly perfectly.
- There are fewer issues with gradients appearing on the image.

The disadvantage of dark-sky flats is that they can be noisy and can introduce some low-level random noise into the final image. This disadvantage can be overcome by acquiring more data for your dark-sky flats, though that is time consuming. However, we feel the advantages far outweigh this disadvantage.

Cloud flats

Cloud flats can be used, but they suffer from non-uniform illumination, and can suffer from spectral issues. This is

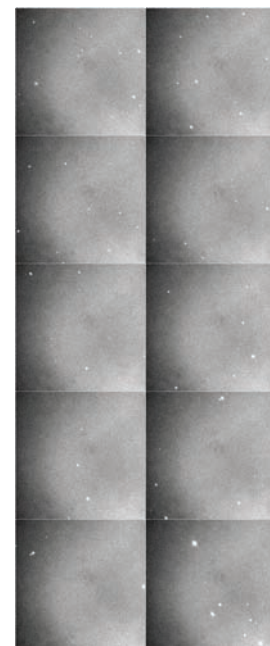


Figure 1 — Individual images acquired for producing a dark-sky flat. The telescope must be moved between frames so the stars are in different positions on the frame and can later be processed out. This night we obtained ten 60-second images.

especially true near a light-polluted area where the clouds will reflect the emission spectra produced by the sodium- and mercury-vapour lights that are used so commonly.

Artificial Flats

Artificial flats are obtained by taking an image of the inside of a dome or some kind of diffuser box. There are several problems associated with artificial flats:

- It is difficult to obtain truly uniform illumination
- The spectra of artificial light sources do not match the natural spectrum of the sky very well. Compact fluorescents are especially bad, as they have an emission spectrum instead of a continuous spectrum.

Processing Flats

Whatever type of flat is used, several should be collected and combined together to reduce noise. Before combining the images, each individual frame should be dark-subtracted and normalized. The master flat is then used to correct your image data by division. The free image-processing program *ImageJ* (West & Cameron 2006) can be used to complete all of these processing steps.

Normalizing the flat involves measuring the mean value of the image as a whole, then dividing each pixel by that mean value to create an image with an overall mean value equal to one. When image data are divided by this flat, the mean value is not altered, since you are just dividing by one. However, pixels that are too sensitive will show bright on the flat, and they will have a value greater than one when normalized. Dividing this pixel on the image by a value greater than one will reduce the brightness of that pixel. The inverse applies to pixels that are not sensitive enough — the value of these pixels will be increased by division by a number less than one. In other words, the flat suppresses the value of “hot” pixels and boosts the intensity of “cold” ones so that they both more closely represent the true value at that point in the sky.

For dark-sky images, the normalized frames must be combined into a single one by using the median value for each pixel. The median takes the middle value of the pixel at a specific location. If you have five images, then as long as no more than two of the images contain a star at a particular location, then those stars that are present will be effectively removed (Figure 2).

The task of normalizing and median-combining a stack of images can be quickly accomplished using the “Background Subtractor” plugin written by one of us (JW). This plugin can be downloaded at <http://umanitoba.ca/faculties/science/astronomy/jwest/plugins.html>

Visually, the different types of flats look very similar, but slight differences are apparent when one looks at a plot of the

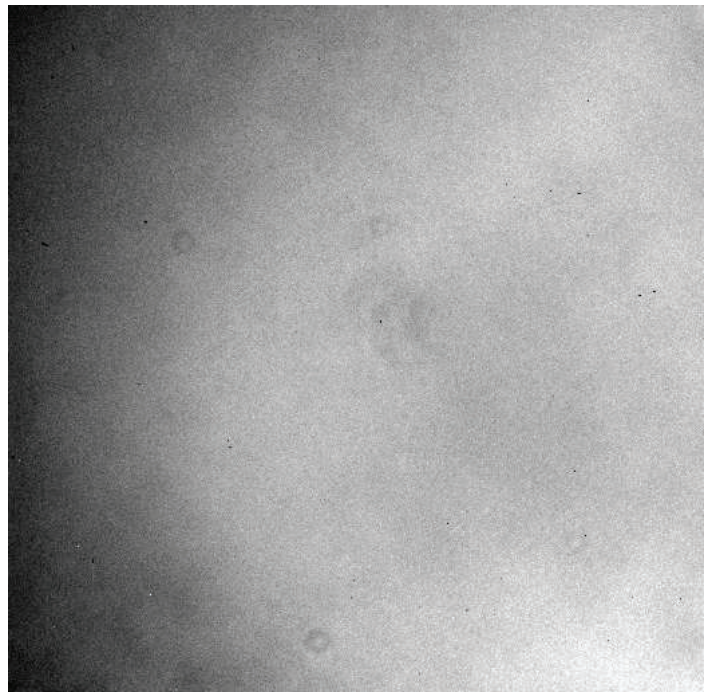


Figure 2 — Final processed dark-sky flat.

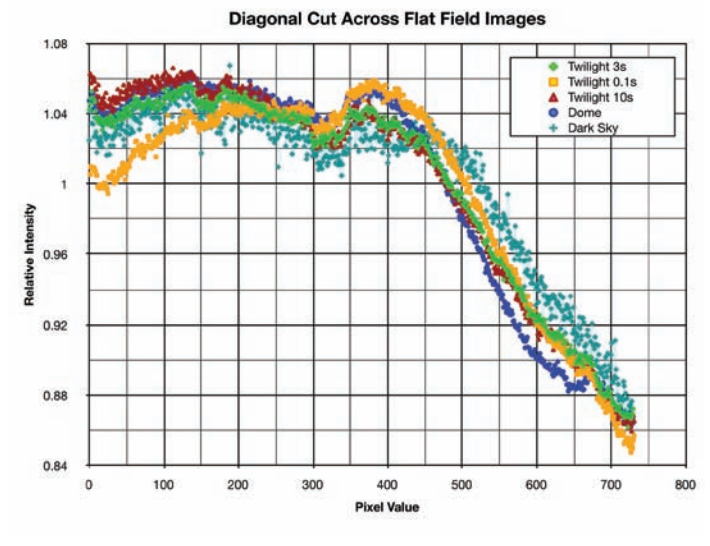


Figure 3 — Plots of diagonal cuts across the dark sky, dome, and twilight flats. Differences between the different types of flats are apparent. Twilight flats were obtained in various stages of twilight, so the exposure times had varying lengths. Sunset in Winnipeg on April 5 took place at 8:07 p.m. CDT. The 0.1-second twilight flats were obtained at 8:20 p.m. CDT (13 minutes after sunset), 3.0 second twilight flats were obtained at 8:39 p.m. CDT (32 minutes after sunset), and 10.0 second twilight flats were obtained at 8:46 p.m. CDT (39 minutes after sunset).

values across the flat (Figure 3). These slight differences can turn into significant differences in the final processed image.

To illustrate the advantages of good flat fielding, we obtained data of the low-surface-brightness galaxy M101

under challenging conditions. On the night of 2009 April 5-6, with a gibbous Moon, moderately poor seeing, and an SQM reading of 18.0 magnitudes/arcsec², we collected five 5-minute exposures of M101, plus dome, twilight, and dark-sky flats

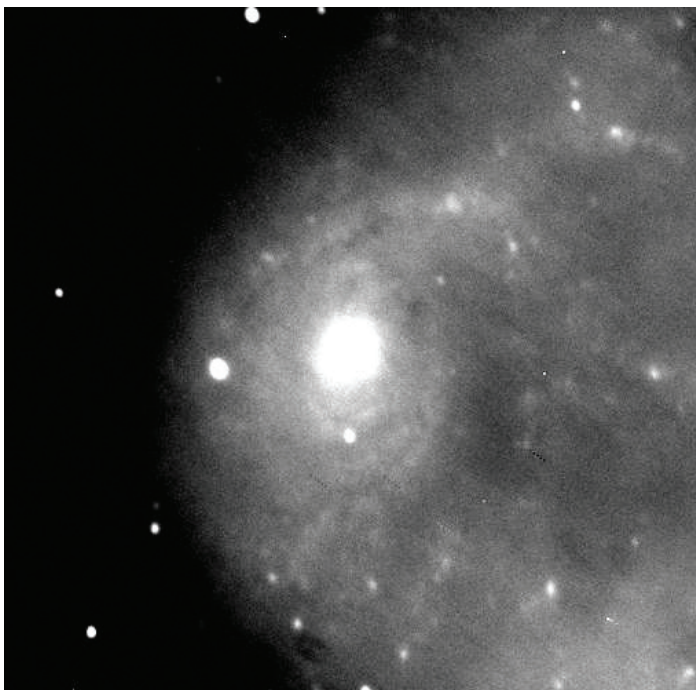


Figure 4a — Five 300-second exposures of M101, dark subtracted and combined using averaging, but with no flat field applied. Note that the faint arms of this galaxy have a signal of less than 5 percent above the background noise.

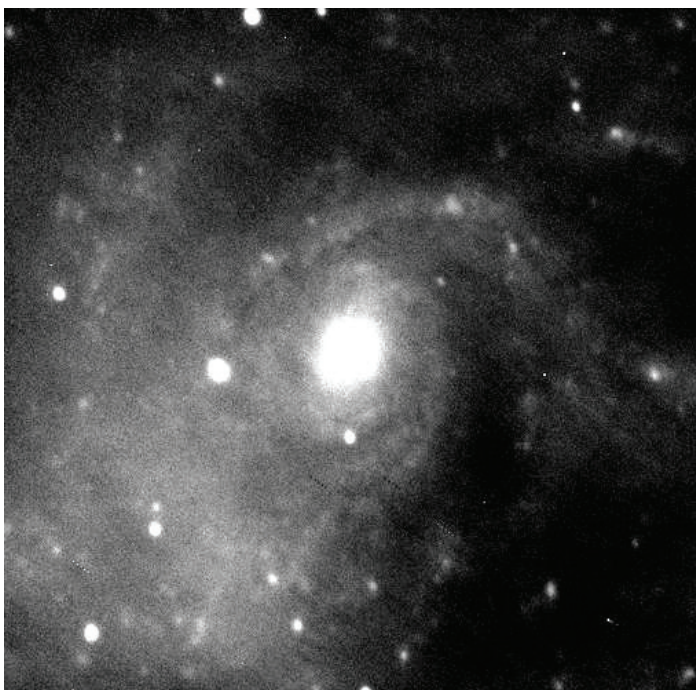


Figure 4b — Five 300-second exposures of M101, dark subtracted and flat fielded using a 3-second twilight sky flat, then combined using averaging.

using the 40-cm Evans telescope at the University of Manitoba's Glenlea Astronomical Observatory. According to the *Observer's Handbook* (2009), M101 has an integrated visual magnitude of 7.9 and a size of 27 × 29 arcminutes, giving it a surface brightness of only 24.0 magnitude/arcsec². Figures 4a-d show the results of processing this data and the significant improvement that the dark-sky flat has made for this image.

Flats are an important processing step for your images if you want to get the best information that you can out of your data and improve the overall appearance, or if you are interested in doing measurements on your data. Flats are especially important if you are interested in seeing the faint nebulosity present in many images. We believe that dark-sky flats provide the best correction possible, and that they are worth that required little extra investment in time. ●

Jennifer L. West received her M.Sc. in astronomy in 2003 at the University of Manitoba and has since been working in the field as an instructor, outreach coordinator, and observatory technician. She has been an active member of the RASC Winnipeg Centre for several years, serving as National Representative, 2nd Vice-President, and Councillor.

Ian D. Cameron has an M.Sc. in astronomy from the University of Victoria and is the Director of the Observatory and Planetarium at the University of Manitoba. He has been a long-time supporter of the RASC and is currently a member of the Winnipeg Centre.

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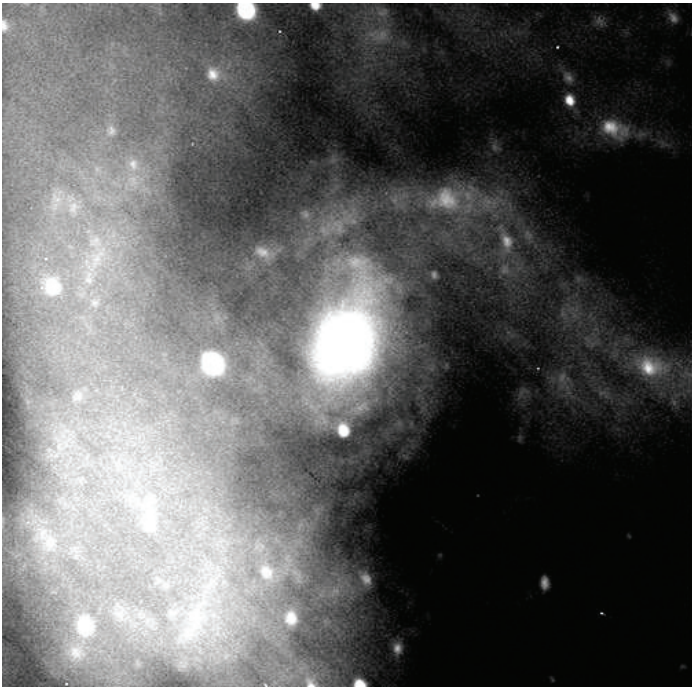


Figure 4c — Five 300-second exposures of M101, dark subtracted and flat fielded using a 1-second dome flat, then combined using averaging.

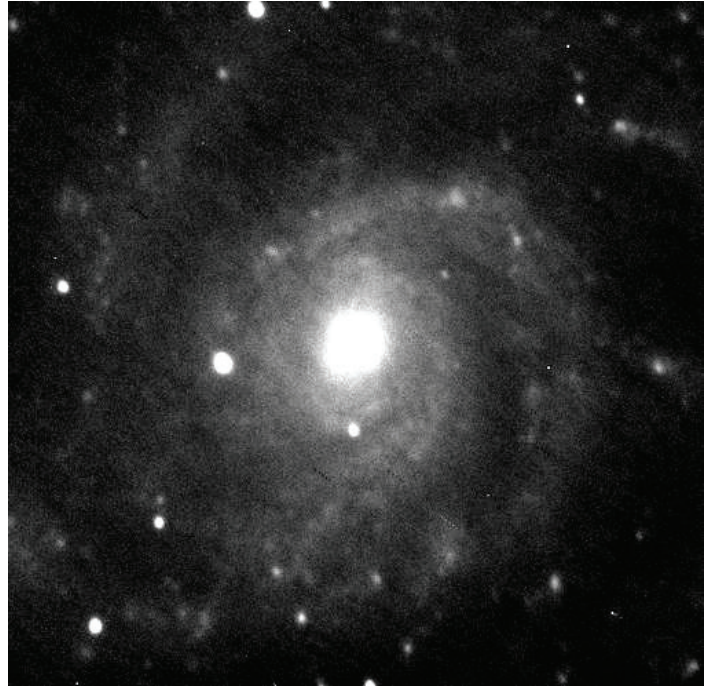


Figure 4d — Five 300-second exposures of M101, dark subtracted and flat fielded using a dark-sky flat, then combined using averaging. The dark-sky flat was produced from a series of ten 60-second exposures (see Figures 1 & 2). Note how much more detail can be seen in the galaxy! The signal from the faint arms of this galaxy is still less than 5 percent above the background noise.

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West, J.L. & Cameron, I. 2006, JRASC 100, 242
Observer's Handbook 2009

A Scholarly Masterpiece After a Thirty-Year International Quest

by Andrew I. Oakes, Unattached Member (Andrew.Oakes@ontario.ca)

Water ripples and wings flap... A pebble is dropped into a lake, and the resulting rise and fall — a tiny wave — begins its gentle outward push across the waters. The journey, now having begun, will evolve and eventually come to some end.

In another part of the world, a butterfly flaps its wings and sets a gentle air current in motion, which travels over time and air space.

In both cases the final outcomes of these straightforward actions are neither clear nor predictable. What impact will that water ripple have along its way? How will the air current eventually evolve and end its journey?

When Nicolaus Copernicus lay on his deathbed, little did he know what his life's great work, *De revolutionibus orbium coelestium libri sex* (*Six Books on the Revolutions of*

the Heavenly Spheres), would cause to happen in the academic and political corridors of natural philosophy, astronomy, the ancient classics, and, in time, in the battle-scarred arena of religious dogma, once *De revolutionibus'* implications were fully recognized. It is traditionally reported that, as the heliocentric, planetary-system theorist lay dying, page proofs of his magnum opus were brought to him. He witnessed them somewhat reluctantly. Copernicus had waited till very close to the end of his life to say "yes" to the typesetting, printing, and eventual distribution of his decades-old manuscript in book form. Since the publication of *De revolutionibus* in 1543 by Nuremberg's Petreius Press, the sands of time have seen more than four and a half centuries go by — 466 years, in fact — and five editions.

In the case of *De revolutionibus* itself, the proverbial

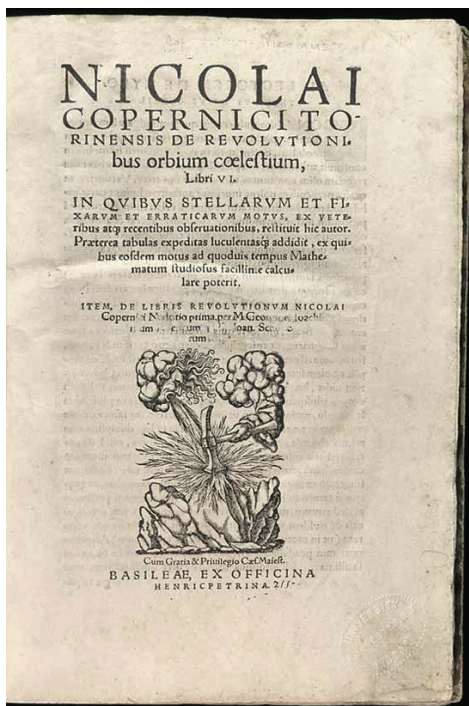


Figure 1 — *Nicolai Copernici Torinensis De Revolutionibus Orbium Coelestium, Libri VI* — *On the Revolutions of the Heavenly Spheres, Six Books* (title page of Second Edition, Basel, 1566)

pebble's ripple became a surging wave, and the butterfly's wing flaps produced a powerful gust of fresh air.

Scientific Revolution

To put all this in perspective, *De revolutionibus*, as Owen Gingerich has stated, began a scientific revolution in its time.

There was a quiet period of a few years before the storm broke. Following this period of contemplation, an increasing controversy developed over *De revolutionibus*, growing stronger in the two centuries after its initial publication. The religious powers that be in Rome felt threatened by the book's siege of the 1600-year-old Aristotelian vision of a geocentric Universe.

A period of condemnation by certain actors in Church officialdom was followed by a steadily increasing worldwide acceptance of the book's message, to the point where in 1836 *De revolutionibus* no longer appeared in the Roman *Index of Prohibited Books*, where it had been placed in 1616, 73 years after it first appeared. Yes, indeed, the Earth did revolve around the Sun. It could no longer be denied, irrespective of the interpretation of sacred Judeo-Christian texts or ancient Athenian teachings.

Over the centuries, *De revolutionibus* has spawned commentaries, debates, Church investigations, books, scholarly articles, historical analyses, and academic studies — all focused on the man and his understanding of the then-Universe as he saw it. In more recent times, there have also been planetarium exhibits and shows, statues honouring the 16th-century

writer/scientist, and commemorative anniversary celebrations.

With the passage of time, *De revolutionibus* has itself been the subject of a lucrative antiquarian booksellers' and collectors' market, with first editions selling for \$2,210,500 US in a recent Christie's auction. A second edition was priced in 2008 at \$120,000 in New York.



Figure 2 — Nicolaus Copernicus: a portrait from his hometown, Tourin, painted at beginning of the 16th century.

Personal Quest

Dr. Owen Gingerich, Professor Emeritus at Harvard University and an honorary member of The Royal Astronomical Society of Canada, set

out on a 30-year quest by dropping a personal pebble into the quiet historical waters of 1971. His project concluded with the publication of two exciting books — one a robust reference volume and the other a popular account of his own Quixotic-like quest on the road to intellectual understanding of a time and period long gone but still of intense interest. In pursuing his objective over three decades, Gingerich brings to mind a mixture of four characters from the world of international fiction: Don Quixote, the knight errant in Cervantes' *The Ingenious Hidalgo Don Quixote of La Mancha*; Hercule Poirot, Agatha Christie's intrepid and sophisticated Belgian investigator; the un-named Time Traveller from H.G. Wells' *The Time Machine*; and Dr. Watson, the Victorian-era colleague and gallant recorder of Sherlock Holmes' adventures, as penned by Sir Arthur Conan Doyle.

Gingerich set himself a mission, which, at the start, seemed like almost an impossible dream. With his trusty lance in hand (a proverbial pen) and riding his modern-day steed (not Rocinante but a commercial airliner), he sought out all first and second editions of *De revolutionibus* scattered across the continents of the world. In the tradition of Hercule Poirot, each successful find led to unexpected and exciting information, especially where the new copy was heavily annotated by past readers. One clue would link to another, and then yet another, and so on over the three decades of searching.

When immersed in the centuries-old marginal annotations inserted by many of the world's legendary Renaissance-age astronomers, philosophers, and thinkers, Gingerich found himself traveling back to earlier societies and places, like the Time Traveller himself, living a long-ago era through the hand-written commentaries of the book's past owners. One of the more difficult tasks was establishing the provenance of each copy of *De revolutionibus*, tracing ownership from person to person, and identifying their individual annotations. From these, he discovered each edition's influence, and the effect of prior annotations on successive readers' thoughts. In

the end, *De revolutionibus* turned out to be a popular and well-read addition to medieval science libraries.



Figure 3 — In *De revolutionibus*...Copernicus first presented the heliocentric model of the Solar System.

At the end of the day, switching his character hats from Sherlock Holmes the sleuth, to Dr. Watson the trusted chronicler, Gingerich crafted his two tales — tales that an intelligent reader, astronomy historian, book antiquarian, adventurer, bibliophile, detective-story aficionado with a healthy curiosity seeking insight and a good yarn, could enjoy immensely.

The first outcome of Gingerich's efforts was *An Annotated Census of Copernicus' De revolutionibus* (Nuremberg, 1543, and Basel, 1566), published in a very limited edition (more about that later) in 2002 by Brill Academic Publishers, Boston and Leiden (\$215.00). The second is titled *The Book Nobody Read, Chasing the Revolutions of Nicolaus Copernicus* (Walter Publishing Company, New York, issued in 2004 as a hardcover edition; \$38.95 and by Penguin Books Ltd. as a soft cover; \$22.00).

An Annotated Census is truly a blockbuster of a book. An invaluable reference tome of 404 pages, it represents a detailed analysis of its intellectual influences on its long-departed readers, and the ownership histories of the first and second editions of Copernicus' *De revolutionibus* — the one published in Nuremberg 1543, and the other in Basel 1566. It's nothing less than a scholarly treasure in its own right, and a refreshing way to present historiography.

The Book Nobody Read is itself unique, too — principally a book that is a tale of two books, that of Copernicus' *De revolutionibus* and the making of *An Annotated Census*.

As a positive outcome, all three volumes taken together —

The Book Nobody Read, An Annotated Census, and Copernicus' De revolutionibus — are themselves now linked via legitimate historical relevance, thanks to Gingerich's prodigious research efforts, persistence, and creativity.

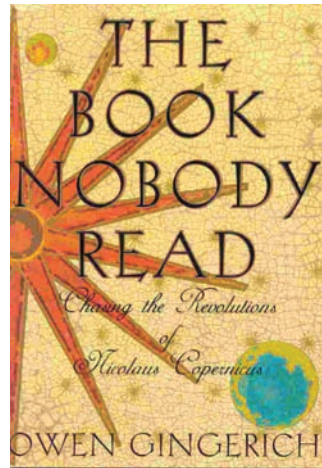


Figure 4 (above left) — The cover of Owen Gingerich's book, *The Book Nobody Read: Chasing the Revolutions of Nicolaus Copernicus*

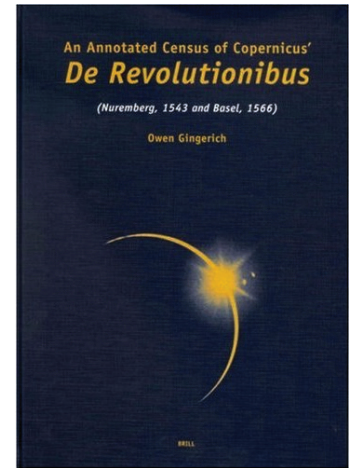


Figure 5 (above right) — Cover of Owen Gingerich's book, *An Annotated Census of Copernicus' De Revolutionibus* (Nuremberg, 1543, and Basel, 1566), published in a very limited edition in 2002.

The Challenge

Gingerich's enterprise was inspired by an unsupported comment by Arthur Koestler in Koestler's best-selling history of early astronomy titled *The Sleepwalkers*, published in 1959. In that book, says Gingerich within the opening pages of the Preface of *The Book Nobody Read*, Koestler "branded" *De revolutionibus* as "the book that nobody read." To let Gingerich tell it:

The epiphany dawned when I least expected it, in the Royal Observatory, Edinburgh, where I was exploring a huge safe full of rare astronomy books in November 1970. Along the rows of volumes, I found a first edition of Copernicus' book. Here, surprisingly, was a copy richly annotated from beginning to end. If the book had so few readers, I wondered, why was one of the handful of copies I had ever examined so thoroughly studied? ... Who could have done this [made the many marginalia notes], and what might I find if I looked at some more copies of the book?

Gingerich discovered, after some sleuthing, that the anonymous annotator was Erasmus Reinhold, the leading astronomy teacher of northern Europe in the 1540s. "His book became the catalyst that inaugurated my obsession to survey every surviving copy of Copernicus' book," wrote Gingerich.

During his 30-plus-years' pursuit, Gingerich examined a total of 601 first and second editions, and travelled countless

of thousands of kilometres around the globe following his academic quest. He finally finished his manuscript and published *An Annotated Census* in February 2002.

Detective Story

The 15-chapter *The Book Nobody Read* is a first-class detective story with plenty of adventure, discovery, and a very good offering-up of information. Its insights range from 16th-century book-publishing practices to an analysis of how some owners of *De revolutionibus* handled their personal copies after the Vatican placed Copernicus' *magnum opus* on its *Index of Prohibited Books* on 1616 March 5. In essence, the book was censored in 1620 "until corrected" with ten specific changes.

In *The Book Nobody Read*, we read of the "invisible college," a 20-century sociology term Gingerich admits to borrowing "to describe the network of 16-century copying of annotations from one book to another." He also underscores the fact that "the [marginalia] notes show that, despite the challenges of travel and communications, somehow the messages made the rounds..." and his tracing of the provenance (history of the ownership) of each copy of *De revolutionibus* indicates "the slow reshuffling of books over time."

Books were precious in those times and *De revolutionibus* was indeed a keeper.

Gingerich indicates that his research "turned up a splendid parade of owners." We read names like Saint Aloysius Gonzaga, Giordano Bruno, Tycho Brahe, Galileo, Johannes Kepler, Gerardus Mercator, Henry II of France, Philip II of Spain, George II of England, Sigismund II Augustus of Poland, Adam Smith, Erasmus Reinhold, John Craig, John Dee, Thomas Digges, and "a host of lesser-known medical doctors, astrologers, and dilettantes..."

By the end of his Quixotic multi-year quest, Gingerich tells the reader he saw 276 first editions (1543) and 325 second editions (1566) for a total of 601 copies of *De revolutionibus*.

But how many could have possibly been found around

the globe? What was Gingerich's best educated guess of the original press runs?

Gingerich estimates that the "likely number of first-edition copies lies between four and five hundred, and for the second edition, between five and six hundred," with as many as perhaps "a dozen undiscovered copies of the first edition and two dozen of the second."

The remainder of the copies, he suggests, could likely have succumbed to water damage, bookworms, hungry grubs of the deathwatch beetle, silverfish, and rodents. "Fire ranks low in the list of book destroyers," writes Gingerich, but he knows of a copy that was lost when the Great Tower burned in Copenhagen in 1728.

Immensely Enjoyable

Any person who loves books and a good story will enjoy *The Book Nobody Read* immensely.

Those with an academic bent will relish understanding the mechanism by which knowledge was exchanged during a time without phones, Internet, texting, peer-reviewed journals, and science magazines.

The Book Nobody Read is highly recommended. It's the type of offering that a reader can find herself or himself saying, "What a read!" It also serves as an excellent companion to its progenitor, *An Annotated Census of Copernicus' De revolutionibus (Nuremberg, 1543, and Basel, 1566)*, which is a scholarly masterpiece itself — a true gem.

Gingerich's 440-page reference book represents a genuine mystery uncovered, a false claim irrefutably discredited, a solid conclusion reached, and the history of astronomy advanced by a respectably wide notch.

And imagine...the author has quietly served as an honorary member of The Royal Astronomical Society of Canada. What a privilege to have him on board. ●

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

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The Hazards of Astro Flashlights

by Murray D. Paulson, Edmonton Centre (murrpaul@telus.net)

This is not an April Fool's edition of the *Journal*, but this article labours to expound on some of the hazards I have identified with Astro flashlights. One common thing amateur astronomers do is holding a flashlight in the mouth as the "third" hand. I have discovered a few hazards associated with this practice. Think twice about that flashlight offered to you in the dark of night. You never know just where it has been!

One potentially harmful side effect is that you tend to inhale past the body of the flashlight, and aspirate a quantity of dust, pocket lint — whatever — into your lungs. The particularly bad culprit for this is the small clip lights that have lots of surface area and pockets for lint-dust to accumulate. These lights do not act as a good seal in your mouth. I once managed to inhale a quantity of debris into my lungs, precipitating a cough that lasted me three or four months. I did get over it, and I now am much more careful.

A second rather serious issue comes about when you are holding onto that flashlight in your teeth and clamp down while straining to do some task, breaking a filling in the process. Yes, Dear Reader, I have done this one too, and at a remote week-long star party to boot. Fortunately, the injured tooth was not painful except with hot and cold fluids, so I lasted the remainder of the week. Moral: if you hold a flashlight in your teeth, buy a soft flashlight, or don't do it if you have fillings!

At the Winter Lights Star Party out at Elk Island Park (Alberta), I managed to encounter a new hazard, but with one of those white-light LED flashlights. It was a small unit made with an aluminum body. It was -20 °C. Do you remember putting your tongue on a chain-link fence in the wintertime? For some reason I didn't at the time, but I was promptly reminded of it

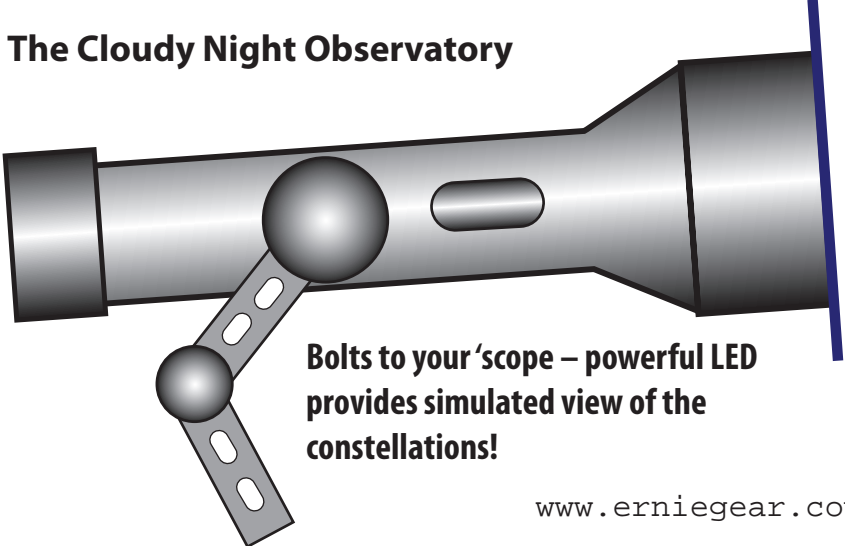
as soon as the metal body of the flashlight touched my moist lower lip. There it was, dangling, frozen to my lip, promising exquisite pain if I tore it off! Oh, did it burn! I quickly realized that I needed to warm the flashlight in a hurry so it would come off without much of my lip attached to it. I clamped my other lip around it and used my tongue to warm it up, and the flashlight came off with only a bit of my taste buds still stuck to it. (OUCH!) Lesson: beware of metal-bodied flashlights in winter!

One last hazard comes with your red-light flashlight. I once was showing off exuberantly a really cool star to friends at a star party. The star was T Lyra, a pulsating variable star, and it was at its very coolest — very, very red. The star is located about 2 degrees south from Vega, but I was not sure of its exact location. I was using the Uranometria and a little bit too-bright red flashlight in hopes of locating it. Did you know that looking at a page illuminated with a red light will photobleach your retina in the red part of your dark-adapted cones? Then, when you look into the eyepiece, you will not see a single red thing in the field of view. Nada! I spent 10 minutes trying to find this gorgeous red star until that particular property of vision occurred to me. Photobleaching! DOH! Dim down the light! Moral of the story; if you are hunting dim red stars, use a dim red flashlight on your charts and let your eyes adjust.

I hope this article on red flashlights was illuminating, and I have deterred you from my follies. ●

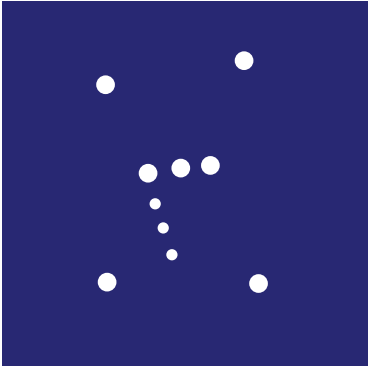
Murray Paulson is a long-time member of the Edmonton Centre of the RASC and an ardent planetary observer. Astro flashlights have been a passion of his for many years.

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Herschel, Babbage, and Isaac Newton's Chair

by R.A. Rosenfeld, M. Tchelebon, J. Taylor, RASC National Office
Contact: randall.rosenfeld@utoronto.ca

ABSTRACT: Recent re-discovery of the RASC's autographed letter from John Herschel to Charles Babbage, and Herschel's letter of introduction for Babbage to Niccolò Cacciatore, allows facsimiles of these documents to be reproduced fully for the first time, along with more accurate transcriptions, and the first translations of the non-English portion. Research undertaken subsequent to C.A. Chant's incomplete publication of these documents in this *Journal* over sixty years ago allows their context to be more securely established.

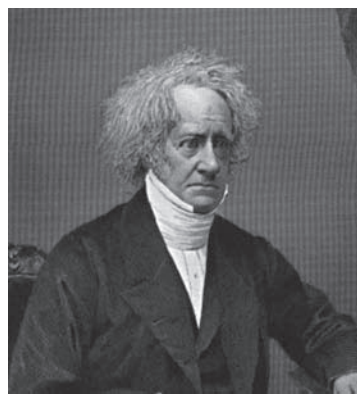
Introduction

The most important literary genre in the history of astronomy is probably the letter. From Antiquity to the early twentieth century, discoveries, theories, treatises, ephemerides, instrument designs, observations, reports, instruction, gossip and praise, and blame were commonly conveyed in epistolary guise. Through letters, societies and associations were formed and nurtured, through letters research programmes and cabals were managed, and friendships fostered and enmities stoked. The letters produced by normal astronomical activity around any significant figure bear this out, as amply shown by a recent study of Tycho Brahe's strategies of communication (Mosley 2007). Letters are the skin of parchment fleshing out the bones of astronomy's past.

The flexibility of the medium is truly wonderful. Embraced are such varied items as Cummián's seventh-century *computus* text, Galileo's *Istoria e dimostrazioni intorno alle macchie solari* of 1613, and Edwin Hubble's brief note of 1924 to Harlow Shapley, concerning which the latter famously said to Cecilia Payne-Gaposchkin: "Here is the letter that has destroyed my universe" (Walsh and Ó Cróinín 1988; Payne-Gaposchkin & Haramundanis 1996, 209). Even the dispatches to and from the Central Bureau for Astronomical Telegrams are a subspecies of letter. No survey of this broad and crucial genre of astronomical communication has yet appeared, and with good reason. The range of styles found in the letters of astronomers is as varied as the writers and their subjects. On the more familiar end of that stylistic spectrum are two autographed letters of John Herschel in the RASC Archives, one addressed to Charles Babbage (1828), and the other addressed to Niccolò Cacciatore on Babbage's behalf.

The RASC Herschel Letters

The Herschel letters came into the possession of the RASC towards the end of the Second World War through the gift of



Sir John Herschel (l) and Charles Babbage (r)

Richard H. Babbage, great-grandson of Charles Babbage and an unattached RASC member then resident in Montreal.¹ In 1944 C.A. Chant published a facsimile of one of the seven pages, along with a brief introduction and a far-from-perfect transcription of the texts (Chant 1944). Even though Chant did not have the time or opportunity to provide translations of the French, Italian, and Latin (the greater part of the texts), physical descriptions of the documents, or explanatory notes, he at least gave notice of the letters to the astronomical community. Fortunately, the recent rediscovery of the letters allows for their publication in full facsimile, accompanied by an edition consisting of a more accurate and annotated diplomatic transcription, a translation, and a brief physical description².

¹ Richard Babbage (1883-1971?) was born in Ireland, but made his career as a journalist in Canada, working for the Montreal Star and associated papers from 1922-1949. His interest in his famous ancestor led him to take part in the memorable Harvard 1947 Symposium on Large-Scale Digital Calculating Machinery (Cohen 2000, 65). Babbage became a good friend of Chant's, and gave him other scarce Babbage materials. There is a Richard H. Babbage fonds (MG55/29-No122) at the National Archives of Canada.

² The letters, previously known, but filed away in an unremembered location, were uncovered while retrieving documents related to the Society's purchase of the former National Office.

Context

By 1828, John Herschel and Charles Babbage had known each other and been the closest of friends for half of their lives (Wilkes 2002, 355).³ Both were from similar middle-class backgrounds, both had received a gentleman's education, and both were well-off enough to pursue natural philosophy as gentlemen. Herschel's name was more famous, partly but not entirely due to the foundation laid by his father and aunt, but Babbage had earned enough scientific distinction to range with his friend. Greater achievements, distinctions, and burdens lay ahead for both.

Sixteen years earlier, when undergraduates at Cambridge, they had caused consternation among the ranks of the elder statesmen of science when they called for the reform of mathematical sciences in England, pushing for the adoption of up-to-the-minute continental methods of analysis, and founding an Analytical Society with a publication programme to promote their radical ends. They had achieved marked although not complete success in those early endeavours. Along the way, some of Babbage's decisions in regard to exam strategy turned on him; not playing the game by the rules, he could not garner any of the prizes. Going down without taking a degree, he departed as an extremely well-educated autodidact.

Eight years previous to the writing of the RASC's letters, Herschel and Babbage were involved in another joint venture of signal importance to the shape of British science, the founding of the Astronomical Society (to become the Royal Astronomical Society by Royal charter in 1831). It too was seen as a radical move at first by some of the elders in British science, most notably by Sir Joseph Banks (1743-1820), president of the Royal Society, who vigorously disapproved of two of his younger fellows forming a possible rival society (Herschel became FRS in 1813, Babbage in 1816). Their Astronomical Society turned out to be a success, not the least through its meetings, publications, awards, and recruitment of foreign associates.

In 1828, Herschel had logged twelve years as a privately funded research astronomer, whose achievements had not betrayed the family reputation. Charles Babbage had run dry of the steam of invention to complete his Difference Engine No. 1, (commenced 1822), the first of his designs for a mechanical computer, a project on which he encountered funding and personnel difficulties that would become all too familiar to him on his later computer projects.⁴ Both men had won honours for contributions to astronomy; Babbage was awarded the Gold

Medal of the Astronomical Society (1824) for the invention of the Difference Engine and its promise of lightening the burden of producing astronomical tables, and Herschel, the Lalande Medal of the Institut de France (1825) and the Gold Medal of the Astronomical Society (1826), for his and James South's re-measurement of William Herschel's double-star catalogue. They were figures of note in the learned world of their day.

The letters are addressed to Babbage in Italy, where he travelled for solace after the death of his wife in 1827, and to pursue his scientific and cultural interests before returning to England. Herschel had agreed to manage Babbage's scientific and learned affairs while he was on the Continent. And one of those was Babbage's election to the Lucasian Chair of Mathematics at the University of Cambridge, the very professorship held by Isaac Newton over a century earlier - Newton, whose hallowed method of "fluxions" he, Babbage, was instrumental in replacing with the Continental calculus. It seemed, at the very least, the ultimate triumph of the Analytical Society "radicals," and, in Babbage's own words, "an instance of forgiveness unparalleled in history" (Babbage 1994, 21), as the University where he had refused to play by the rules had subsequently rewarded him handsomely. He reported it as unexpected. Perhaps it was. But it had all been planned.

Babbage had tried on previous occasions for various professorships, as had his friend Herschel. Herschel had come closer than Babbage several times, and had declined firm offers of appointment to leave himself free to pursue his own research unhampered (*e.g.* CCJH 1548, 1550-1552, 1648). What was not widely known at the time that Chant published his article is that Herschel himself was the front runner for the Lucasian chair (CCJH 1653-1654, 1677, 1682, 1685). It seems to have been chiefly through Herschel's influence that the Professorship went to Babbage (CCJH 1683, 1685, 1689, 1691, 1693). When influential people wrote Herschel to urge him to stand for the position, he wrote back recommending Babbage. The RASC's Herschel letter to Babbage (CCJH 1694) was sent to Naples to inform him of the appointment, and to impart advice on how he should act upon the intelligence. Herschel sent another letter with the same intent but more circumstantial information to Babbage at Rome, for Herschel certainly wanted his friend to be prepared with the news as soon as possible to adjust to his change in status, and he likely wanted to be the first to inform him (purely by chance Babbage learned of his success first from a newspaper account; Babbage 1994, 21). As it turned out, within the university, Babbage was not the most memorable of the Lucasian Professors, being particularly noted for non-residence and absenteeism during his tenure (Schaffer 2003).

The style of the letter is terse. The friends know each other so well that they can use an abbreviated syntax, and a word choice which would have confused the uninitiated. Herschel states that he writes in haste, and there is no reason to doubt him. While his script is a common cursive of little

³ Babbage was born in 1791, Herschel in 1792; both died in 1871. (DSB 6, 323-328; DSB 1, 354-356). For a genial introduction to Herschel, see Buttman 1970, and for Babbage, see Hyman 1982. Time's work has rendered both in need of revision, particularly Buttman.

⁴ All attractively recounted by Swade (2000). The Difference Engine No.2 has been reconstructed at the Science Museum in London (www.sciencemuseum.org.uk/onlinestuff/stories/babbage.aspx). For an excellent account of the wider context of Babbage's dreams of automation see Grier 2005. (I owe this reference to Peter Broughton.)

...text continues on page 116

9 Nov 1828

Dear Babbage

You were elected to the Lucasian Professor at Cambridge being having served Pluribus in room of Woodhouse departed this life - I have written all the particulars to you "Posta Restante Rome" but to be sure of hitting you I put several lines to Naples ~~to be sent~~ on the chance you may have left R. though unlikely - It was done in a most handsome way and though two others were candidates you had 8 votes out of 11. Therefore my advice is that you write forthwith to the VC. (Dr. Baile) of Paris - who has written me a very pretty letter about it and thank the Electors

in good set terms and the time you will be best in time to Laminia for the hope Smith's price or any other time as much earlier as you please - as your presence at the Board of Longitude will be very acceptable (if which you are as you are now a member until office).

I refer for particulars to my letter at Rome which if you return by Rome you cannot miss.

Remember me to Leontucci most kindly
Yours truly in great haste

John Herschel

Naples March 9
1828



Mon cher Américain -
Cette lettre vous sera portée par M. Babbage, le Secrétaire de l'Académie des Sciences et belles-lettres de cette ville. Il vous fera part de tout ce que nous faisons dans votre pays et de votre part - avec la toute bonne l'amitié que vous savez nous devoir de la recevoir avec bienveillance. Il en est probablement indisposé (comme les sommes sont dans un état) sur les travaux importants qui vous occupent.

This page and next: samples of manuscripts

se sont avec plaisir des vœux
si intéressants dans le volume de
vos ~~ouvrages~~ ouvrages au Capé Longh.

Cape S. va établir une observation
des horloges — il aura des instruments
que lui a fournis la Société
littéraire dont j'espère il fera bon
usage.

Il a publié un ouvrage
signifié dans son catalogue de
312 étoiles doubles fait avec le
grand télescope de Flamsteed à
Dorset. — Ce sera pour lui un objet

pour l'immortalité

Adieu mon cher monsieur
Toutes mes complimens à Mrs votre
Frère — et à Sylvia Jamison et
George moi votre très fidèle
J. Longh

Ms. C'est Mrs. D. qui a mis cette célèbre ma-
chine pour calculer les Tables dans un tout petit
J. Longh attend l'arrivée
de cette lettre j'espère que vous
avez reçu vos Chronomètres.

P.P.S. — L'avez la bonté pour l'auteur
de m'adresser vos lettres non pour le Secrétaire
de la Société ni Astronomique ni Royale — mais sim-
plement pour M. Archibald Stough, Colbrook,
London.
et quand aux livres — vous pouvez me les adresser
par le moyen du Secrétaire du Bureau des Longitudes. St. Young
London.

all. ill. Astronomo e
Giuseppe Cacciatore
Direttore della Scuola Reale
a Palermo
Sicilia
(per il Sig. Babbage)

Pen & Pixel



Figure 1 — Kevin Black of the Winnipeg Centre took this image of the Horsehead Nebula and its neighbourhood from Arizona in March using an FLT 132 refractor and a QHY8 one-shot colour camera. Exposures were 8x426 seconds and 2x364 seconds. To the left, the Flame Nebula lies below the bright star Zeta Orionis (Alnitak), the easternmost star in the belt of Orion. The Flame is an easy target in small scopes, in contrast to the much more difficult Horsehead.



Figure 3 — Comet Lulin meets Regulus in this three-filter combination from Jim Chung of the Toronto Centre. Jim took this from his front-door step through H α and OIII filters using a modified Canon 20D and f/2.8 200-mm L-series lens. Exposure was 30x120 s in each of the filters for a total of 60 minutes. The image was extensively processed with *Nebulosity* and *Photoshop CS2* to freeze both star fields and comet.

Figure 2 — This spectacular panorama of the *ISS* passing above Brackley Beach, in PEI National Park, was taken by Clair Perry of the Charlottetown Centre. As Clair says: “Shot...on a beautiful clear, early-spring evening under perfect conditions — not cold and no wind or bugs to contend with. Heavens-Above (www.heavens-above.com) provided the planned track — a perfect 29-30 deg...” Clair used a Canon 40D, 17-35 f/2.8 L lens, ISO 800, lens wide open with 8x30-second exposures. Brian Gorveatt, a fellow member and astro-shooting partner, stitched the images together to produce this great image.





Figure 4 — Markarian's Chain was captured by the Toronto Centre's Mickey Milankov from his backyard in March. Mickey used a modified Canon XT with a 2-inch Skyglow filter and an Equinox 80 scope, riding on his 8-inch SCT and wedge. The stacked image consists of 37 3-minute exposures at ISO 400.



formality, the letter height and slant of the nib to the page are well controlled, and the consistency of the line spacing is well disciplined. Herschel, like his contemporaries, was well used to being his own scribe. It is worth noting that the only specifically Cambridge duty attached to the Lucasian chair singled out by Herschel is examining for the Smith's prize. It was one of the few duties Babbage did perform conscientiously. North Americans would not now see such a duty as paramount among those attached to an endowed chair.

The letter of introduction to Cacciatore on Babbage's behalf is intriguing for the opinions about astronomers and their work. Cacciatore would not now be rated with Herschel, but it seems Herschel treated him with respect (they collaborated on some vulcanology), and there is a trace of fondness underneath the formality. We catch Wilhelm Struve at thirty-five with his stellar reputation recognized across Europe, and William Henry Smyth just embarked on his lesser but no less congenial work. The light-hearted nickname for the great comet hunter Jean-Louis Pons is amusing, and unlikely to be derogatory from Herschel's pen. This letter carries no date, but scholarly consensus seems to place it in 1828. There is no evidence, other than that of provenance, that these two letters travelled as one. We are disinclined to believe Herschel mailed them together, as the letter to Babbage does not refer to the letter of introduction. Material analysis reveals that the paper for the letters were produced by different firms, and are of different quality; as well, the ink may have come from different batches.⁵ Chant states that the letter of introduction was never presented to Cacciatore, but doesn't offer a reasoned argument to support his assertion. He may be reading too much into Babbage's silence regarding Cacciatore in his autobiography; it is after all simply an argument from silence. It is also scholarly consensus that much is missing from Babbage's autobiography.

The text and physical qualities of these letters allow us a glimpse over the shoulder of a thirty-six-year-old astronomer who has just laid aside pen and paper. He has written rapidly to post news to a close friend, equal in years, only recently elected to occupy Newton's venerable chair.

Edition

Principles of the edition: a diplomatic transcription is presented below, which respects the original orthography, punctuation, expunctuation, and *mise en page*. No attempt has been made to correct or modernize the French, or otherwise obscure the evidence for Herschel's usage and style. Editorial interventions are enclosed in square brackets. Notes are provided to aid comprehension, mark points of interest, and provide context for the content. Every effort was made to decipher the script

⁵ This evidence can be discounted if Herschel was in the habit of using different papers for differing types of letter. An analysis of his surviving correspondence would be necessary to establish this.

under the erasures, but the readings should be treated as tentative. The erased ink did not become appreciably more legible with exposure to near ultraviolet light at wavelengths of 375 nm and 405 nm. The evidence of the mistakes is useful for those attempting to reconstruct Herschel's thought processes when composing and writing quickly.

Letter of Herschel to Babbage (CCJH 1694)

- max. page dimensions: 19.8 cm × 25.24 cm
- line spacing: 9.6 cm-20.15 cm
- minim (i-stroke) height: 1 mm-3 mm
- thickness of paper: folio (sheet) 1: 0.127 mm; folio 2: 0.124 mm
- watermark: R MUNN & C^o/1825
- pH<6.8 (acidic)
- colour of paper: Munsell 7.5R 8/2 Light Pink
- colour of ink: Munsell 5R 2.5/1 Reddish Black (consonant with iron-gall ink)
- script: common late-Georgian cursive, very rapidly penned; few abbreviations. Ink wash used for expunctuation
- the two leaves were laid one on top of the other, then folded five times into a packet, which was then sealed; the outermost layer of the packet is darker than the other surfaces
- traces of red sealing wax remain, but the design of the seal (John Herschel's signet?) is completely obscured
- condition: some minor tearing around the edges of the leaves, with splitting along the folds. The corrosive potential of the ink appears not to have been activated. The paper shows no signs of acidic disintegration

endorsement: Professor Babbage/Poste Restante/Naples/(Italy)

small script at upper right: 9 Nov 1828⁶ /W J. Herschel/to CB

small script in box to right of main endorsement: In Slough Post./March 9.th

Text:

Dear Babbage

You were elected on the 6th Lucasian Professor at Cambridge⁷ Airy⁸

⁶ The disagreement of date may have arisen from reading the month in Herschel's dating clause at the end of the letter as "No[ve]mb[er]".

⁷ Perhaps the most prestigious of the endowed professorships in natural philosophy at the University of Cambridge, although not the most lucrative. Founded by a bequest of Henry Lucas in 1663, the two most famous holders of the chair are Sir Isaac Newton (second: 1669-1702), and Stephen Hawking (seventeenth:1980-). Babbage was the eleventh holder of the chair from 1828-1839 (Knox & Noakes 2003).

⁸ Sir George Biddell Airy (1801-1892), seventh Astronomer Royal (1835-1892), and tenth Lucasian Professor (1826-1828). For most of their careers he and Herschel were on very amicable terms, but Airy's relations with Babbage turned sour over the subsequent web of politics that entangled Babbage's research and development in the nascent field of "computer science" (DSB 1, 84-87; BEA 1, 19-21; NDSB 1, 24-26 — an important updating of the DSB entry). Babbage attributed the origin of this to their support of opposing sides in the South-Sheepshanks affair, a bitter dispute which ran through the English astronomical establishment during the second quarter of

having turned Plumian⁹ in Room of Woodhouse¹⁰ departed this life — . I have written all the particulars to you “Poste Restante Rome”¹¹ but to be sure of hitting you I just scrawl this to Naples to take you on the chance you may have left R. [*i.e.* Rome] though unlikely. — It was done in a most handsome way and though two others were candidates you had 8 votes out of 11.¹² Therefore my advice is that you write forthwith to the VC. [*e.g.* Vice Chancellor] (D^r Davy of Caius¹³) — who has written me a very pretty letter about change in Luc about it and thank the electors in good set terms¹⁴ and tell him you will be back in time to examine for the next Smith’s prize¹⁵ or any other time as much earlier as you please — as your presence at the Board of Longitude¹⁶ will be very acceptable (of which you are as you[re] aware now a member virtute officii [*i.e.* by virtue of the office]).

I refer for particulars to my letter at Rome¹⁷ which if you return by Rome you cannot miss.

Remember me to Monticelli¹⁸ most kindly.

the nineteenth century (Hoskin 1989; Hoskin 1991).

⁹ Airy was elected to the Plumian Professorship of Astronomy (1828-1835), an endowed chair with less prestige but greater emoluments than the Lucasian (Airy & Airy 1896, 77-81).

¹⁰ Rev’d Robert Woodhouse (1773-1827), Plumian Professor (1822-1827), and reforming mathematician (DSB 14, 500).

¹¹ A practice in which mail is kept at the receiving post office for the addressee, until he or she should call for it.

¹² From this point on the thickness of the script is much reduced, indicating either that Herschel recut the nib of his quill, or used a different pen. From the script, it is impossible to tell if Herschel used pens from bird feathers (*i.e.* quills), or the metal-nibbed “pens” gaining in popularity (Finlay 1990, 44-50, 163-172), or even glass pens (Anon. 1831; Finlay 1990, 44). Herschel had a lifelong interest in the hardware of written communication, experimenting with glass pens (CCJH 53[1812], 14226[1870]), and asking his friend Augustus De Morgan for advice on steel pens (CCJH 5791, 6156, 6165). (Glass pens were also commonly used as part of scientific apparatus in mid-century; Bond 1851, 163). Given the haste with which he wrote this letter, it is unlikely that the change in the appearance of the script indicates a hiatus in writing at this point. This interpretation is supported by the stability in the visual appearance (chiefly colour) of the ink throughout the letter.

¹³ Martin Davy (1763-1839), physician and master of Caius College Cambridge, and Vice Chancellor of the University (second term:1827-1828), a very powerful figure within the university, whose office made him an important contact for any newly appointed senior faculty (DNB 14, 196).

¹⁴ Herschel is advising Babbage to express his gratitude in no uncertain terms.

¹⁵ The Smith’s prize in question is one of several prestigious awards for Cambridge undergraduates reading mathematics and natural philosophy, established by legacy of Robert Smith (1689-1768) in 1769 (Barrow-Green 1999; it is now part of the Smith-Knight Prize). Smith was Plumian Professor of Astronomy (1716-1760), and became rather wealthy from extra-university activities (DSB 12, 477-478). He is best known today for his very influential *Complet System of Opticks* (Smith 1738); the aerial telescope plate from that work (2, 152) has been used in many modern histories of astronomy, and graces the cover of the *Journal for the History of Astronomy*. The Lucasian Professor was by virtue of his office, one of the examiners for the Smith Prize. Both Herschel (1813) and Airy (1823) were prize winners. Babbage effectively made himself ineligible for the prize, partly through errors in judgement in the management of his undergraduate career, and partly through a reluctance to compete against his close friend Herschel.

¹⁶ The Board of Longitude was established in 1714 by Act 12 Anne, cap. xv “for Providing a Publick Reward for such Person or Persons as shall Discover Longitude at Sea;” it included many astronomers among its number from its founding to its dissolution in 1828 (Forbes 1970).

¹⁷ Presumably the letter to Rome reports on matters more fully. It may be extant as CCJH 1695.

¹⁸ Fr. Teodoro Monticelli (1759-1845), a well-known geologist and pioneering vulcanologist (CCJH 1005, 1090, 1345, 1444, 3322, 4275).

Yours truly in great haste

JFW Herschel

Slough March 9

1828 —

Letter of Introduction for Babbage from Herschel to Cacciatore (CCJH 1656)

- max. page dimensions: 22.9 cm × 22.82 cm
- line spacing: 11.5 cm-17 cm
- minim (i-stroke) height: 2 mm-3.9 mm
- thickness of paper: folio (sheet) 1: 0.144 mm; folio 2: 0.142 mm
- watermark: three stylized “prince of Wales” feathers above three diamond-caped *flèches* on a simple coronet; scrolls to either side of crown, with the crown placed above “JMM” in cursive capitals
- pH<6.8 (acidic)
- colour of paper: Munsell 7.5YR 8/3 Pink
- colour of ink: Munsell 5R 3/1 Dark Red Grey (consonant with iron-gall ink)
- script: common late-Georgian cursive, very rapidly penned; few abbreviations. Ink wash used for expunctuation
- one large leaf folded six times into a packet; the outermost layer of the packet is darker than the other surfaces (*n.b.* the formerly single leaf has separated along the major fold to form two separate pages)
- no traces of ever having been sealed
- condition: some minor tearing around the edges of the leaves, with splitting along the folds. There may be the slightest traces of the beginning of ink corrosion, as well as acidic disintegration

endorsement: All ill^o Astronomo il/Professore Cacciatore¹⁹/Direttore della Specola Reale²⁰/a Palermo/Sicilia/(per il Sig^r. Babbage)

Text:

Mon cher Monsieur —

Cette lettre vous fera porter par Monsr. Babbage, le Secetaire de Notre Societé Astronomique pour la Correspondance Etrangere.²¹ Il vous fera fait de tous ce que

¹⁹ Niccolò Cacciatore (1780-1841), director of the Royal Palermo Observatory (1817-1841), and one-time assistant to Fr. Giuseppe Piazzi (1746-1826), the discoverer of the asteroid 1 Ceres (DSB 10, 591-593; BEA 2, 902-903). Cacciatore (BEA 1, 191) is perhaps best known today for identifying α Delphini and β Delphini by a palindrome of the Latin version of his name (Saulocin =Nicolaus= α Delphini and Rotanew =Venator= β Delphini) in the star catalogue he compiled with Piazzi, to signal that he should be considered Piazzi’s successor, on analogy with the heir to the main branch of the Bourbons being called the “dauphin” (Piazzi 1814, 147)!

²⁰ Chinnici & Serio 1997.

²¹ Within learned societies between the sixteenth and the early twentieth centuries, the position of Secretary for Foreign Correspondence was one of vital importance to the reputation, standing, and success of such a body. An honourable appointment, there was nothing purely honorific about it. A good analogy could be drawn between

nous faisons dans votre Science ici. De votre part - ayez le bonte pour l'amitie qui vous portez Secours moi²² — de le recevoir avec la bienveillance. Il est extremement interessé (comme le sommes tous nous autres) sur les travaux importants qui vous occupere si dont vous avez publie des resultats si interesant dans le volume de vos Ob[servatio]ns envoyée au Cap[i]t[aine] Smyth.²³

Cap. S. [e.g. Smyth] va etablir une observatoire pres Bedford²⁴ — il aura des instruments ~~appareit~~ que lui a fournis la Societe Astron[omi]que donc j'espere il fera bon emploi —

Struve²⁵ a publie un ouvrage magnifique dans son Catalogue de 3112 etoiles doubles fait avec le grand telescope de Fraunhofer a Dorpat.²⁶ — Ce sera pour lui un titre pour l'immortalite[.]

Adieu mon Cher mons[ieur.] Faites mes Compliments mons[ieur] votre Frere²⁷ — et a Signor Janitor²⁸ et

Croyez moi
votre tres fidele

the office and that of the Canadian Minister of Foreign Affairs. The activities of Henry Oldenburg (ca. 1619-1677), first Secretary of the Royal Society, provide a well-documented illustration of what could be accomplished in that role through energy and intelligence — and ambition (DSB 10, 200-203; Hall 2002). In the early years of the RASC, the Secretary often acted as a Secretary for Foreign Correspondence, and indeed, the office was at one time that of official “Corresponding Secretary” (Broughton 1994, 70).

²² If Cacciatoro played such a role, it was not noted in the official history of the Royal Astronomical Society (Dreyer & Turner *et al.* 1923). Cacciatoro’s “support” for the Astronomical Society may have consisted largely of his agreeing to be elected an associate of the Society during a critical period in its history (CCJH 1111, 1136 [both 1825]).

²³ Herschel is probably referring to Cacciatoro 1826 a, although Cacciatoro 1826 b cannot be dismissed (we have been unable to inspect either of these works). Captain (later Admiral) William Henry Smyth (1788-1865) was a good friend of Cacciatoro’s mentor Piazzzi (BEA 2, 1070-1071). He did put the equipment to good use as Herschel had hoped, publishing his efforts as the Bedford Catalogue (Smyth 1844), a very well-received guide to observational astronomy, and a direct predecessor to Webb’s (1859) and Burnham’s (1978) handbooks.

²⁴ Smyth’s observatory was famous in its day for the excellence of its equipment (King 1979, 194-195).

²⁵ Friedrich Georg Wilhelm Struve (1793-1864), one of the greatest observational astronomers of the period and an important figure in the development of the field of double star research (DSB 13, 108-113; BEA 2, 1101-1102; Batten1988). The work that so impressed Herschel is Struve (1827), for which he received the Astronomical Society’s Gold Medal.

²⁶ The Great Dorpat refractor, one of the most influential astronomical research telescopes ever built, the work of the master optician and experimentalist Joseph Fraunhofer (1787-1826; DSB 5, 142-144; Jackson 2000). The instrument is now in the museum of Old Tartu Observatory (www.obs.ee/obs/instrumendid/fr.htm). Fraunhofer’s achievements in instrument design, manufacture, and innovation, and his sensational spectroscopic results were well known to Herschel’s circle. One perhaps unwelcome result of Fraunhofer’s work was the shaking of the hegemony of the British precision-instrument industry, although it was consonant with Herschel’s character to view the result as beneficial for natural philosophy.

²⁷ We have been unable to identify a brother of Cacciatoro’s who worked as an astronomer.

²⁸ This is a jocular reference to Jean-Louis Pons (1761-1831), the greatest discoverer of comets by visual means in the classical age of observational astronomy, racking up 37 comets in 26 years (DSB 11, 82; BEA 2, 924). At this time, he was director of the Grand Ducal Observatory in Florence. He started his astronomical career as concierge (janitor in Latin) at the Observatory in Marseilles (a modern equivalent would be Milton Humason [1891-1972], who was mentored by Hale and Hubble from janitor to astronomer to work with them and Zwicky, Mayall and Sandage; BEA 1, 537-538). Chant’s reading of “Taunton” for Janitor has no warrant in the palaeography of this letter (1944, 227), and no one named “Taunton” is attested among the nearly fifteen-thousand surviving letters to and from Herschel (CCJH).

JFW Herschel.

NB. C’est Mons[ieu]r B. [*i.e.* Babbage] qui a inventé cette celebre machine pour calculer les tables donc on a tout parlé.²⁹

PS. Longtems avant l’arriveé de cette lettre j’espere que vous aurez bien vos Chronometres.³⁰

PPS. — Ayez la bonte pour l’avenir de m’adresser vos lettres non pour le Secretaire de ~~qui~~ la Societe ni Astronomique ni Royale — mais simplement pour M[onsieur] Herschel[.] Slough. Colnbrook.

Bucks

Angleterre.

De quant aux livres — etc — vous pourrez me les adresser par le moyen du Secretaire du Bureau des Longitudes.³¹ D^E. Young³² London.

Translation:

endorsement: To the astronomer, Professor Cacciatoro, Director of the Royal Observatory at Palermo, Sicily (through Mr. Babbage)

My dear Sir,

This letter is brought to you by Mr. Babbage, the Secretary for Foreign Correspondence of our Astronomical Society. He will inform you of all that we do in our Society here. For your part—would you be so kind, out of the friendship you bear me—to receive him with kindness? He is extremely interested (as are we all) in the important work which so occupies you, the very interesting results of which you have published in the volume of your observations sent to Captain Smyth.

Captain Smyth has established an observatory near Bedford—he will have some instruments which the Astronomical Society has provided, so I hope he will make good use of them.

Struve has published a magnificent work in his Catalogue of 3112 double stars made with the great telescope of Fraunhofer at Dorpat. This will be his claim to eternal fame.

Farewell my dear Sir. Please convey my regards to Monsieur your brother—and to Signor “Janitor”.

Believe me your very faithful [friend,]

J.F.W. Herschel

N.B. It is Mr. Babbage who has invented that famous engine for calculating tables [*i.e.* ephemerides], thus no more need be said.

P.S. I trust that you will have your chronometers well before the

²⁹ By this date only parts of Difference Engine No. 1 had been built (Hyman 1982, 47-61), yet the concept and its promise brought Babbage considerable notice.

³⁰ On the fourth of January 1827 Cacciatoro had asked Herschel to procure mainsprings for some chronometers (CCJH 1451).

³¹ See note 16 above.

³² Thomas Young (1773-1829), an early champion of the wave theory of light, and a polymath whose range of interests, achievements, and abilities could stand comparison with those of Herschel and Babbage. He was appointed Secretary to the Board of Longitude in 1818, and Superintendent of the Nautical Almanac, one of the models for the RASC Observer’s Handbook (DSB 14, 562-572).

arrival of this letter.

P.P.S. Would you be so kind in the future to address your letters to me not as the Secretary of either the Astronomical or the Royal Societies, but simply as Mr. Herschel, Slough, Colnbrook, Bucks, England?

Concerning books, etc., could you send them to me by means of Dr. Young, the Secretary of the Bureau of Longitudes, London?

Acknowledgments

The authors wish to thank Peter Broughton for his comments on a draft of this paper. Any errors remaining are their sole responsibility. ●

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CCJH: A Calendar of the Correspondence of Sir John Herschel, ed. M.J. Crowe *et al.*, 1998, Cambridge University Press, Cambridge

DNB: Dictionary of National Biography, ed. L. Stephen and S. Lee, 63 vols., 1885-1900, Smith, Elder, and Co., London

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Dark-Sky Ratings for Star Parties in 2009

by Terry Trees, Toronto Centre (TreesT@Comcast.net)

Introduction

I received an unexpected early retirement beginning in February. Fortunately it was not a forced layoff like so many others have recently experienced.

There were many benefits in what I was offered. For example, we were able to pay off what we had borrowed to send our two sons to college. There's not much money coming in now, but at least our debts are paid. So, I am doing some substitute teaching in a few local school districts, earning money to cover a few trips to camp-over star parties — I need to escape the light pollution! Going to warmer weather locales will not hurt either.

I used *Astronomy Magazine*, *Sky & Telescope*, the RASC, and Google's Web sites, among others, to create a list of as many North American star parties as I could find. (According to their Web site, *SkyNews* will not be listing star parties until sometime in March.)

I next got the idea to use Attila Danko's Clear Sky Chart Web site to examine the darkness rating of each. (I didn't see a reason to drive for 10 or 12 hours only to wind-up in a site that is no better than my back yard.) As a summary, here is what I found to be the darker star-party sites of eastern North America. The colour codes are explained below:

Colour Code (in order of increasing darkness)

White (W)
 Red (R)
 Orange (O)
 Yellow (Y)
 Green (G)
 Blue (BL)
 Charcoal (C)
 Black (BK)

Feb. 22-28 Cedar Key Star Party, Cedar Key, FL (BL)
 Feb. 22-28 Winter Star Party, Marathon, FL (BL)
 Feb. 25-Mar 1 Orange Blossom Star Party, Dade City, FL (Y)
 Feb. 28 Wagman Winterfest (O)
 Mar. 7 Tri-Star 2009, Greensboro, NC (R)
 Mar. 25-29 Hodges Garden, "Kisatchie" Star Party, LA (BL)
 Apr. 3,4 Wagman (O)
 Apr. 16-19 NEAF, Suffern, NY (R)

Apr. 17,18 Mingo (O)
 Apr. 19-26 Texas Star Party, Fort Davis, TX (BK)
 Apr. 22-25 Mid-South Star Gaze, French Camp, MS (BL)
 Apr. 23-24 South Jersey Star Party, Belleplain State Forest, NJ (Y)
 Apr. 23-24 Georgia Sky View, Indian Springs State Park, GA (Y)
 Apr. 23-24 Two Rivers Spring Star Party, Barry, IL (G)
 May 1,2 Mingo, Wagman (O)
 May 2 Kunkle (O)
 May 13-17 Southern New Mexico Star Party, City of Rocks State Park, NM (C)
 May 15,16 Mingo (O)
 May 21-25 Joshua Tree Star Party, Joshua Tree Nat'l Park, CA (Y)
 May 22-25 RTMC Astronomy Expo, Big Bear City, CA (Y)
 May 29,30 Wagman (O)
 Jun. 12-13 Apollo Rendezvous, Dayton, OH (W)
 Jun. 12,13 Mingo (O)
 Jun. 13 AAAP Picnic (O)
 Jun. 13 Kunkle (O)
 Jun. 13-20 Grand Canyon Star Parties-North (BK), South (BL)
 Jun. 18-21 Cherry Springs Star Party, PA (BL)
 Jun. 25-28 Almost Heaven Star Party, Spruce Knob, WV (BK)
 Jun. 26,27 Wagman (O)
 Jun. 27 Mingo (O)
 Jul. 2-5 Greenbank Star Party, WV (BK)
 Jul. 11 Kunkle (O)
 Jul. 16-19 Gateway to the Universe, Restoule Provincial Park, ON (BL)
 Jul. 17-21 Stargazing Manitoulin (C)
 Jul. 19-24 Nebraska Star Party, Valentine, NE (BK)
 Jul. 23-25 Table Mountain Star Party, Ellensburg, WA (BL)
 Jul. 24,25 Mingo, Wagman (O)
 Jul. 24-26 Butterpot Star Party, Butterpot Provincial Park, NF (BL)
 Jul. 24-26 Star-B-Que, Caroline, AB (Y)
 Jul. 24-26 Mason-Dixon Star Party #1, Shreveport, PA (O)

Aug. 8	Kunkle (O)	Sep. 15-20	Northern Prairie StarFest, Black Nugget Lake, AB (G)
Aug. 13-16	Stellafane (Y)	Sep. 17-20	Huronian Star Party, Duntroon, ON (Y)
Aug. 13-16	RASC General Assembly, Saskatchewan Summer Star Party	Sep. 17-20	RASC-Toronto Centre, Algonquin Adventure, Mew Lake, ON (C)
	Cyprus Hills Interprovincial Park, SK (C)	Sep. 18-20	Hidden Hollow, Mansfield, OH (Y)
Aug. 14-18	Manitoulin Star Party, Manitoulin Island, ON (C)	Sep. 18-20	Black Forest Star Party, Cherry Springs Park, PA (BL)
Aug. 15-23	Mt. Kobau Star Party, BC (BL)	Sep. 18-20	Blackwater Falls Star Party, Blackwater Falls State Park, WV (BL)
Aug. 18-23	Astroblast, Oil City, PA (Y)	Sep. 26	Mingo, Wagman (O)
Aug. 19-23	Oregon Star Party, Ochoco National Forest OR (BK)	Oct. 10	Mingo, Wagman (O)
Aug. 20-23	StarFest, Mt. Forest, ON (G)	Oct. 12-18	Mid-Atlantic Star Party, Robbins, NC (G)
Aug. 21,22	Mingo (O)	Oct. 14-17	Enchanted Skies Star Party, Socorro, NM (C)
Aug. 28,29	Wagman (O)	Oct. 16-18	Mason-Dixon Star Party #2, Shreveport, PA (O)
Aug. 29-Sep 1	Nova East, Smileys Provincial Park, NS (Y)	Oct. 18-25	Peach State Star Gaze, Sharon, GA (G)
Sep. 5-7	Spruce Woods Star Party, Spruce Woods Provincial Park, Manitoba (BL)	Oct. 24	Mingo, Wagman (O)
Sep. 12	Kunkle (O)		
Sep. 12	Mingo, Wagman (O)		
Sep. 12-20	Okie-Tex Star Party, Kenton, OK (BK)		
Sep. 12-19	Fall Star Quest, Loon Lake, BC (BK)		

Kunkle, Mingo, and Wagman indicate astronomy public nights occurring in the Pittsburgh, PA area. ●

On Another Wavelength

IC 1805 - The Heart Nebula



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

Sometimes called the Valentine or the Running Dog Nebula, this diffuse emission nebula is not only beautiful, but as a new-star-forming nebula, has a lot of interesting detail buried within it. It can be found at RA 02h 32m 36s and Dec +61° 29' 2", lying some 5° NNE of the Perseus Double Cluster and about 7500 light-years from Earth in the constellation Cassiopeia. The nebula itself is quite difficult to see, having an apparent magnitude of 18.3. You will need more than 16 inches of aperture for visual observation — or better yet, add a digital camera to a smaller scope, and you may get results similar to that in Figure 1.

At the centre of the nebula are several very hot O- and B-type stars in an open cluster discovered by Philibert Jacques Melotte (1880 - 1961) and now known as Melotte 15. This cluster can be seen with a much smaller telescope. It is the UV radiation from these cluster stars that gives the Heart Nebula its characteristic red (H α) colour. In addition, the ultraviolet radiation from the central cluster of stars has blown the dust

clouds into an enormous heart-shaped structure with an overall width of about 200 ly.

IC 1795 is the bright nebula that can be seen on the upper right side of IC 1805, and NGC 896 is a catalogue number given to the brighter part of this appendage. Near the left edge of the photo is the open cluster NGC 1027. Continuing our tour of this complex region, we find a few stars in a line that make up the open cluster Markarian 6 towards the bottom-right edge of the nebulosity. Finally, another small cluster known as Berkeley 65 can be found along the edge of the nebulosity; it is somewhat diagonally across from IC 1795 and IC 1805.

IC 1805 is similar to the Rosette Nebula in that it is rich with bright-rimmed molecular clouds (BRCs) that are typically found in and around HII regions (ionized atomic hydrogen). These bright-rimmed clouds are often sites of star formation, triggered by compression and shockwave fronts from the strong UV radiation. Astronomers often study sites like this looking for pre-main-sequence stars in order to understand stellar

evolution. In fact, recent studies by Motoyama, Umemoto, and Shang (2007) have suggested that triggered star formation can increase the luminosity of these protostars by several orders of magnitude. A model called Radiation-Driven Implosion (RDI) is used to describe this process (Bertoldi & McKee 1990). There is an interesting video of this process on *YouTube*. Check it out at www.youtube.com/watch?v=bCkKsYtNgYk.

So, not only are nebulae such as IC 1805 beautiful objects to image, there is also a great deal of science in the background. The next time you are observing the Double Cluster, take a moment to slide over a few degrees and have a look at the cluster Melotte 15. Then try to imagine the Heart Nebula, the other smaller nearby star clusters, bright-rimmed clouds, and all the new protostars that are just getting started. ●

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

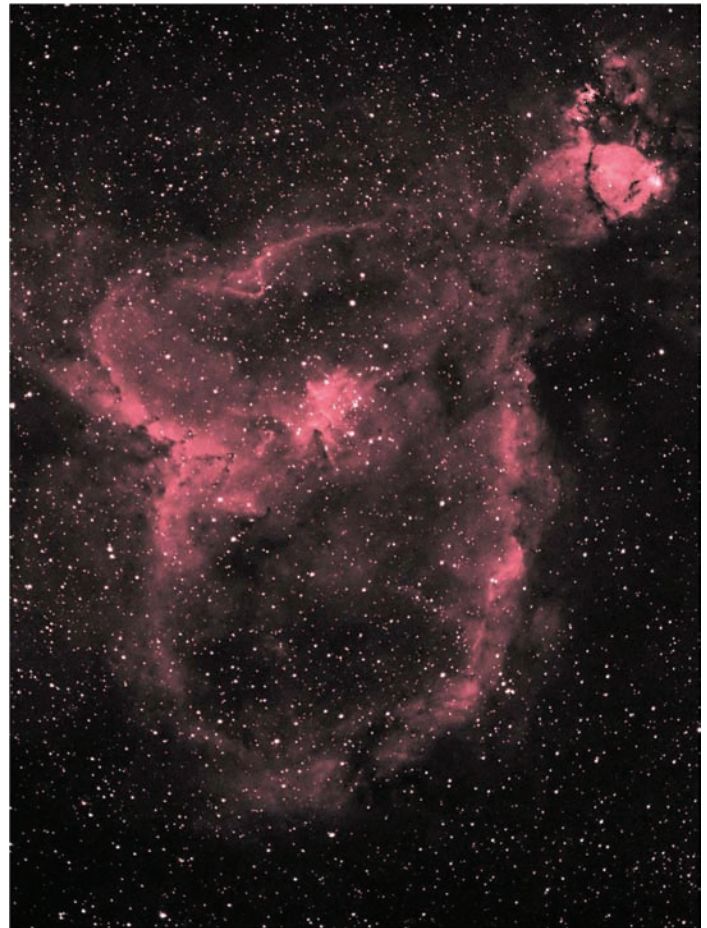


Figure 1 — This image of the Heart Nebula and its surroundings was captured by Steve Holmes of the Kitchener-Waterloo Centre. Steve used a 66-mm Skywatcher Equinox with a 0.8x Williams Optic reducer/flattener and a Baader 7-nm H- α filter. The exposure is 12 x 10 min using a QHY8 single-shot colour camera.

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Something Completely Different



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

I've now been an amateur astronomer, off and on, for nearly 52 years. I was very keen as a teenager but, as happens with many young people, my interest faded when I reached my early twenties and didn't really revive until 1997. It's remained really strong since then, and I've managed to keep it that way by avoiding most of the things that turned me off astronomy in the '60s (such as RASC politics) and by rejuvenating my interest from time to time by taking on new and different projects that keep my interest forever young and alive.

Asteroids

I've always been a fan of planetary observing. A few years ago, I faced a spring when there would be no planets in the sky for several months, so I decided to do something I'd never done before: observe a number of asteroids.

Our *Observer's Handbook* has a wealth of information on just about any area of observation. We publish a set of ephemerides of bright asteroids every year. These include all asteroids that will be brighter than magnitude 10.0 at some point during the year. The ephemerides are given only for the season when their magnitude is above magnitude 10.0, and it's a simple matter to spot the dates when they are brightest, which normally are those closest to opposition. It's easy then, to put together a list of dates of opposition, which gives you a list of priorities for a given night.

In the bad old days, it was necessary to plot these ephemeris positions in a star atlas manually, which, while an interesting exercise to do once or twice, becomes tedious when faced with a long list of asteroids. Fortunately, most modern planetarium programs include the orbital elements for current bright asteroids, so most of the observing charts can be generated automatically. It's interesting to see the asteroids' paths against the background stars. Most asteroids in the main belt behave much like planets, but some, notably Ceres, have orbital paths that take them far from the ecliptic. Some are moving quite rapidly when closest to the Earth, making for interesting observing, as you can actually see the asteroid move in real time. The year I undertook this project, Pallas passed south to north along the eastern edge of the open cluster

M47 in Puppis, making for a memorable night of watching an asteroid move against a bright pattern of stars (2000 February 28/29).

These observations of asteroids, while challenging and enjoyable in themselves, were also good preparation for my more recent attempts to observe near-Earth asteroids. One of my first discoveries was that asteroid positions are often somewhat off from predictions, because these small bodies are easily influenced by the gravity of the larger objects in the Solar System.

Double Stars

For many years, most of my observing was done from my backyard, six blocks away from the Yonge and Eglinton intersection in Toronto. This pretty much precluded observation of deep-sky objects, except perhaps once a month when I traveled to a dark-sky site. In order to keep my starhopping skills active, I undertook to observe all the stars on the Astronomical League's Double Star Club list (www.astroleague.org/al/obsclubs/dblstar/dblstar1.html). This is a fine list of 100 double stars spread all over the northern sky, which includes most of the best doubles. It includes pairs in challenging constellations like Lacerta and Draco, unfamiliar to most city dwellers. Some are wide enough to be visible in binoculars, most are visible in a small telescope, and a few are major challenges, notably Porrima (Gamma Virginis). This binary star was quite easy at the time the list was first established, but became a major challenge in the last few years because of its narrowing separation. Fortunately, it is now widening again, and soon should be an easy target.

Daytime observing

One day it struck me that I was only getting half the use of my telescope that I might be, because I was using it only at night. It is frequently possible to observe the Moon in daylight. I'm amazed at how many people are not even aware that the Moon can be seen in the daytime sky, despite the fact that it's there roughly half the time. A red filter will help kill the scattered

light from the sky, and give you a view almost as good as at night, perhaps even better because the Moon's glare will be dampened by the daylight sky.

The Sun is usually an interesting target, though it requires some special equipment. My preferred way of taming the Sun's overpowering radiation is to use a Baader Solar Film filter over the aperture of the telescope. This material is better optically than glass. I own several Baader filters manufactured by Kendrick, which come with nice powder-coated aluminum frames and three nylon thumbscrews to lock them in place on the telescope, an important safety feature. I prefer an aperture filter to the alternative methods, since all dangerous radiation is blocked before it *enters* the telescope. There are many horror stories of meltdowns and fires from people who have ignored this advice.

However, I'd hold off buying a solar filter for a while, because the Sun is being abnormally slow about getting its new activity cycle going. As I write this (in early April), the Sun has been without a spot for over 24 days, so wait until the sunspot cycle really begins.

I found that I liked solar observing so much that I purchased a Coronado Personal Solar Telescope (PST). This has kept my interest in the Sun alive, since, even though sunspots have dropped to zero, there are still flares and prominences visible on the Sun in hydrogen-alpha light. There's almost always something happening on the Sun in hydrogen alpha, so the PST is well worth its purchase price to me.

My favourite daytime observing target is the planet Venus. The main trick is finding it. I used to do this using old-fashioned setting circles, starting at the Sun and then offsetting by the difference in coordinates between the Sun and Venus. Now that I have a GOTO telescope, I'm able to use its "Solar System Align" to set up on the Sun, and then use its GOTO to find Venus. This must be done with great care, and with the lens cap securely fitted over the main telescope. If you lack setting circles or GOTO, you can catch occasional views of Venus when it is close to conjunction with the Moon — check your *Observer's Handbook!* Using GOTO, I was able to observe Venus five out of six days in a row in the last week in March, as it moved to within 9 degrees of the Sun on March 25. At that point, my luck ran out and the clouds rolled in — better luck next time!

Recently I added a new daytime target when I successfully picked up Jupiter as a pale yellow disk against a deep-blue sky. I used the same technique as for locating Venus.

These are just a few of the ways that I have enhanced and increased my viewing experiences over the years. I hope this will inspire you to try something similar. ●

Geoff Gaherty was the recipient of the Society's Chant Medal for 2008. Despite cold in the winter and mosquitoes in the summer, he still manages to pursue a variety of observations, particularly of Jupiter and variable stars. Besides this column, he writes regularly for the Starry Night Times and the Orion Sky Times.

A Moment With...

Danielle Cormier



by Phil Mozel
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"That's one small step for a man, one giant leap for mankind." Uttered by astronaut Neil Armstrong as he stepped onto the Moon, these are the most famous words spoken during the space program. "Failure is not an option!" might be a close second. This was the comment made by Flight Director Gene Kranz during the *Apollo 13* mission. It highlights the important fact that, without ground support, nobody flies in space. This was true during the missions to the Moon and it is true now with operations involving the *Space Shuttle* and *International Space Station*. With its own space program, and hardware constantly in orbit, Canada requires its own people, its own flight controllers, on the ground. One of these is Danielle Cormier.



Danielle Cormier

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Growing up in a small town in northwestern Quebec, Danielle has always had her mind on the sky. One of the first books she read, at age five, dealt with astronomy. (She also eventually fed herself a steady diet of science fiction, especially Arthur C. Clarke.) Danielle also informed her mother that she would one day work for NASA. To make that happen, Danielle earned her degree in Mechanical Engineering from the École Polytechnique de Montréal and then obtained a position as a co-op student at the Canadian Space Agency (CSA). This eventually led to her current position as a CSA Flight Controller.

Danielle is specifically involved with Canadarm II on the *ISS*. With headset plugged in, and the aid of computers, she monitors the arm, its mobile base, the Special Purpose Dexterous Manipulator (DEXTRE), and the relevant interior controls. She also checks data from the spacecraft, assessing whether everything in space is working as it should, and communicates with the Flight Director, other controllers and, indirectly, with the crew. "Have you seen *Apollo 13*? I do that."

The communications aspect of this work is half the job and extends her engineering skills beyond mere nuts and bolts. This is something generally not covered in engineering school. In fact, most of those who work in flight control got their start right out of school and received on-the-job training by watching experienced controllers and working in simulators. And, just because the simulations are not "real" missions, it doesn't mean you can relax. As Danielle points out, "You train like you fly."

Much of her training took place in Houston, where she spent several years (she was, in fact, a member of the first group of Canadian controllers to train there). Currently, she spends most of her working time at the control centre in Montréal, but returns to Houston for training every couple of months. Since a controller needs to know exactly what is going on in space, Danielle has been trained to operate the robot arms just as the astronauts were. This includes both *Shuttle* and *ISS* arms.

Since her initial training, she has been kept busy working every mission but two since the installation of Canadarm II on the *ISS*. She admits that some missions are more stressful than others, but she learns to deal with it. For example, on the Canadarm II installation mission, all the main computers on the *ISS* had hard-drive failures as a result of trying to operate in micro-gravity. They were all eventually replaced with solid-state devices but, in the meantime, controllers had to work the problem.

On another occasion, in 2002, the astronauts' focus wasn't quite where it should have been and, while operating the robot arm, nearly hit the *Shuttle's* cargo bay door. With the *Shuttle's* radiators located there, a potentially dangerous leak could have resulted. Danielle and her team saw what was about to happen and stopped the crew in time. They received a very nice thank you note from the *Shuttle* manager for that one.

Being the adventuresome type, Danielle has sought out

means of seeing how the other, astronaut-half, lives. The *ISS* isn't accessible so she went to Mars instead . . . sort of. There are two places on Earth where one might go to get a feel for the Martian life style: the Mars Desert Research Station in Utah and the Mars Arctic Research Station on Devon Island in the Canadian arctic. Danielle did two 2-week tours of duty at the former, first as chief engineer (when lots of things requiring her attention went wrong) and once as executive officer. As an engineer, she wasn't just pushing buttons, but got her hands dirty taking things apart. She is interested in exploration, and this experience provided a taste of what she hopes Canada may be doing in the future. She is so keen about these kinds of programs that she does them on her own time. One day she would like to be a controller for a human expedition to the real Red Planet. In the meantime, CSA, recognizing the depth of her commitment, provided the means for her to become a flight controller for the *Phoenix* Mars mission. One of her jobs was to build command sequences for MET, the Canadian meteorological station aboard the lander. She hopes that other planetary missions lie in her future.

To that end she is involved with SCARAB (Selectively Compliant Articulated Robot Arm Rover) built largely by the Field Robotics Center of Carnegie Mellon University's Robotics Institute. SCARAB is designed to explore and sample the Moon's surface using, among other devices, a drill built by the Northern Centre for Advanced Technology (NORCAT), Sudbury, partnered with Ottawa-based Neptec (the company that built the 3-D laser camera used on the end of Canadarm II for inspecting the *Shuttle's* underside after reaching orbit). Some of the operational control for the rover's tests, which took place in Hawaii, originated with CSA. Danielle will play a role in the next round of tests, planned for January 2010, when she will likely be one of the remote-drill operators. Perhaps one day she will become a lunar prospector, guiding the drilling operations of SCARAB's descendants on the Moon.

With eyes always trying to peer over the horizon, Danielle recently applied to the CSA's annual competition to attend the International Space University — and was accepted. As a result, she will be spending a couple of months at the NASA-Ames Research Centre studying a wide range of topics in ISU's Space Studies Program.


Canada has long been a player in the space business, from *Alouette* to the highly recognizable Canadarms. We even have our own astronauts. But the breadth of our contribution is greater still with the involvement of a great many people working behind the scenes. This includes the small but absolutely crucial group of Canadian flight controllers that includes Danielle Cormier. ●

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

Quick Picks for Observing



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

June 2009	Event	August 2009	Event
Friday, June 5 21:00 UT	Venus at greatest elongation W (46°). Look east in the morning.	Monday, August 3 1:00 UT	Moon at apogee* (406,026 km)
Sunday, June 7 18:12 UT.	Full Moon (Honey Moon)	Wednesday, August 5	Penumbral Lunar Eclipse — NE America
Tuesday, June 9 8:06 UT	Double Shadow transit on Jupiter	Thursday, August 6 0:55 UT	Full Moon
Wednesday, June 10 16:00 UT	Moon at apogee* (405,787 km)	Thursday, August 6 22:00 UT	Jupiter 3° S of Moon
Saturday, June 13	Moon-Neptune-Jupiter grouping Look SE after 00:00 UT	Tuesday, August 12	Perseid meteor shower peak
Monday, June 15 22:15 UT	Last quarter Moon	Thursday, August 13 18:55 UT	Last quarter Moon
Friday, June 19	Moon-Mars-Venus grouping visible in morning twilight	Thursday, August 13- Sunday August 16	Saskatchewan Summer Star Party and the RASC General Assembly visit www.rasc.ca/ga2009/index.shtml
Sunday, June 21 1:45 am EDT	Summer Solstice Venus-Mars grouping look E in morning Mercury-Moon grouping NE in morning	Monday, August 17 21:00 UT	Venus 1.7° S of Moon
Monday, June 22 19:35 UT	New Moon	Tuesday, August 18 21:00 UT	Mercury 3° S of Saturn
Tuesday, June 23 11:00 UT	Moon at perigee* (358,014 km)	Wednesday, August 19 5:00 UT	Moon at perigee* (359,639 km)
Monday, June 29 11:28 UT	First quarter Moon	Thursday, August 20 10:02 UT	New Moon
		Saturday, August 22 4:00 UT 6:00 UT	Venus 7° S of Pollux Saturn 7° N of Moon
		Monday, August 24 16:00 UT	Mercury at latest elongation E 27°
		Thursday, August 27 11:42 UT	First quarter Moon
		Monday, August 31 11:00 UT	Moon at apogee* (405,269 km)
		Plan your summer vacation around a summer star party. See page 356 of the 2009 <i>Observer's Handbook</i> for selected star parties, and on pages 12-14 for the latitude and longitude of each location.	
		 <p>2009 International Year of Astronomy</p> <p>As we celebrate the global celebration of Astronomy, make sure to visit www.astronomy2009.ca for more information on Canadian and local events. It's never too late to help volunteer for an event or just to offer a spare set of hands.</p> <p>Come be part of the excitement in 2009!</p>	
		<p>Meteor Showers for June to August www.imo.net/calendar/2009 this includes several minor and major meteor showers see page 258 in the 2009 <i>Observer's Handbook</i>.</p> <p>*Perigee - the point in the orbit of the Moon that is closest to the Earth *Apogee - the point in the orbit of the Moon that is farthest from the Earth for more dates on Perigee/Apogee of the Moon, and new and full Moon dates, visit www.fourmilab.ch/earthview/pacalc.html</p> <p>The RASC offers a Lunar Observing Program called the I.K. Williamson Program. Learn to explore the Moon and find out about craters, rilles, mountain ranges, and ancient volcanoes. Go to www.rasc.ca/observing to find out more.</p>	
Items for this article from the 2009 Calendar and <i>Observer's Handbook</i> . Both of these publications are great sources of information — get yours today!			

Light on Dark Matter?



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

Dark matter makes up about 80 percent of the matter in the Universe. We can see its effect in individual galaxies, through their rotation curves, in large-scale structure of filaments of clusters of galaxies, and in its imprint on the cosmic microwave background. Within the last decade, dark matter has become “mainstream” and is accepted by all but a few holdouts. Some cosmologists have even said that dark matter is boring; dark energy is where the action is. Be that as it may, we still don’t know what dark matter is. Two recent studies by John Wefel of Louisiana State University and his colleagues, and by Piergiorgio Picozza of the University of Rome “Tor Vergata” and his colleagues, just might, however, have confirmed the signature of dark-matter annihilation in cosmic rays. (See the 2009 April 2 and 2008 November 20 issues of *Nature*.)

Dark matter has a long and somewhat chequered history in astronomy. The first evidence for dark matter surfaced in the 1930s, when Fritz Zwicky of Caltech found that individual galaxies within clusters were moving so fast that, unless there were unseen matter, the clusters would rapidly dissipate. In the late 1960s and early 1970s, Vera Rubin of the Carnegie Institution of Washington found that the outer regions of disk galaxies were rotating more rapidly than they ought to, given the visible mass. The results were treated skeptically, but, over time and with many other people confirming her data, they came to be accepted. More recently, observations of gravitational lensing — where the path of light is deflected from a straight line — have settled the issue, along with ripples in the cosmic microwave background. Dark matter exists, but what might it be?

It is fairly easy to say what dark matter is not. Primordial nucleosynthesis is the process by which the hot soup of quarks in the first moments after the Big Bang turned into the lightest atoms (hydrogen and helium) we see in the Universe today. Models of what has come to be dubbed “standard Big Bang nucleosynthesis” indicate that the missing mass cannot be composed of baryons (protons and neutrons), because that would change the ratio of helium to hydrogen abundance from what is observed. While it is possible to hide some baryons in very cold clouds of gas, nowhere near enough baryons can be hidden to explain lensing, rotation curves, *etc.*, without running

into the constraint imposed by primordial nucleosynthesis.

When an important problem like dark matter is almost unconstrained by data, it causes the theoretical equivalent of a feeding frenzy. All kinds of dark-matter particles have been suggested over the last 30 years or so. The most popular current ideas are “weakly interacting massive particles” — referred to generically as WIMPs — or heavy “sterile” neutrinos. Within the WIMP category are some particularly appealing possibilities: the neutralino from supersymmetry models, or the lightest “Kaluza Klein” particle from models with extra spatial dimensions.

Originally intended to address a problem in the formation of large-scale structure, the idea of a supersymmetric particle that can interact with itself and annihilate (such as what happens when an electron hits a positron) has gained a lot of traction. Given that dark matter pervades our Milky Way galaxy, it ought to be possible to find the signature of such annihilation, or at least place interesting upper limits on it. This is what researchers Wefel and Picozza set out to do.

Using the Advanced Thin Ionization Calorimeter (ATIC) mounted on a balloon and flown in Antarctica, Wefel and his collaborators found an excess of cosmic-ray electrons and positrons in the energy range 300-800 GeV. This bump is a deviation from the smooth decline in numbers with increasing energy that is generally seen in cosmic rays.

Picozza and his colleagues obtained their data from a spacecraft in orbit around Earth; the Payload for Antimatter Matter Exploration and Light-nuclei Astrophysics (PAMELA). They have found that in the energy range 1.5-100 GeV the ratio of positrons to electrons increases, particularly sharply above



The ATIC cosmic-ray detector ascends to the stratosphere tethered to a high-altitude research balloon.
Image: NASA.

10 GeV. Soon they should have data for electrons over much of the same energy range sampled by ATIC. Everyone is waiting to see if the abundance will decrease again around 700-800 GeV, as it does in the ATIC data.

These results are very intriguing, because the positron signal is inconsistent with a secondary source (interactions between cosmic rays and atoms in the interstellar medium) and the bump in the electron+positron distribution is consistent with the decay of a 620-GeV “Kaluza-Klein” particle.

So, does this mean that the signature of dark-matter annihilation has been seen? Perhaps. The signals may also be arising from an unseen astrophysical object, such as a pulsar whose pulse happens not to point in our direction, or a microquasar.

The results have set off another theoretical feeding frenzy, with about 60 percent of papers pushing the dark-matter annihilation explanation, and about 40 percent pushing a more mundane one. (One of the aspects of modern astronomy I find most distasteful is the game of rushing some theory papers into print before the observations can be shown to be correct. While it is good to explore new directions, the “me too” look-alike papers outnumber the serious ones usually by

a factor of ten or more.)

Hopes for confirmation of the signature of dark matter now rest mainly with the relatively new *Fermi* satellite, launched in 2008. Most astrophysical sources, such as pulsars, should be concentrated toward the plane of the Milky Way, while dark matter should be distributed approximately spherically. PAMELA is continuing to take data, and eventually will measure the energy spectra of positrons up to around 300 GeV.

In a year or so, we should know one way or the other whether dark matter actually has been seen. I’ll be sure to report back on that! ●

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

Orbital Oddities

Delight(s) of Day, Part 1



by Bruce McCurdy
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That lucky old sun got nothin' to do but roll around heaven all day

— Haven Gillespie “*That Lucky Old Sun*”

“What on earth can you see in the daytime?”

I frequently hear this question at my summer job at the Public Observatory of Telus World of Science Edmonton. Visitors typically walk in the door with low expectations, and frequently walk out a little while later, very pleasantly surprised at their experience. Stargazing in the daytime? Who knew?

Blue-sky observing is the order of the day in a facility whose extended summer hours of operation are 1 to 10 p.m., 7 days a week, from late June through Labour Day. The year-round public programming run by RASC volunteers on weekends throughout the school year is augmented during tourist season, with the science centre hiring a couple of us to

share the daily grind of making this great facility available to all comers.

Given that the Sun doesn’t set until after (official) closing time for the first couple of weeks of that period and is above the horizon for over 90 percent of the scheduled hours throughout the summer, it’s incumbent on us to deal with the challenges and enjoy the subtle pleasures of daylight astronomy. Fortunately, there are more celestial targets than meet the eye.

First among them is, of course, the Sun. The only star we can see up close is a fabulously interesting sight. Not surprisingly, many visitors, especially parents, express doubts about the wisdom of observing the brilliant luminary. Typically, we will start visitors with #14 welder’s glasses installed in a cardboard frame for easy use, a simple method that often meets a delighted response from kids and parents alike. We explain the principles of safe solar observing before moving on to the solar telescopes. We are fortunate to have white-light, hydrogen-alpha, and calcium K-line filters at our disposal.

It is of paramount importance that all precautions be taken to make such observations completely safe. The Sun demands to be treated with a healthy respect, bordering on fear. Solar filters are regularly checked for scratches and screwed or taped in place to prevent them falling off in the wind. Finderscopes are removed; those of us who point these scopes are experienced in using the shadow of the telescope to align them. I'm pleased to report that not a single accident involving unfiltered sunlight has been reported in the Observatory, which will celebrate its 25th anniversary on Canada Day of IYA 2009.

The risks safely eliminated, the Sun puts on quite a show. It's a dynamic body that rewards repeated observation from one day to the next, allowing one to develop a series of snapshot observations into a mental movie. It's fascinating to watch an existing, complex, active region emerge around the Sun's limb, and to follow its development as it rotates across the nearside over the subsequent fortnight. On occasion I have observed a new group developing on the solar nearside during the course of a single afternoon.

In the grander scale, the rise and fall of the solar cycle over the course of a decade is a remarkable phenomenon. During many summers, I have undertaken a daily sunspot count using the Wolf method of 10 for each active region plus 1 for each individual spot within it. In 2001, the counts peaked at over 400 on a few days. By comparison, in 2008, I observed a pair of tiny spots barely larger than pores on July 18; otherwise my entire summer count consisted of a column of zeroes.

Views in the red light of hydrogen alpha can be even more interesting. The subtle details of plages, magnetic field lines, and prominences are best seen under a dark cloth to minimize the interference of stray light. I sometimes wonder what visitors might think upon walking into a quiet observatory to find a single individual sitting at a telescope seemingly wearing a bag over his head! Most visitors are happy to experience the dark cloth for themselves, which I drape over them after a few words of explanation. The improved contrast they experience is quickly apparent in muffled exclamations of delight.

Solar prominences are frequent features, even on a quiet Sun. A large quiescent prominence can easily span several percent of the solar diameter, looping many tens of thousands of kilometres in extent or even more. It can take several days for one to fully rotate around the solar limb, and if they occur near a pole they can last longer still.

Active prominences are more exciting. Many an afternoon or early evening I have enjoyed what I call a "lava pool" near the edge of the solar disc — an area that brightens and spits little blobs of red light that rise into the darkness beyond the limb before fading and falling back.

Best of all are solar flares. I have seen any number of these in C and M class, as recorded by the very useful real-time updates from the *GOES* satellite X-ray flux monitor at www.swpc.noaa.gov/rt_plots/xray_lm.html. On a few occasions near the time of solar maximum, I was fortunate to observe a violent X-class flare. The first such outburst occurred near one edge of the disc; a huge eruptive prominence soon burst from the nearby limb, rose majestically upward and outward, before gradually fading from view. Rather than merely detect changes over time, I could literally see this thing move.

A few weeks later, another X3-class flare erupted, much closer to the Sun's centre. A complex active region appeared, unstable in both white and red light for much of the afternoon, so I observed it closely. Very suddenly, two brilliant white ribbons of light formed parallel to each other, maintaining a fixed separation, likely due to opposing polarities. The areas to the outsides of the two ribbons rapidly destabilized into a jumbled maelstrom of angry red light. The whole eruption lasted about an hour, with the most intense action happening within just a few minutes. After things settled down a bit, the sunspot group had noticeably changed in white light. It's difficult to describe the details, but in the aftermath of the discharge, the whole region appeared to have lost its potency.

Two nights later, I wrote on the Observatory blackboard "watch for aurora tonight," and sure enough, right after sunset, an all-sky aurora was already in progress even as the blue deepened. It continued unabated all night long. The sudden and unpredictable movements of the curtains were strangely reminiscent of the violent event that powered them. This remarkable dual observation of cause, then effect, ranks among my favourite observation of any type. ●

Ever the contrarian, Bruce McCurdy's personal observing program is never more active than in the summer months, when perpetual twilight at his latitude near 54 degrees north encourages many of his deep-sky brethren into hiatus. Besides the daytime astronomy described here, Bruce is an enthusiastic observer of the noctilucent clouds of June and July, as well as the August Perseids.

Five Easy Pieces



by Gerry Smerchanski
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The third installment investigating low-power, wide-field viewing

In previous articles dedicated to low-power, wide-field viewing, I first looked at a selection of binoculars (June 2008) and then rich-field telescopes (August 2008) suitable for the task. Two guidelines employed then were to review affordable offerings and to compare with some older, used instruments to give an idea of the progress in optics through time. This time I investigated the other aspect of rich-field viewing — eyepieces.



Figure 1 — Left to right: 40-mm TMB Paragon, 42-mm Orion Superwide, 42-mm GSO Superview, 45-mm Celestron Ultima, and the 45-mm University Optics Plossl.

In keeping with the self-imposed mandate of the previous articles, I assembled a group of five affordable “bargain basement” eyepieces that are or were commonly available. They span a good many years of production and so can be used as a general indicator of the progress made in eyepiece design in the last several decades. In accordance with the general theme, they were all two-inch format eyepieces so as to provide the maximum field of view possible. They were tested in a variety of telescopes from $f/10$ SCTs to $f/4.8$ Newtonians over an extended period. In fact, I became so familiar with the subtleties of each eyepiece, that, after a long while, I could identify one just by looking through it in the dark with no other hint to its identity.

That is not to say that all these eyepieces were vastly different in performance — they were in some respects quite similar — but instead that the investment of a great deal of time in their use will reveal subtle differences in their performance.

The good news of this test was that low-powered, wide-field viewing is rather undemanding of optics in many respects, and all these eyepieces provided satisfactory performance. Each lived up to the title of being “easy eyepieces,” in that all gave wide fields of view and sharp, on-axis images with plenty of eye relief. They worked in all telescopes that I tried (some Newtonians did not focus older eyepieces without using an extender) and exhibited no deal-breaking quirks.

That said, there were distinct differences between some of these eyepieces, and I ended up preferring some of them in certain combinations and on specific objects. Another factor that influenced my preferences was the task that I was concerned with at the time. For example, if I was just cruising the Milky Way and not looking for anything in particular, I found myself distracted by poor edge performance, as I was on the lookout for anything that was non-stellar. Fuzzy stars at the edge of the field of view would have me peering all over the place, like a one-eyed cat in a fish market. However, when I went to look at a known or specific target, the edge performance was no longer of great concern and I was then more interested in how well the eyepiece framed the target and how contrasty was the view. There were also issues dealing with the ergonomics of each eyepiece, as many low-powered eyepieces had too much eye-relief and made critical viewing tedious. In the end, I could see why someone would want to have more than one of these eyepieces at their disposal despite the seeming redundancy. As a result, this review lends support to the argument for keeping a larger-than-you-might-expect collection of optical gear.

TMB Paragon 40-mm

The newest and largest of the eyepieces tested, the Paragon was almost the heaviest at about 500 g. It had modern multi-coatings and a complete all-black appearance — even the inserted barrel section was a nice anodized black colour. It had very agreeable eye relief that was not too short and not too

long. My eye was well-located with the large rubber eye-guard flipped up for non-eyeglass wearers; the eyepiece was about perfect for eyeglass wearers with the guard flipped down. It was perhaps the most comfortable eyepiece of the bunch with little to no blackouts; it was very forgiving of eye positioning and the field stop was sharp. The apparent field of view (AFOV) is listed as 69 degrees.

Orion Superwide 42-mm

This was the heaviest eyepiece in the test at 530 g, and it was the second-largest. It too had full multi-coatings but had a brighter reflection than the TMB Paragon. It had about the same eye relief as the Paragon, but its shorter rubber eye-guard allowed eyeglass wearers to get a good view even with the guard flipped up — a good feature, as the guard is very stiff and has trouble remaining rolled down to get a tighter view. For non-eyeglass wearers, the guard was a bit too short for proper positioning, but still worked well enough. Therefore, no flipping of the guard was required for many eyeglass wearers. Curiously, the Superwide is listed as having a 65-degree AFOV, but, in a direct comparison, it was wider than the TMB. It is sufficient to say that both gave a pleasing non-cramped image.

GSO SuperView 42-mm

This eyepiece was representative of a new generation of economical wide-field eyepieces on the market today. It had eye relief that was similar to the two above but, being a 5-element lens, its AFOV was noticeably smaller than the two wide-fields above, despite having a published AFOV of 65 degrees — the same as the Orion. The edge of the field is also annoyingly blurred — a pet peeve of mine — and requires some hunting around to view the field when the eye-guard is up. The green multi-coatings revealed a reflection that is the brightest in this group. At 331 g, it was the second lightest eyepiece in the bunch, and it had a price that made this eyepiece perhaps the best-for-the-buck of the decade.

Celestron Ultima 45-mm

This eyepiece represented higher-end optical effort from the past. It has been out of production for many years and is quite rare from my experience. Nevertheless, it did show what was available a decade or so ago, and provided an interesting point of view from which to view the modern glasses. It had slightly more eye relief than those listed above and hence required somewhat careful positioning of the eye, but nothing annoying or distracting. It did not have a rubber eye-guard, which would have come in handy for eye positioning. Its AFOV was smaller than even the GSO, but it had the merit of having a sharply focused field stop and a comfortable view of the entire FOV. Second smallest in size, it weighed in at 358 g.



Figure 2 — No squinting here: All of these 2-inch format eyepieces have large eye lenses and multi-coated optics.

University Optics Plossl 45-mm

This venerable eyepiece was quite common in its day and was the oldest in this group. It had the most eye relief of the group — too much actually, and, like so many long focal eyepieces of its day, it required careful placement of the eye to take in the entire FOV; the tendency was to get too close to the eye lens, which caused a severe tunnel-like vignetting. It has the smallest AFOV at about 50 degrees. Although it had no rubber eye-guard, it still was new enough to have multi-coated optics on most elements. It is the smallest and lightest of the group at 247 g — less than half the weight of the heaviest.

Test Results

At first thought, all of these eyepieces did the job. At such low powers, the views were mostly of sharp stars on-axis with each eyepiece eventually yielding up some distortion towards the very edge — some more so than others. The older the eyepiece, the more eye positioning became an issue. The new ones were near-perfect. The older designs did not go after extra AFOV at the expense of edge sharpness, and, for the most part, gave the best performance at the edge of whatever field of view they could provide. If you would rather have sharp stars in a crisp field, then the older designs are probably more to your liking. The GSO Superview was uncanny in its ability to get good edge performance even in $f/6$ scopes. If what you wanted was that immersive view and the open vistas of a wide AFOV, then the TMB and Orion are for you. Faster focal-ratio telescopes liked the newer designs, but oddly enough, no one eyepiece really suffered more than the others as focal ratio changed.

The discoveries made during the test were hardly unequivocal. So much of the perceived performance of each eyepiece depended on the aesthetics of the view, which was influenced by such serendipitous variables as framing (which varied from target to target) and slight differences in magnification. For example, if one were only concerned with the largest true FOV with sharp stars, the lowly old Plossl was the most qualified. In fact, I also tried an old University Optics 55-mm Plossl with a small AFOV that yielded wonderful results when used with scopes slower than $f/6$. The view was small and

much detail was lost at lowest power, and the eye positioning would have taxed a mime, but if you wanted the largest true field of view full of sharp stars, this was the choice. So take this little tangent story as a caveat that you should try many eyepieces to find out what you really want from your wide-fields.

At certain tasks, a subgroup of the eyepieces proved to be the most suitable. In particular, the more inclusive wide apparent view of the TMB and the Orion set them apart from the bunch. I found the TMB to be slightly sharper on axis and to show less astigmatism toward the edge. It always felt just right and required no compromises from the viewer. The Orion was very close, but it had more edge distortion and was just the slightest bit less sharp on axis. It did however, reach just as deep for fainter stars, which suggested that it has somewhat better light transmission. Nebulae, such as M42, had slightly more contrast in the Orion.

The smaller AFOV eyepieces have their merits as well, and depending on the target and the desires of the observer, they could prove to be as satisfying, and sometimes even more so, than the newer more-expensive glass. Open clusters look best when properly framed, and any one of the cheaper or older wide-fields could deliver that satisfying combination of framing and magnification. However, among these alternate view eyepieces, the Celestron Ultima accomplished this most often. It is a fine representative of what a good eyepiece can be, even though it is long out of production and short on AFOV. It delivered a sharp image that held almost right to

the very edge, and it did so in a comfortable manner. The GSO also showed promise, with very good edge control. In a test of observing in which I followed the Moon in the Pleiades, the GSO showed flare control as good as any, and better than that of the Ultima. However, tricky eye placement left it slightly less satisfying than the Ultima.

On the subject of old versus new, the venerable University Optics 45-mm Plossl yielded views that were comparable to the new bargain 42-mm GSO and some of the other stalwarts. However, even a used UO Plossl will have trouble coming in cheaper than the GSO, which was as affordable as it was capable. So, budget shoppers have more options than ever before, particularly if they include wide-fields from times past. There were also many Erfles from that era that deserve a look — especially if edge performance isn't an issue for the target at hand. So I'd want two of these for my style of low-powered observing, and I'd like the TMB and the Ultima (if I could find one), but I wouldn't feel that I was missing out if I had to settle for the Orion and either the GSO or the UO Plossl. ●

Acknowledgment: I would like to acknowledge the gracious loan of one the eyepieces in this test by the late James McLeod. Jim was an inspiration to all of us scope junkies, and a true comrade in looking for that magical combination of glass. I hope to someday carry out some of the tests that he and I talked about. I will miss him.

Gizmos

Springwater Observatory - The Pier



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

Springwater Observatory was built at the north end of the small meadow at our home on Salt Spring Island. It is a place that we treasure, and to spare it from excavators and concrete trucks, we built the observatory in as low-impact a way as possible. For example, the floor is not concrete, but wood framing resting on pressure-treated posts dug into the ground, each post set in only a wheelbarrow-full of concrete, like a fence post.

The most substantial and permanent component is the pier. This consists of a six-foot length of 10-inch square steel tubing set in a concrete base about 3 feet square and

10 inches thick.

The hole for the pier was dug square and clean to undisturbed ground below the frost line. This is only two feet below the surface here, but is much deeper in most other parts of the country. It was necessary to get below the frost line because an observatory is not heated, and, if frost forms beneath the footing, it could lift and ruin the alignment of the mount it supports. The concrete was reinforced with four two-foot pieces of 1/2-inch rebar tied with wire to form a tick-tack-toe grid. Four additional pieces were bent into L shapes and tied in so that the vertical legs come up in the centre. This

arrangement was set into the bottom of the hole and supported about three inches up on rocks or bricks. The steel tube was lowered overtop until it rested on the rebar and was braced plumb. We used C-clamps to secure the 2x4 braces to the top edge of the tube.



Figure 1 — This image shows the arrangement of the rebar. The tube has been raised and made shorter for clarity.

We mixed concrete in a wheelbarrow and placed it carefully with a shovel so that nothing was displaced. We filled to a depth of about eight to ten inches outside the tube and about a foot up the inside. Finally we embedded a length of 1/2" threaded rod in the concrete in the centre of the tube. We allowed 24 hours for the concrete to set, and we backfilled what was left of the hole with the earth we dug out of it and then filled the tube with sand.

To make the top, we cut down a manhole cover (don't ask) to the correct diameter, drilled and tapped it to thread onto the 1/2" rod, and spun it down onto the top of the tube.

That's our pier. Because it's square, things like the hand box for the mount and power supplies for cameras can hang from magnetic hooks. And because it's full of sand, there is no vibration. None.

If you do this, the 10-inch tubing is overkill. 8-inch tubing would be just as good. (They hold up buildings with it!) Get the length right: ours rises to about 30" above the finished floor of the observatory.

Get the square steel tube at a local metal fabrication shop. Check around, someone may well have a crop on the rack that they would let you have at a good price. Get them to make the circular steel top as well (unless you have a manhole cover handy). It could even be welded to the tube, but you would need to leave at least a 2" hole in the centre to get the sand in. I preferred to bolt it down because that enabled me to shim it to dead level.

Email me if you decide to build this pier or even the traditional sonotube-and-concrete pier. I'll be glad to answer questions. ●

Don and Elizabeth Van Akker belong to the Victoria Centre of the RASC. Don builds things for a living. Very few of them are as much fun as this observatory.

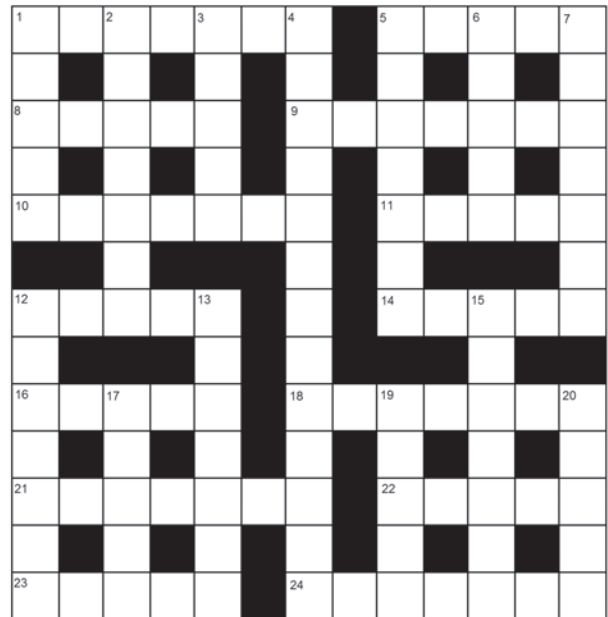
Astrocryptic

ACROSS

1. Unable to come around the eastern end of clouds (7)
5. Spore scatters developing sunspots (5)
8. Kong devours one modified Erfle (5)
9. Fred found comets while going about very softly (7)
10. Revolutionary period around the first measure of lens refraction (7)
11. Martian mountain seen right in Asia (5)
12. Taking prism glass to the emergency room, he wrote when the stars come out (5)
14. April night is for observing Leon exit the Y (5)
16. Support given to the Governor-General for a crater on the lunar limb (5)
18. Try wildly to reset a colourful nebula (7)
21. Tibetan monk hugs friend on a Canary Island (2,5)
22. He followed a fabulous bird into the Pup's lobe (5)
23. Shoemaker's head was seen around north with comet filters (5)
24. De-orbiting process to be viewed in the Pleiades centuries from now (7)

DOWN

1. Eye barely sees sodium and potassium apochromatic glass (5)
2. Traditional Nova East breakfast Bok can scramble around the beginning of night (7)
3. Flight doesn't start at this speed (5)
4. Editor has drawback with hearty transplanter and charter of dark nebulae (6,7)
5. Pray Mir collapse didn't damage your mirror (7)
6. Lunar cliff composed of unusual pure sulphur (5)
7. Sounds like a quintet but it's his black body law (7)



12. Voids blasted by supernovae in a trailer park (7)
13. Sulu returned after Reg called him Lionheart (7)
15. Lines in the eyepiece with two notes, mostly clef (7)
17. Research and development lost on Alphard, but it's still Hydra's brightest (5)
17. Help requested about turning right ascension through 223 lunations (5)
19. IYA happening at the singularity horizon (5)

Society News



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

While various people gathered in Toronto for National Council meeting NC091, some of us took the opportunity to visit our new digs at 4920 Dundas Street West. Most of the Executive hadn't been there since the Society had leased the office, and we were anxious to see how it would suit our needs. We knew that our Executive Secretary, Jo Taylor, was enthusiastic about the space and its potential to make her job flow more smoothly. One thing we noted immediately was that the conference table, formerly half-hidden in the basement at 136 Dupont, was out front and centre — it makes an excellent place to gather for

impromptu meetings, a work area to lay out large projects, and it has instantly become a focal point to the “outer office.” The actual floor area is smaller than we had in the former office, but that isn't a hindrance. What we have is more economical in space, yet is more productively laid out, and has great potential!

As I write this, “100 Hours of Astronomy” is well underway — participation has been great! This is a tremendous way to spread the word worldwide. In addition, it adds impetus to the IYA2009 theme. Make sure you get out and celebrate! ●



2009 is the International Year of Astronomy.

Tell your friends and the world about how we do astronomy here.

The Royal Astronomical Society of Canada is sponsoring a competitive writing contest, *Canada and the Stars*, so that you can tell the story of Canada's record of achievement in astronomy and space science to other Canadians, and the world. Winners will receive cash prizes of up to \$500 and the opportunity for publication. Any subject with significant Canadian astronomical involvement, from pre-contact (*ca.* 1497) to the present, is suitable for entry. Your article can be on a research project, a discovery, a theory, a technique, an instrument, an observatory, amateur or professional astronomers, or an expression of astronomy in the wider culture, such as in art, thought, social structures and interactions, or any combination of these. Canadian citizens, landed immigrants, or anyone resident in Canada during the window of submission (deadline 2009 August 1) is eligible (the requirement of Canadian nationality/residency is waived for RASC members).

For more information, guidelines, and rules visit: <http://www.rasc.ca/education/iya/csc.shtml>



DISCOVER SASKATCHEWAN'S LIVING SKIES!

Enjoy the magic of Cypress Hills Interprovincial Park (CHIPP) and Dark-Sky Preserve in August 2009 and do something never done before at an RASC General Assembly: be armchair astronomers during the day and real astronomers at night! We are delighted that the 2009 RASC GA has been awarded to the Saskatoon Centre of the RASC. The GA will be held in conjunction with the Saskatchewan Summer Star Party (SSSP). 2009 is also the International Year of Astronomy when a GA will be held, for the first time, at a dark-sky site. It is our goal to provide an affordable, memorable GA where participants can observe under some of the darkest skies in Canada and still enjoy the traditional social & business activities of a GA.

Featured Events

- **Special Pre-GA/SSSP Tour of the Canadian Light Source (Synchrotron)** - For attendees who can arrive in Saskatoon on Tuesday, August 11, we have arranged a special evening tour of Canada's premier scientific facility.
- **BBQ** - A traditional SSSP event held Thursday evening before the Ruth Northcott Lecture
- **Ruth Northcott Lecture** - Presented by Alan Dyer. Alan is a planetarium show producer, co-author with Terence Dickinson of *The Backyard Astronomer's Guide*, and a contributing editor to *SkyNews* and *Sky & Telescope*.
- **RASC National Awards and Friday Supper Social** - Awards ceremony followed by a reception and informal meal featuring a menu of beef brochettes, free-range chicken skewers, canapés, and refreshments.
- **Fr. Lucien Kemble Lecture** - Presented by Dr. Carolyn Shoemaker, best known for her comet discoveries and her extensive studies of asteroid impact sites all over the world.
- **Saturday Banquet** - Our banquet features Saskatchewan delicacies: Lake Diefenbaker Steel Head Trout, Saskatoon Berry Stuffed Pork Loin, Saskatchewan Wild Rice Pilaf, and wine from the Maple Creek Winery.
- **Tour of Fort Walsh and the Maple Creek Winery** - On Sunday afternoon, join us for a tour of Fort Walsh and the Maple Creek Winery, finishing with supper at the Star Café in Maple Creek.



GA/SSSP 2009 Tentative Schedule of Events

Thursday, August 13:

- National Council Meeting
- Sod Turning for Dark-Sky Campground and Observatory
- BBQ
- Song Contest and Sing-along
- Ruth Northcott Lecture
- Observing

Friday, August 14:

- Paper Sessions
- Solar Observing
- First Nations Storytelling in the Park
- RASC Awards Presentations
- Supper Social
- Park Public Presentations - Astro Interpretive Program
- Observing Clinic 1
- Observing

Saturday, August 15:

- Swap Meet
- Light-Pollution Panel/Workshop
- Fr. Lucien Kemble Lecture
- Invitation to GA 2010
- SSSP Awards and Door Prizes
- Group Photo
- Banquet
- Walk-about Social in the Meadows
- Observing Clinic 2
- Observing

Sunday, August 16:

- Annual General Meeting
- National Council Meeting
- Tour of Fort Walsh and Maple Creek Winery
- Potluck Supper for those not on the Tour
- Observing

Registration

Registration is now open! Early registration is \$40/person or \$60/couple or family. Early registration ends July 3. Visit our Web site for more information and to download the printable registration form. Mail-in payments by cheque only; payments by credit card will not be accepted.

Transportation

CHIPP is located in the southwestern corner of Saskatchewan, 30 km south of Maple Creek on Hwy 21. We strongly suggest that fly-in delegates who will be attending the National Council Meeting on Thursday, August 13, fly into Saskatoon on Tuesday so that we can transport you to the Park on Wednesday, August 12. We will arrange transportation back to Saskatoon for Monday August 17.

Accommodations

The Cypress Hills Resort Inn, (306) 662-4477, is full. We are maintaining a waiting list for Resort accommodations. We will also try to connect people without accommodations with those who may wish to share their condos, cabins, or hotel rooms. Contact our registrars to ask about our waiting list and shared accommodations. Alternate accommodations in Maple Creek may be available. Visit our Web site for contact information. The entire Meadows Campground has been reserved for us from Thursday through Sunday for those who wish to camp at the observing site. All sites in the Meadows, powered and non-powered, are rush: first come, first served. When you arrive at the Park, register at the camping office, show proof of registration with the GA/SSSP and tell the staff that you want to camp in the Meadows Campground. You will have to pay the appropriate camping fees. Additional information is available at www.tpcs.gov.sk.ca/CypressHills.

Call for Papers

We will have two sessions of scientific talks and a poster session where delegates can share their astronomical experiences, data, and insights. To participate, please submit a proposal by email to Gord Sarty, and in that proposal please include:

- Author list - with the speaker as first author
- Title
- Preference for a talk or poster
- One paragraph abstract, limit 150 words
- One image, jpeg format (optional - large images will be reduced in size)

Except for the image, please submit all material in the body of the email, no other attachments please. Deadline for the submission of proposals is 2009 June 1. Late proposals can only be considered for posters and only if there is room. Detailed instructions will be emailed to the submitters of accepted proposals.

Astrophoto Display and Contest

The Astrophoto contest will accept film or digital photos taken by the exhibitor in the following categories: Prime Focus - Solar System; Prime Focus - Deep Sky; Piggy-back; Tripod. Contact Al Hartridge for details.

Astronomical Sketch Display and Contest

This year we are holding a contest to promote a dying art: sketching astronomical objects at the eyepiece. Contact Al Hartridge for details.

“Starry, Starry Night”: Art, Quilt, and Poetry Exhibition

This astronomy-themed art exhibition is open to kids (4-12 years), youths (13-17), and adults. Art created by the exhibitor is welcome in the following categories: quilt, hand-work, poetry, drawing, painting, collage, and any photograph not in the photography contest. Contact Kathleen Houston for details.

Contact Us

- Primary email for information, registration, and art exhibition: sssp.sk@sasktel.net
- Scientific program: Gord Sarty at gordon.sarty@usask.ca
- Astrophoto and Sketching contest: Al Hartridge at ahartrid@sasktel.net
- Phone: Barb Wright (Chair) at (306) 249-1990 or Rick Huziak and Kathleen Houston (Registrars) at (306) 665-3392

The most up-to-date information about GA/SSSP 2009 will be found on our Web page at: homepage.usask.ca/~ges125/rasc/sssp2009.html. We will also be placing announcements on the RASC eNews Web page, with links to our Web page. ●



THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

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Executive Secretary	Jo Taylor, 203 - 4920 Dundas St W, Toronto ON M9A 1B7 Telephone: (416) 924-7973

CENTRE ADDRESSES/ADRESSES DES CENTRES

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

Belleville Centre

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

Calgary Centre

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

Charlottetown Centre

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

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

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PO Box 31011, Halifax NS B3K 5T9

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

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PO Box 1793, Kingston ON K7L 5J6

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

London Centre

PO Box 842 Stn B, London ON N6A 4Z3

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

Centre francophone de Montréal

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

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18455 Meloche St, Pierrefonds QC H9K 1N6

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

Niagara Centre

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Okanagan Centre

PO Box 20119 TCM, Kelowna BC V1Y 9H2

Ottawa Centre

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

Prince George Centre

7365 Tedford Rd, Prince George BC V2N 6S2

Québec Centre

2000 Boul Montmorency, Québec QC G1J 5E7

Regina Centre

PO Box 20014, Regina SK S4P 4J7

St. John's Centre

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

Sarnia Centre

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

Saskatoon Centre

PO Box 317 RPO University, Saskatoon SK S7N 4J8

Sunshine Coast Centre

PO Box 577, Sechelt BC V0N 3A0

Thunder Bay Centre

286 Trinity Cres, Thunder Bay ON P7C 5V6

Toronto Centre

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

Vancouver Centre

1100 Chestnut St, Vancouver BC V6J 3J9

Victoria Centre

3046 Jackson St, Victoria BC V8T 3Z8

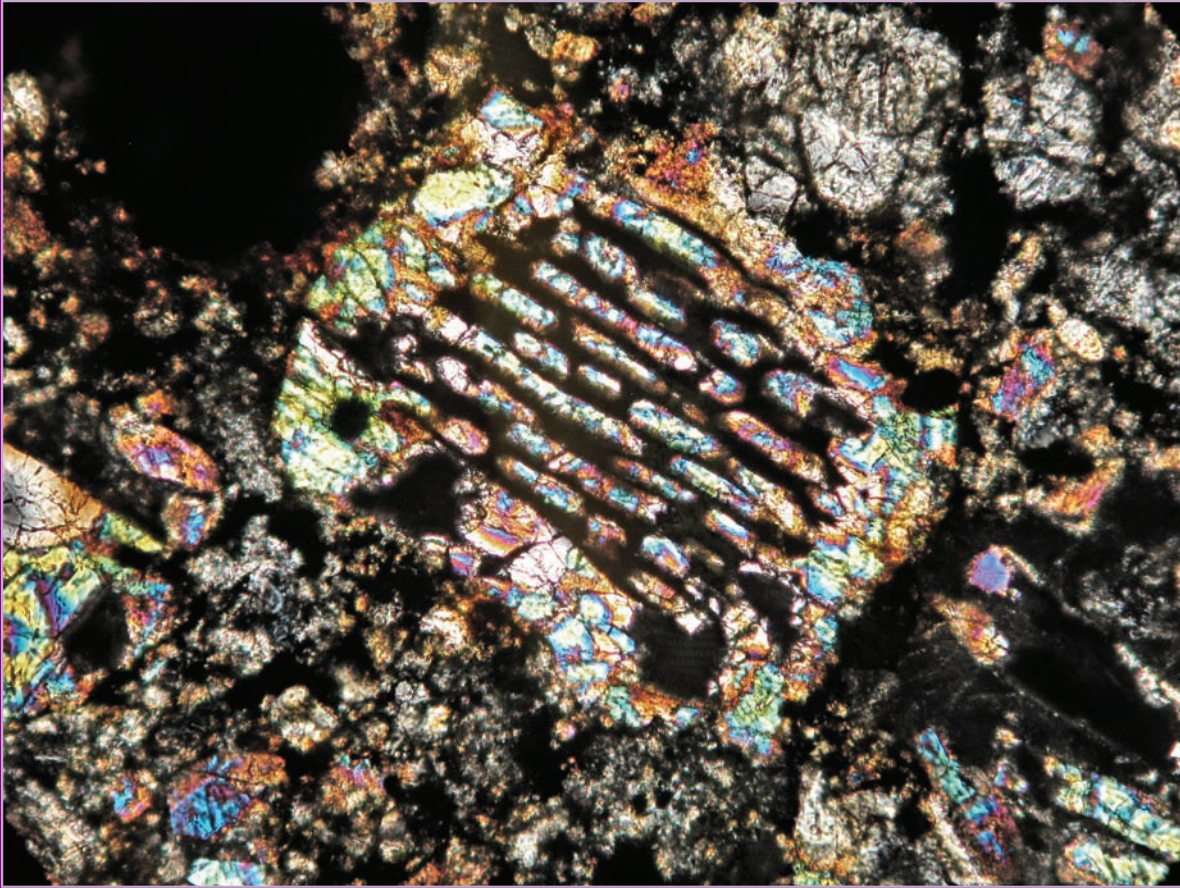
Windsor Centre

2831 Alexandra Ave, Windsor ON N9E 2J8

Winnipeg Centre

PO Box 2694, Winnipeg MB R3C 4B3

Great Images



Under the microscope and in cross-polarized light, a thin slice of a Buzzard Coulee meteorite specimen reveals spectacular structural detail. One of the larger features at ~250 microns (1/4 mm) is a chondrule of barred olivine. Copyright Department of Earth and Atmospheric Sciences, University of Alberta. Used with permission.