

The Journal of The Royal Astronomical Society of Canada

# Journal

Le Journal de la Société royale d'astronomie du Canada

PROMOTING  
ASTRONOMY  
IN CANADA

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**Inside this issue:**

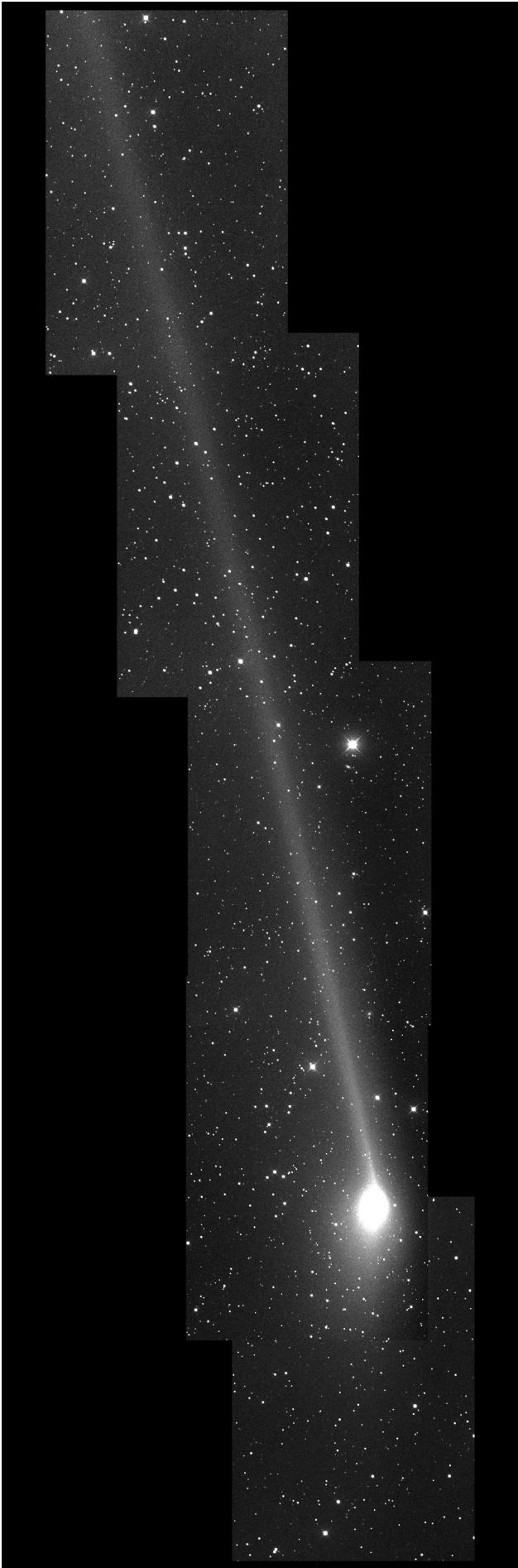
Planetary Science  
Congress

Oz Odyssey

Light-Pollution Mapping  
Device

Eclipse Crossword  
Answers

*Spiral Dance of the Antennae*



## Astrophotographers take note!

This space is reserved for your B&W or greyscale images. Give us your best shots!

*Paul Mortfield found Comet PanSTARRS too large to fit on one ½-degree frame, so he put together this superb mosaic to show as much as he could. The images were taken with an RCOS 16-inch f/8.9 telescope on 2013 June 2 from his Sierra Remote Observatory. The comet was notable for its prominent anti-tail, a part of which can be seen in the lower part of the image, spreading downward from the nucleus, although at this date, the best viewing angles had passed.*



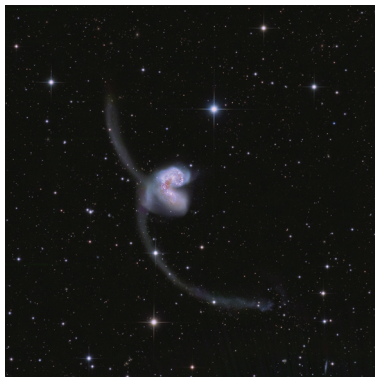
## contents / table des matières

### Feature Articles / Articles de fond

- 147 **Madrid Planetary Science Congress Brings European Experts Together**  
*By Andrew Oakes*
- 150 **Oz Odyssey**  
*by Jay Anderson*
- 157 **A Light-Pollution Mapping Device**  
*by Sean Dzafovic*
- 158 **Solar Eclipse Crossword Answers**  
*by Naomi Pasachoff*

### Columns / Rubriques

- 159 **Great Images: Comet Lemmon Struts Its Stuff**  
*Images by Paul Mortfield*
- 162 **Astronomical Art and Artifact: The Society's "Royal" Charter**  
*by R.A. Rosenfeld*
- 165 **Cosmic Contemplations: Planetary Imaging with DSLRs.**  
*by Jim Chung*
- 167 **Through My Eyepiece: Questions and Answers**  
*by Geoff Gaherty*
- 169 **Cheap Stuff From China: Putting a Raspberry Pi on your Telescope**  
*by Rick Saunders*
- 173 **Second Light: Planet Formation inside Dense Clusters of Stars**  
*by Leslie J. Sage*



### Departments / Départements

- 142 **News Notes/En manchettes**  
*compiled by Andrew Oakes*
- *Herschel ceases work; observatory parked in safe orbit around the Sun*
  - *First global topographic map of Titan developed*
  - *International Year of Water values increased cooperation of water sustainability*
  - *Obama: U.S.A. should aim R&D investments at former space-race levels*
  - *Hamilton Centre's Astronomy Trade Show attracts enthusiasts*
  - *Kepler's mission at an end?*
  - *The Ring Nebula as you've never seen it*
- 160 **Pen & Pixel**
- Annular Eclipse at Sunrise / Annular Eclipse at Sunrise / Milky Way "E" / Comet PanSTARRS**  
*by Madi Hall / Lach Hall / Jay Anderson / Lynn Hilborn*
- 174 **Reviews / Critiques**  
*The International Atlas of Mars Exploration: The First Five Decades*
- 175 **Award Nominations**
- 178 **Great Images: Chris Hadfield**
- 179 **Letters to the Editor**
- 180 **Society News**  
*by James Edgar*
- 180 **Astrocryptic Answers**  
*by Curt Nason*
- 180 **It's Not All Sirius—Cartoon**  
*by Ted Dunphy*

**Front cover** — *The Antennae Galaxies are a tempting target for amateur astronomers ever since Hubble brought them to life 20 years ago. Their small size on the sky demands a large telescope and long exposures. This superb image was acquired by Eric Benson using a 3420-mm Planewave CDK20 telescope and an Apogee U16M camera from South Australia in March last year. The exposure is made up of 6 hours in L, 5 in R, 3.5 in G, and 4 hours in B. The galaxies lie in the constellation Corvus at a distance of 45 million light-years.*

# Journal

The *Journal* is a bi-monthly publication of The Royal Astronomical Society of Canada and is devoted to the advancement of astronomy and allied sciences.

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

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## News Notes / En manchettes

Compiled by Andrew I. Oakes

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### Herschel ceases work; observatory parked in safe orbit around the Sun

The European Space Agency's (ESA) *Herschel* space observatory ceased its pioneering observations of the Universe on 2013 April 29 when its supply of liquid helium coolant finally evaporated. In May, *Herschel* was propelled into a long-term stable parking orbit around the Sun, remaining safe from Earth impact for several hundreds of years.

The coolant supply of over 2300 litres of liquid helium was exhausted according to plan, concluding over three years of observations. The helium cooled the observatory's instruments to close to absolute zero, allowing *Herschel* to make highly sensitive infrared observations of the cold Universe.

The confirmation that the helium is finally exhausted came at the beginning of a daily communication session with its ground station in Western Australia, when a clear rise in temperatures was measured in all of *Herschel's* instruments. According to the ESA, the *Herschel Space Observatory* exceeded all expectations, providing scientists with a treasure trove of data that will keep astronomers busy for many years to come.

## The Royal Astronomical Society of Canada

### Vision

To inspire curiosity in all people about the Universe, to share scientific knowledge, and to foster collaboration in astronomical pursuits.

### Mission

The Royal Astronomical Society of Canada (RASC) encourages improved understanding of astronomy for all people, through education, outreach, research, publication, enjoyment, partnership, and community.

### Values

The RASC has a proud heritage of excellence and integrity in its programs and partnerships. As a vital part of Canada's science community, we support discovery through the scientific method. We inspire and encourage people of all ages to learn about and enjoy astronomy.



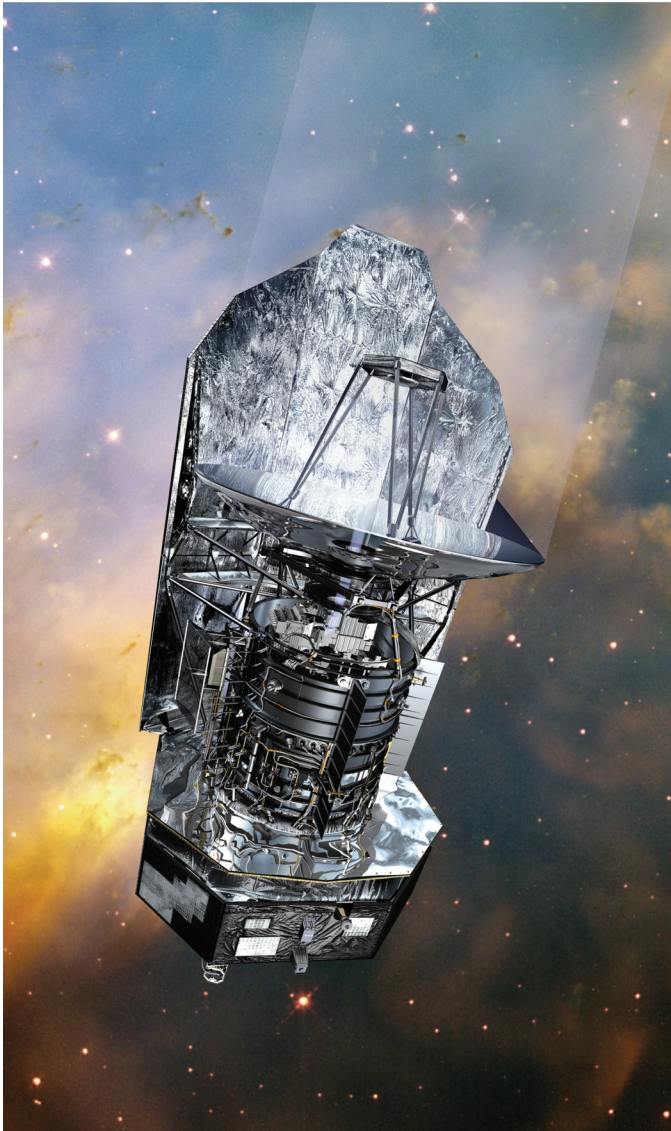


Figure 1 — The Herschel spacecraft. Source: ESA/ AOES Medialab; background: Hubble Space Telescope image (NASA/ESA/STScI)

The space-based observatory made over 35,000 scientific observations, amassing more than 25,000 hours of science data from about 600 observing programs. The rich dataset, archived at ESA's European Space Astronomy Centre, near Madrid, Spain, remains the legacy of the mission. It will be made accessible in the form of the best possible maps, spectra, and various catalogues to support the work of present and future astronomers.

European industry, institutions, and academia helped develop, build, and operate the observatory and its instruments. The mission resulted in a number of technological advancements applicable to future space missions and potential spin-off technologies. It saw the development of:

- Advanced cryogenic systems;
- Construction of the largest telescope mirror ever flown in space;

- Utilization of the most sensitive direct detectors for light in the far-infrared to millimetre range; and
- Applications to the next generation of ESA's space missions of techniques enabling the *Herschel* mission;

Launched on 2009 May 14, the *Herschel Space Observatory* featured the following four instruments, all cooled to  $-271\text{ }^{\circ}\text{C}$  inside a cryostat filled with liquid superfluid helium:

- A primary mirror, 3.5 m across, the most powerful infrared telescope ever flown in space;
- Two camera/imaging spectrometers, PACS (Photoconductor Array Camera and Spectrometer) and SPIRE (Spectral and Photometric Imaging Receiver), together covering wavelengths from 55 to 670 microns; and
- HIFI (Heterodyne Instrument for the Far Infrared), a very-high-resolution spectrometer covering two wavelength bands, 157–212 microns and 240–625 microns.

*Herschel's* chief goal was the study of star formation throughout the cosmos, surveying thousands of galaxies across a wide span of the Universe's history. According to astronomers, the data, using observations at shorter or longer wavelengths, revealed that galaxies in the first few billion years of cosmic history contributed many more stars than had been previously estimated.

The *Herschel* research program studied the chemical composition of cosmic objects through high-resolution spectroscopy and searched for water in a variety of environments. It found that a cold pre-stellar core in the vast Taurus molecular cloud hosts a reservoir of water ice amounting to a few million times the amount of water stored in Earth's oceans. As well, the massive proto-planetary disc surrounding nearby star TW Hydrae contains a water-vapour supply equivalent to several thousand times Earth's oceans.

This means that there is plenty of water available to enrich the surface of future planets, should they form in similar discs around their stars.

*Herschel* strengthened the case that comets also could have brought water to an early Earth—asteroids had been considered to be the primary source—after its instruments detected water in comet 103P/Hartley 2 with the same isotopic composition as Earth's oceans. The role of comets still remains uncertain, as later *Herschel* observations of comet C/2009 P1 Garrard found a different isotopic composition.

Astronomers suggest that the contribution of water by comets may have far-reaching implications. Besides enriching Earth with water, comets might also be responsible for the delivery of other species, such as the carbon- and nitrogen-based compounds important to the emergence of life on Earth.

## First global topographic map of Titan developed

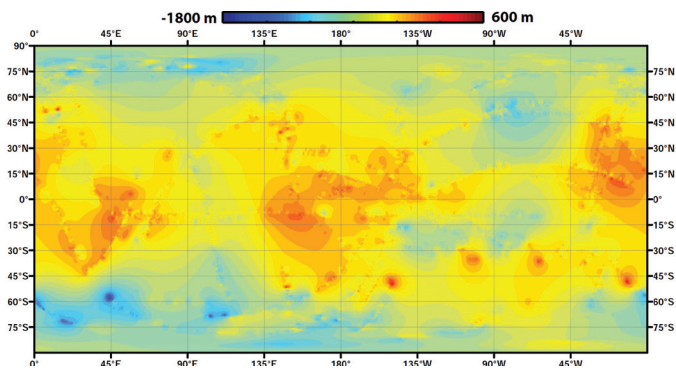


Figure 2 — Using data from the Cassini spacecraft, JPL scientists have constructed this global topographic map of Saturn's moon Titan. Image credit: NASA/JPL-Caltech/ASI/JHUAPL/Cornell/Weizmann

Researchers now have a valuable tool for learning more about one of the most Earth-like and interesting worlds in the Solar System. Scientists have published the first global topographic map of Saturn's moon Titan in *Icarus*, a journal dedicated to the field of planetary science.

As Saturn's largest moon, Titan has a radius of about 2574 kilometres. It's bigger than Mercury and is the second-largest moon in the Solar System. Titan is also the only moon in the Solar System known to have clouds, surface liquids, and a mysterious, thick atmosphere. Under a cold, mostly nitrogen, atmosphere, the organic compound methane acts on Titan the way water vapour does on Earth, forming clouds and falling as rain and carving the surface with rivers.

Methane-derived organic chemicals are found in Titan's atmosphere, lakes, and rivers. These may someday offer clues about the origins of life.

The *Cassini* spacecraft's radar team was involved in the 3-D map design, interpreting data from NASA's Saturn-orbiting spacecraft. To compile the map, the radar team used data acquired up to 2012 but is considering revising the map when the *Cassini* mission ends in 2017, when more data have accumulated, filling in some of the gaps in present coverage. The team used a mathematical process called splining—effectively, using smooth, curved surfaces to “join” the areas between grids of existing data.

The *Cassini-Huygens* mission is a cooperative project of NASA, the European Space Agency and ASI, the Italian Space Agency. The Jet Propulsion Laboratory (JPL), a division of the California Institute of Technology in Pasadena, manages the mission for NASA's Science Mission Directorate, Washington. The radar instrument was built by JPL and the Italian Space Agency, working with team members from the United States and several European countries.

## Obama: U.S.A. should aim R&D investments at former space-race levels

To honour the 150th anniversary of the National Academy of Sciences (NAS), American President Barack Obama addressed the organization on 2013 April 29. The president reflected on Abraham Lincoln's founding of the NAS, asserting the importance of setting priorities for research and continuing the United States of America's scientific advance, and maintaining its cutting edge with a fidelity to facts, truth, and evidence.

President Obama emphasized that investments made today in science, technology, engineering, and medicine are all critical to the nation's prosperity and are bound to pay off for many years to come. His remarks on the current declining situation in America appear verbatim below in order to illustrate precisely his vision for knowledge generation and the value of cutting-edge research by a leading nation-state.

*Today, all around the country, scientists like you [in the NAS] are developing therapies to regenerate damaged organs, creating new devices to enable brain-controlled prosthetic limbs, and sending sophisticated robots into space to search for signs of past life on Mars. That sense of wonder and that sense of discovery, it has practical application but it also nurtures what I believe is best in us.*

*And right now, we're on the brink of amazing breakthroughs that have the chance, the potential to change life for the better—which is why we can't afford to gut these investments in science and technology. Unfortunately, that's what we're facing right now. Because of the across-the-board cuts that Congress put in place—the sequester, as it's known in Washington—speak—it's hitting our scientific research. Instead of racing ahead on the next cutting-edge discovery, our scientists are left wondering if they'll get to start any new projects, any new research projects at all over the next few years, which means that we could lose a year, two years of scientific research as a practical matter because of misguided priorities here in this town.*

*With the pace of technological innovation today, we can't afford to stand still for a year or two years or three years. We've got to seize every opportunity we have to stay ahead. And we can't let other countries win the race for ideas and technology of the future. And I say that, by the way, not out of just any nationalistic pride—although, obviously, that's part of it—but it's also because nobody does it better than we do when it's adequately funded, when it's adequately supported. And what we produce here ends up having benefits worldwide. We should be reaching for a level of private and public research and development investment that we haven't seen since the height of the Space Race. That's my goal.*



*And it's not just resources. I mean, one of the things that I've tried to do over these last four years and will continue to do over the next four years is to make sure that we are promoting the integrity of our scientific process; that not just in the physical and life sciences, but also in fields like psychology and anthropology and economics and political science—all of which are sciences because scholars develop and test hypotheses and subject them to peer review—but in all the sciences, we've got to make sure that we are supporting the idea that they're not subject to politics, that they're not skewed by an agenda, that, as I said before, we make sure that we go where the evidence leads us. And that's why we've got to keep investing in these sciences.*

*And what's true of all sciences is that in order for us to maintain our edge, we've got to protect our rigorous peer review system and ensure that we only fund proposals that promise the biggest bang for taxpayer dollars. And I will keep working to make sure that our scientific research does not fall victim to political manoeuvres or agendas that in some ways would impact on the integrity of the scientific process. That's what's going to maintain our standards of scientific excellence for years to come.*

## Hamilton Centre's Astronomy Telescope Show attracts enthusiasts

The Hamilton Centre of The Royal Astronomical Society of Canada (RASC) held its first Canadian astronomy trade show, featuring vendors from across Canada and the United States.

Seminar presentations were offered over a two-day period on different aspects of the hobby, and two keynote speakers addressed participants.

Terence Dickinson, a leading Canadian amateur astronomer



Figure 3 — The RASC booth at Hamilton Centre's Astronomy Telescope Show.



Figure 4 — The SkyShed booth attracted plenty of attention at the ATS.

and science writer, gave the keynote address on Saturday, May 25, titled “21st Century Trends in Backyard Astronomy.”

Dickinson is the editor of *SkyNews* magazine and an astronomy commentator for Discovery Channel Canada. He has written 15 books that are widely regarded as some of the best resources available for beginners in astronomy.

Jim Fitzgerald, a retired NASA Educator, spoke on “20 Years of NASA Education...What a Ride!” on Sunday, May 26. In 1990, a unique opportunity took Fitzgerald out of the classroom and into the world of NASA, where he became part of the NASA Aerospace Education Services Project.

Andrew Blanchard, RASC Hamilton Centre President, noted in an earlier communication “I sure hope everyone understands that this is a RASC show, and we all benefit, either by having a Canadian show of our own, or through the outreach programs that we hope to achieve through the show.”

According to organizers, *AstroCATS* was a “smashing success” with hundreds of people participating, the seminar rooms overflowing, and over \$15,000 in door prizes awarded.

*AstroCATS* was situated at Sheridan Community College in Oakville, Ontario. It provided an alternative for attendees who would otherwise need to travel to New York or Chicago, California or Arizona, to get their exposure to the latest astronomy instruments.

Plans have already started for next year's event—*AstroCATS* 2014.

## Kepler's mission at an end?

The planet-hunting *Kepler* telescope, stationed 64 million kilometres from Earth, has lost the ability to point precisely toward stars, and NASA scientists fear that the spacecraft's search for planets around other stars is over. Space-agency officials made the announcement on May 15, a day after engineers noticed that one of the reaction wheels, devices that keep the telescope precisely pointed to its targets, was giving trouble.

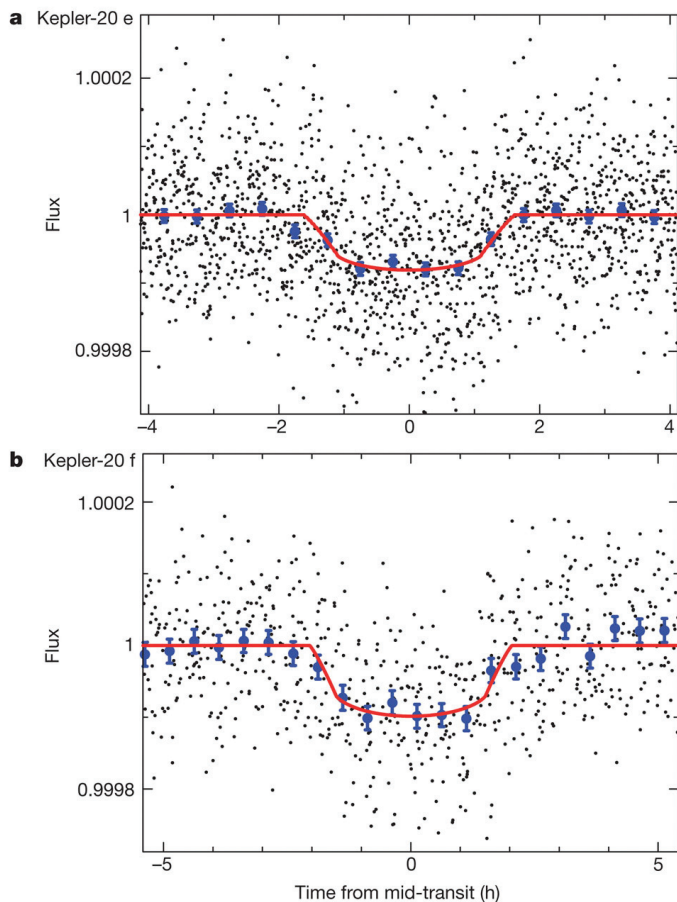


Figure 5 — The light curve of two Earth-sized planets orbiting Kepler-20. Image: F. Fressin et al., *Nature*, Dec. 2011.

Ground controllers communicate with *Kepler* twice a week, and engineers established radio contact with the observatory as scheduled on May 14, only to find the spacecraft had placed itself in safe mode on the 12th, when its on-board computer detected that the craft was drifting from where it was supposed to be pointing. *Kepler* will be unable to discern the scant signatures from small rocky planets like Earth unless engineers can restore the telescope’s pointing ability. An attempt will be made in mid-July.

Engineers say the evidence from telemetry suggests an internal failure in the reaction wheel. The spacecraft has been placed in a “Point Rest State” to conserve fuel, while a response team manages recovery attempts. In the meantime, on June 7, the *Kepler* team placed 1913 new “Objects of Interest” (interesting objects that deserve further investigation) in the exoplanet archive, bringing the total count of confirmed and suspected planets to 3216.

## The Ring Nebula as you’ve never seen it

New observations of the Ring Nebula by the *Hubble Space Telescope* have revealed a new level of detail in the glowing gas shroud that surrounds the central star. The nebula is “filled with material in the middle,” noted C. Robert O’Dell of

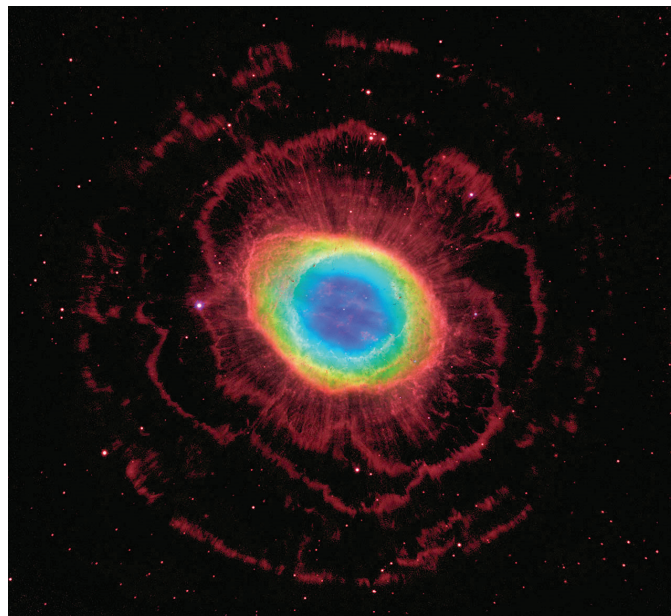


Figure 6 — Hubble’s new view of the Ring Nebula in Lyra.

Vanderbilt University in Nashville, Tennessee. His research team used data from *Hubble*, the Large Binocular Telescope in Arizona, and San Pedro Martir Observatory in Baja California, Mexico. The images have allowed them to construct a more precise 3-D model of the nebula.

Previous observations and even amateur telescopes had revealed the gaseous material in the ring’s central region, but the new view by *Hubble*’s Wide Field Camera 3 suggests that the ring wraps around a blue, football-shaped structure. Each end of the structure protrudes out of opposite sides of the ring. In the *Hubble* image, the blue structure is the glow of helium, which is excited by radiation from the central white-dwarf star. O’Dell’s team was surprised at the detailed views of the dark, irregular knots of dense gas embedded along the inner rim of the ring. These gaseous tentacles formed when expanding hot gas pushed into cool gas ejected previously by the doomed star. The knots are more resistant to erosion by the flood of ultraviolet light unleashed by the star.

All of this gas was expelled by the central star about 4000 years ago from an original star that was several times more massive than our Sun. After billions of years converting hydrogen to helium in its core, the star began to run out of fuel. It then ballooned in size, becoming a red giant. At this stage, the star shed its outer gaseous layers and began to collapse as fusion reactions died out.

The outer petal-like rings were formed when faster-moving gas slammed into slower-moving material. The nebula will continue to expand for another 10,000 years, becoming fainter and fainter as it merges with the interstellar medium. ★

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



# Madrid Planetary Science Congress Brings European Experts Together

by Andrew Oakes  
(copernicus1543@gmail.com)

More than 700 of the world's leading planetary scientists from 34 countries met in Madrid, Spain, at the seventh annual European Planetary Science Congress (EPSC) 2012.

Held in September 2012, the six-day event witnessed presentations on the latest research about planets, moons, comets, and Solar System asteroids, exoplanets orbiting other stars, astrobiology, and astrochemistry. Participants also heard updates on current and planned space missions.

The EPSC 2012 Congress was organized by Europlanet, a research infrastructure for planetary science funded by the European Commission's Framework 7 Program in association with the European Geosciences Union and support of the Centro de Astrobiología of Spain's Instituto Nacional de Técnica Aeroespacial (CAB-INTA).

Anita Heward, an outreach and press liaison officer with EPSC and Europlanet, was asked a series of questions about the 2012 Congress and Europlanet's work by *Journal* contributing editor Andrew Oakes, who attended the Congress as a media representative.

*Q. What has been Europlanet's main objective in organizing these annual congresses?*

A. The main aim of the Europlanet project has been to overcome the fragmentation of the planetary science community that is spread across Europe. One of its major successes has been to establish a major annual meeting. The number of participants and abstracts has been steadily rising since the first European Planetary Science Congress (EPSC) was held in Berlin in 2006, and EPSC has grown into a strong, self-supporting, thriving meeting. The 2011 Joint meeting with the Division of Planetary Sciences (DPS) of the American Astronomical Society was a hugely successful meeting, attracting more than 1500 scientists—twice the number of participants to previous EPSCs. Following on from this, there will be a second EPSC-DPS Joint meeting in 2015, which will be held in the USA. We expect EPSC 2013 in London to attract around 800 participants.

*Q. What was specifically unique about EPSC 2012?*

A. It was the first time we'd held the meeting in Spain. Each meeting takes on a flavour of the host organization. In this



Figure 1 — Welcoming billboard. The European Planetary Science Congress (EPSC) 2012 took place at the IFEMA-Feria de Madrid, Spain, from 2012 September 23 to 28.

case, the Centro de Astrobiología in Madrid (CAB) chaired the Local Organizing Committee (LOC), so there was an added emphasis on CAB's area of expertise—astrobiology and field studies in planetary analogue sites.

*Q. The scientists presenting in Madrid appeared to be quite young—in their 30s and 40s. Is the Congress geared to younger scientists?*

A. We hope that we have the perfect mix at EPSC: we have Principal Investigators (PIs) of missions and instruments presenting, *e.g.* Scott Bolton gave a keynote talk on *JUNO*, Chris Russell presented an update on Dawn, Bernard Foing spoke on the ongoing analysis of the *SMART-1* lunar data; but we also have a lot of young scientists giving their first presentation at a major conference. In the past, Europlanet has used funding from the European Commission to subsidize places for young scientists—into the future, we hope that EPSC will be able continue to show the same commitment to young scientists. Although the Framework 7 Program funding for Europlanet from the European Commission finished on 2012

December 31, the Local Organizing Committee for EPSC 2013 has raised sponsorship to support the attendance of a number of young scientists to the next meeting in London.

*Q. The number of female scientists that were on hand and presenting papers was quite impressive. Is this a trend in Europe of more women entering the astronomy/planetary science fields?*

A. Europlanet organized a dinner debate in the European Parliament...[recently] on this very topic. The picture is quite varied from country to country: historically, there are a higher percentage of women astronomers/Solar System scientists in southern European countries (Italy, France, Spain, Greece, etc.) than in northern countries (Germany, the UK, Denmark, Finland, etc.). However across the board, there are still only a small percentage of women reaching the top academic positions across Europe. According to Women in Aerospace Europe, there is an even smaller pool of women represented in the engineering and technical fields of Solar System exploration.

There is some good news: in key missions like *Rosetta* and *JUICE*, women are taking leading roles, which gives some real, high-profile role models.

It's a complicated issue and, as a community, we are initiating events like the dinner debate to discuss and address issues related to gender balance and diversity.



Figure 2 — A small contingent of scientists attends a plenary session. More than 600 leading planetary scientists participated in the European Planetary Science Congress (EPSC) 2012.

*Q. Will the 2013 Congress focus on the same priorities as 2012 and earlier ones, or is there a shift in topics / presentations anticipated in 2013?*

A. We try to have sessions that cover the complete range of planetary science, so will have the usual session streams on terrestrial planets, giant planet systems, magnetospheric, and space physics, astrobiology, outreach. For the first time, EPSC 2013 will also include an industry day. The proposed sessions should allow the science community and industry to discuss and explore technological solutions to the challenges and requirements of future missions such as the *JUICE* mission to Jupiter's icy moons.



Figure 3 — Scientists Olga Prieto (left), Felipe Gómez (centre), and Ricardo Amils (right) address a press conference on their "Results from field trips to Mars analogue sites in Antarctica and Rio Tinto" at the EPSC 2012.

## Scientific Announcements Source of Congresses

The seven Congresses held to date have generated their share of important scientific announcements by attending scientist. Below is a sampling of the top stories (in terms of coverage found through the Google News Aggregation service) for past EPSC meetings.

### EPSC-DPS Joint Meeting 2011 top stories:

1. Subtly Shaded Map of Moon Reveals Titanium Treasure Troves
2. *Dawn* at Vesta: Massive Mountains, Rough Surface, and Old-Young Dichotomy in Hemispheres
3. Enceladus Weather: Snow Flurries and Perfect Powder for Skiing

### EPSC 2010 top stories:

1. Two Days in the Life of Saturn's Aurora – The Movie
2. Martian Moon Phobos May Have Formed in Catastrophic Blast
3. Discovery of Water on Moon Clouds Plans for Lunar Astronomy

### EPSC 2009 top stories:

1. Longest Lightning Storm on Saturn Breaks Solar System Record
2. Jupiter Captured Comet for 12 Years in Mid-20th Century
3. Spot Discovered on Dwarf Planet Haumea Shows up Red and Rich with Organics and Minerals

### EPSC 2008 top stories:

1. Calculations Show Saturn's Rings May Be More Massive, Older
2. STONE-6 Artificial Meteorite Shows Martian Impactors Could Carry Traces of Life
3. Zukunft der deutsche Mondmission LEO auf der EPSC in Münsterdiskutiert



## EPSC 2007 top stories:

1. The Changing Rings of Uranus
2. Calculating the Biomass of Martian Soil
3. Could Enceladus's Icy Plumes Pose a Threat to *Cassini*

The 2012 Congress itself was the subject of two press conferences featuring Mars researchers—one on “Results from field trips to Mars analogue sites in Antarctica and Rio Tinto” and the other “Updates on *Mars Science Laboratory*, the REMS and DAN instruments.”

## Scientists, Industry and Policy Makers

Despite the many successes experienced to date, a new phase is developing within the European organization, which was discussed during a Congress luncheon session focusing on new and future directions.

Steve Miller, Europlanet Outreach Deputy Coordinator who also directs the European Science Communication network, *ESConet* (training Europe's scientists to communicate with the public), prepared the following response for the *Journal* on upcoming developments.

*Q. What is the planned new direction and what will it mean to the organization?*

**A.** The key aspect of the new direction is that Europlanet wants to open up much more to include as much of the European planetary science community as possible. So why is this?

Under the first Europlanet (Framework 6—2005–2008), it was mainly a network activity that enabled some 120 institutes to cluster around the organization. But under the more restrictive applications of Framework 7 (2009–2012), a much smaller number of contract signatories was allowed (27, and this was very large for FP7).

So we are trying to create a new organization that once more can have 100-plus institutions together.

There will also be something of a change of focus: Europlanet has been more or less exclusively for scientific institutes up till now, although we did start an orientation towards industry and policy-makers. Under *Horizon 2020*<sup>1</sup>—assuming Europlanet does get funding—we will be turning our faces much more towards industrial partnership. This is in no way to dilute the science, but it means an explicit appreciation that successful planetary science research—especially in the area of missions to planets *etc.*—requires strategic partnership with relevant industries.

This is both inward and outward. Planetary science puts demands on existing technology that stretch its capabilities to the limit. It demands new technologies: radio-thermal genera-



Figure 4 — Dr. Yaël Nazé (left), a Belgian scientist, writer, and advocate of astronomy careers for young women, receives the Prize for Public Engagement with Planetary Sciences (see the October 2012 issue of the *Journal's* News Notes section for more details), while colleague Dr. John E. Chambers of the Carnegie Institution for Science, Washington, DC, USA, is the recipient of the Paolo Farinella 2012 Prize recognizing work in planetary science and specifically studies of the formation and early evolution of the Solar System.

tors are a case in point, where exploration of planets outside of Jupiter or very-long-duration missions are involved. But this technology could also have outward applications in, say, the oil industry, where pipeline exploration makes the use of traditional energy sources difficult.

Another example might be detector technology—very cold, infrared-detector technology is vital for exploring exoplanets, but is almost certain to have medical applications. Or again, pattern recognition has recently been cited in terms of astrophysics providing software for cancer diagnosis.

The European Planetary Science Congress 2013 will take place at University College London, from 2013 September 08 to 13. ★

*Andrew Oakes is a Contributing Editor of the Journal.*

## Footnotes

- 1 *Horizon 2020* is a European Commission proposal for a framework program for research and innovation (2014–2020) within the space and European planetary science community.

# Oz Odyssey

by Jay Anderson, Winnipeg Centre  
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I use eclipses as an excuse to travel, so when an annular eclipse presented a justification to go to Australia, I counted the pesos and decided it was time for a thorough exploration of the northwest corner of the down-under. I'd been there before, but except for a week at Alice Springs to watch the transit of Venus last year, I'd not had an opportunity to explore the Outback. This was the chance for the 2013 May 10 eclipse.

Ordinarily, I'd not put a lot of effort or money into seeing an annular eclipse—"just an unusual partial eclipse," in the words of one of my eclipse-chasing acquaintances. But this eclipse was different: it could be observed at sunrise, perhaps climbing over the horizon as a distorted ring of light. Annular eclipses that begin at convenient locations on land come by only so often (the next is in 2019, in Saudi Arabia). In this case, the Moon's shadow track began in Western Australia, south of the mining town of Newman and just west of the Great Northern Highway, an easy location to reach and observe. Well, easy except for the flight to the continent.

Of course, a trip to the Land of Oz can't be done for "just an eclipse." There is far too much to see in the spectacular southern sky, so an eclipse trip had to be combined with an exploration of the countryside and some astrophotography. Fortunately, a friend in Brisbane, astrophotographer Terry Cuttle, liked the idea of a sunrise eclipse as well, so we agreed to share the cost of a 4WD camper van on an expedition that would start in Darwin and end in Perth. It wasn't hard to find a camper rental that would allow us to begin and end in different locations, and the complexities of insurance just about put the kibosh on the whole thing. But in the end, even that worked out.

Winnipeg, Denver, San Francisco, Sydney, Darwin. Thirty-two hours in the air and airports. It was mid-afternoon, over 30 degrees, and brilliantly sunny when I arrived—just what a jet-lagged traveller from a winter climate needs to reset the body's clock. First job: check out the camper; then grab a look around Darwin; and when night starts, head south for a few miles to get a good morning start on the way to Katherine.

We were meticulous about that camper. It came with dishes, bedding, cutlery, blue bikini bottoms (we found them later) and a small sampler of "needs"—coffee, tea, sugar, and a few candies. We made sure there was a jack and a spare tire, water on board, and that we could operate all of the bits and pieces, not that it was very complicated. We needed the 4WD capability, as Australian renters won't let you go more than 12 km off sealed (paved) roads in a 2WD vehicle. Even then, we had to phone in to the rental service desk to get permission to travel extended distances on gravel and dirt roads. It



Figure 1 — Home sweet home for three weeks.

was probably a good idea, as they kept track of the state of the roads and which ones were passable after wet weather.

The camper was advertised as "sleeps four" but they'd have to be very good friends, as one pair would have to climb over the other to go to the biffy at night. However, the top "bunk" was of generous proportions and able to accommodate the numerous tripods, cameras, computers, and other astrophotography paraphernalia. Not content with the usual trappings of camping, we mounted antennae for cell-phone communication and CB radio on the front bonnet (slipping into Australian slang already) by stringing wires into the cab to satisfy our anticipated communication needs (we barely used them). A third line tapped into the battery and brought power to run an inverter, since all the "cigarette" outlets were used to recharge camera batteries. Too much stuff.

The tour of Darwin culminated in a dinner of barramundi on the waterfront, and we were off, heading south toward Katherine. First hiccup: campgrounds close early, never later than 6 p.m. and sometimes as early as 4. Why? Australians generally do not drive in the Outback at night, as there are too many species that use the roadways and make a mess of a car and driver. After several fruitless tries to find a spot, we hit on a solution that served us for the rest of the trip: call the office when it's after hours and ask for a space. They will usually open up for you when you arrive, as long as it's still a sensible hour—9 p.m. in this case.

The next day, to Katherine was only a few hundred kilometres travel, so the trip was used to become familiar with driving in the Australian style. Keeping to the left side was an easy adaptation, but it's not so simple to get the habit of shifting with the left hand or using the turn signals. The sign of a tourist driving in Australia is a sudden invocation of the windshield wipers on a dry day, when the driver uses the wrong hand to engage the turn lights. As we travelled inland, the humidity dropped steadily, and by mid-afternoon, was pleasant enough to keep a Prairie boy comfortable. We stopped



overnight, using the opportunity of being in a sizeable town to complete our shopping. Essential stuff such as Vegemite, tins of hearty-man stew, canned spaghetti, and peanut butter (hey, it's an astronomy trip, not a culinary adventure tour). Since it's a long way between fuel stops in Australia, one of our more important purchases was a 20-litre container to carry emergency (*i.e.* bad planning) diesel fuel.

Katherine brought the first of numerous gorges that we would investigate in the next three weeks. The word *gorgeous* could have originated in Australia! Everything in northern Australia is red, and red gorges at sunrise are all the more spectacular because of it. That refractive index of the atmosphere does wonders for one's artistic perspective. But, alas, no crocodiles and no kangaroos. We did, however, make the acquaintance of Wilberforce, a wallaby who cadged dinner and breakfast from us in the Katherine campground. Two tourist-immune pythons in the campground were content to hunt the fruit bats, while the kookaburras just kept to themselves, but looked pretty, just like that girl in grade 5 who wouldn't look your way.



Figure 2 – Quintessential Australia: red, straight, spinifex and mulga.

Heading westward out of Katherine, we began to encounter the quintessential northern Australian landscape: rolling hills covered in mulga trees and spinifex. Spinifex is not really spinifex (as taxonomists would know it), except where it grows in dunes along the coast, but the spiny-leaved plants that carpet the inland countryside are tagged with that name by the locals. It's a spiny tussock-forming grass that is more than an annoyance for ankles when you're walking through it, and that is of no use to cattle. The mulga is a form of acacia that is highly desert-adapted, and more of a shrub than a tree. Other trees made an appearance in the few days before the trip ended and we got into wetter climates, but that came much later. Our first goal after Katherine was Purnululu National Park and the mysterious Bungle Bungle range.

Purnululu is one of Australia's great national treasures, and the Bungle Bungles are a unique structure described in one guidebook as the "most outstanding example of cone karst

in sandstone anywhere in the world." This range of low mountains (hills really) is composed of layers of red and black rock, incised by deep canyons and sprinkled with deeply shadowed pools of cool water that tempt visitors for a swim. We were early in the morning and alone at the largest of the pools, deep within a brick-red dead-end chasm, shaded from the hot sun, but even so, two 60-year-old skinny dippers detracted considerably from the scenery. After an afternoon of hiking through strange rock formations, while standing on an overlook that faced the best of the Bungle Bungle range, we realized that this was the place to begin our astronomical photography.

The Moon rose at 10 that night, so we returned to the overlook an hour before sunset after a quick meal of canned spaghetti. Our viewpoint was perfect: looking due south, over the best part of the Bungle Bungle formation. There were no lights anywhere, as we were kilometres away from the unlighted and unpowered campground, and anyway, the campers with generators had all shut down for the night. The season was right too, as the Large Magellanic Cloud was sinking, the Southern Cross was high in the sky, and the bright clouds of Sagittarius were scheduled to rise above the east horizon. Even the geometry worked, for in the Southern Hemisphere, the Milky Way arcs much closer to the pole than in the North, so the video photographer has two big advantages: the Milky Way is much slower to move out of the field of view and there is less trailing in the images during an exposure.

We elected to shoot single frames on a tripod rather than a tracking mount, since the rising Moon would later bring a dramatic revelation of the horizontal layers of the Bungle Bungle hills. Our biggest challenge was to decide how to manage the exposures through twilight, so that there was a smooth transition from 1/500 s in daylight to 60 s for the night sky. I didn't quite get it right, but the animation is still useful. It was fortunate that the Moon rose early, as we were able to retire before midnight and then get up at dawn to travel onward.



Figure 3 – Moonrise over the Bungle Bungles.

On the highways, Australia isn't America. Fuel has to be managed carefully, as it's not uncommon to find petrol stations 200 kilometres apart. Major highways in the Northern Territory or Western Australia are a single lane each way, often with no shoulder. So-called "truck trains"—big semi-trailer trucks with four carriages—are common, and they travel right at the speed limit (110 km/h). Fortunately there is little traffic in the daytime in that region and almost none at night, save for the trucks. At one point, we travelled for more than 130 km in the evening without seeing another vehicle. Australians are surprised to discover that you are planning night travel (we did so, infrequently), and there are occasional ominous warnings of open range and wandering animals "for the next 290 kilometres." The main hazard is cattle, which roam freely and pack a lot of mass.

After Purnululu, our goal was the Wolfe Creek Meteor Crater, which required a diversion of 130 km down the Tanami Road. The gravel and dirt track was well graded, smooth for the most part, and wide, which allowed us to fly along at 120 km/h for much of the distance to the crater. Wolfe Creek lies on private land, so there were gates to open and close before we reached the crater, but when we arrived, we were the only ones on the site.

On the approach, the crater walls show up as a pair of hummocks on the horizon, much like the approach to Meteor Crater in Arizona, but more subdued. Up close, the sight is much more impressive, consisting of blocks of red rock, tossed upward from the centre of the crater and embedded in sand. The whole thing is a pinkish-red colour, mirroring the general appearance of all of the landscape in this part of Australia. A sparse covering of spinifex and mulga covers the rim and its slopes.

The rim of the crater stands about 35 metres above the surrounding terrain and has a relatively gentle slope on the outer side and a steeper one toward the middle, descending 50 metres into a flat sandy bottom. The trail up to the rim

from the parking lot is not groomed, but seems to have developed spontaneously from the footsteps of the many visitors over the years. The route continues into the crater bottom but is hardly defined at all, and so the curious must pick their own way down, stepping carefully in the loose boulders and the waiting spinifex.

From the rim, the middle of the crater is dominated by a circle of paperbark trees surrounding a field of shoulder-high grasses (thankfully, not all spinifex)—the "eye" of the crater. It really does look as if a bulls-eye has been placed in the middle of the formation, but the cause is more mundane. The trees surround a pool of alkaline soil created by the accumulation of water in the wet season, while the grasses in the centre are those that can tolerate the salty soil. It seems to be popular to scratch names and dates into the white hard-packed surface, and a small fire pit marked the approximate centre of the formation. Magical, perhaps?

The meteor crater is known as Kandimalal in the local Djaru language. The signage at the crater tells the aboriginal dreamtime story of two rainbow snakes, which, on passing by, left trails that became the nearby Wolfe and Sturt Creeks. The crater is the site where one of the snakes emerged. The crater has a tragic modern story attached to it as well, for it was on the Tanami Road that geologist Dr. Eugene Shoemaker was killed in a traffic accident.

Dark skies at the crater, without a hint of horizon lights, demanded serious nighttime photography, so the two of us unpacked the equipment we'd brought along and set up for a long evening, at least until the thinning crescent Moon climbed above the horizon. I'd brought along a Vixen Polarie tracker and the necessary tripod, and setup was quick and easy. The main question was "how do I point to the South Pole?" Although the Polarie is a wonderful device, just the thing for travelling, its polar-alignment procedures leave a little to be desired, especially away from the familiar haunts of the North Star. Southern skies don't have the advantage of a bright star near the pole for positioning.

Using binoculars and a star chart, along with some guidance from Terry, I traced my way from star to star until I had memorized the field in the vicinity of the pole. The polar scope was inserted into the Polarie, but the inverted field completely flummoxed my memories of the stars around the pole, and I was completely lost. Then, an idea—I'd brought along a green laser. By shining it through the polar scope, we were able to produce a beam of light that could be used to precisely point the Polarie. The laser had to be kept parallel to the optical axis of the polar scope, but it didn't seem to matter if it was in the centre of the field or not. Within a minute, we had our alignment, as I was using a geared tripod head from Manfrotto that allowed for precise pointing of the mounting. It will probably work just as easily for the Northern Hemisphere,



Figure 4 — Wolfe Creek Crater from the rim.





Figure 5 — *The Emu rises from Wolfe Creek. The dark lanes of the Milky Way trace out the shape of an emu.*

though we are more accustomed to aligning on Polaris rather than having to guess at some unmarked location in the sky where the southern pole resides.

We hiked around the crater the next morning, casually touching a magnet to the jumble of rocks in the apron of debris outside the rim, hoping to find some meteorites of our own. Alas, Western Australia has one of the highest concentrations of iron-bearing soil and rocks in the world, and after several meteor-wrongs, we gave up the attempt. It would have been illegal to collect them anyway.

Eclipse time was approaching and we were anxious to get to Newman, our base for selecting a viewing site. However, there was one important stop to make—Karijini National Park. What a treat it was! True, it was more gorges, streams, pools, dried rivers, and marvelous rock formations, but the ruggedness of its offerings and the spectacular overviews rivalled the Grand Canyon. Not as deep or wide as its Arizona rival, the Karijini canyons nevertheless offered scenery that recalled that larger vista. At Karijini, we also met other eclipse chasers who were converging on the sunrise point, and we discussed

viewing plans with them. The discussions were valuable, as our precise location for viewing the event was not yet set. With a sunrise or sunset eclipse, sky transparency, refraction, horizon clouds, and the configuration of the Sun and Moon as they peep above the horizon are important points that don't normally warrant consideration at locations farther along the eclipse track.

Newman is the home of one of the world's largest open-pit mines, a modern town with little to recommend it other than as a place to stock up and move on. It was actually within the eclipse path, though on the northern limit, and so we passed out eclipse glasses and talked up the event with the locals. Terry managed to get the radio station interested, and the safety manager of the BHP Billiton Whaleback mine sent emails to all of the company employees (80 percent of the town) explaining the event to them. By the end of the day, even the store clerks were talking about it, thanks to the magic of text messages and Twitter.

The area south of Newman is marginal cattle country, and our initial planning suggested that the best location would be close to the "central eclipse begins at sunrise" line, just west of the highway. While we didn't have a site in mind at the time, much of the property in the area we favoured was part of a million-acre outback farm named Bulloo Downs. We telephoned, arranged a meeting time, and then drove to the homestead, some 30 km off of the highway and itself in a near-perfect location to view the eclipse. The Hall family was gracious in their permissions and described some of the locations on the property that might suit our needs. Before we left, we promised to try to stop by on the night before the eclipse to give 6-year old Lach and 8-year-old Madi a tour of the stars and planets. Education in Australia's remote farms is home-based and delivered via the Internet, so a visit by two real (amateur) astronomers and a tour of the sky would be a special treat.

The area at the sunrise terminator of the eclipse consists of rolling hills and mulga trees, so it was essential that we get on a bit of a rise in order to see to the horizon. After several hundred kilometres of driving back and forth along the highway, we picked our spot on a rocky knoll with a clear view to the east, about 50 km south of Newman. We were ready to go, with a day and a half until the magic moment. A half-dozen other sunrise eclipse chasers had arrived at our camper park by the time we returned to Newman, so an impromptu "Barbie" was inevitable. Through the evening, we discussed options for observing: Sun rising before central eclipse; Sun rising during central eclipse, Sun rising at the edge *vs.* the centre of the track. We shared the results of our own site survey and thoughts about appropriate lenses and exposure routines and discussed the weather. It was an intense and detailed evening.



Figure 6 — Late night eclipse planning. Terry is in the centre.

The next evening, we made the excursion back to Bulloo Downs Station, pulling up to the house in pitch-black skies and hardly any yard lighting. The star party was on!

Jupiter first, then the stars of Crux, Eta Carina, the Jewel Box, the Southern Pleiades (IC 2602), Leo, Scorpius, M4, the LMC and SMC, and, finally, Saturn. The laser pointer was especially popular, as were tea and cookies. By 9, it was bedtime for Madi and Lach, with a promise of a very early morning to catch the eclipse. Their drawings of the eclipse can be seen in the colour section of this issue.

By midnight, we had returned to our selected spot on the north side of Bulloo Downs and set up the telescope and cameras. I had decided on a 400-mm lens on a Canon 60Da under manual control; Terry used an 80-mm Tele Vue on a tracking mount with computer control. The overhead skies were excellent, though the computer models were suggesting that the distant hills to the east would host some cloud in the morning. At 3 a.m., lightning flashed occasionally to the distant southeast, low down on the horizon, but close enough to cause concern. Sure enough, the deep morning twilight revealed the remnants of the storms: clouds were hugging the horizon where we wanted nothing.

As the horizon brightened, the clouds obtained a golden silhouette—pretty, but not welcome. Where would the Sun actually rise? The clouds provided the answer, as just before sunrise, crepuscular rays pointed the way back to the exact spot where the first blip of light would come over the horizon. We didn't see it, but a minute later, the left and then the right horn of the nearly fully eclipsed Sun peeked through a gap in the clouds, revealing a narrow strip of chromosphere along the upper solar limb. We were just where we wanted to be; the clouds were definitely in the wrong spot.

In the next two minutes, the chromospheric gap closed and the eclipse became central. The squashed-football annulus rose above the clouds just before third contact, and we watched the beads reform on the bottom of the annulus as the Moon



Figure 7 — Eclipse-rise. Note the solar chromosphere arcing above the bright horn of the Sun in the upper image.

began to leave, rising above the solar disk. All in all, it was an excellent eclipse, spoiled a bit by the clouds, which compensated by adding a little drama to the horizon. We watched until the end, running the cameras to complete a time-lapse video. We packed up quickly, as there was a lot of travelling yet to do that day, this time deep into the Outback.

We had a flat tire.

Even worse, the rental company had not included the correct wrench to remove the wheel nuts. So, it was up the hill to find a cell-phone signal and make a service call. Three hours later we were on our way—back to Newman to buy a new tire, a wheel-nut wrench, and a jack handle. The day was lost. However, the evening was a great post-eclipse gathering, as we returned to the campground to look over the images collected by our fellows. Most had been affected by the same clouds that obscured our sunrise view, but one camera had not. Those images revealed a D-shaped Sun climbing above the horizon in the midst of central eclipse. Suddenly, annular eclipses became a lot more interesting! The images can be seen on the back cover.

With the lost day of travel, the Outback was out, and swimming with whale sharks moved up in the itinerary, so we headed west to the coast. That allowed us a second night



in Karijini and a second visit to the gorges, this time in the morning light. A hard day's drive brought us to the Indian Ocean at Exmouth, where cool, salty, and humid air helped us shake the desert sands from our hair. Winds and circumstances conspired against snorkeling with the whale sharks that day, so we explored the hillside and the coastal beaches, and looked over the lay of the terrain for the 2023 total eclipse that will pass through this area. At day's end, we headed south for 150 km to Coral Bay, where another opportunity would present itself for swimming with the whale sharks.

Fate is an unforgiving travel companion, for just out of Exmouth we encountered the broken-down rental van of three of our fellow eclipse seekers. We were the cavalry, riding to the rescue, for they too had reservations at Coral Bay; all of us packed into our camper and we returned to Exmouth as a fivesome. They rented a car, and as darkness settled, the five of us convoyed southward to Coral Bay, dodging kangaroos in the darkness. The whale sharks delivered on cue, but at the end of the day, back in Exmouth, our stranded compatriots were no less stranded. By the time the situation was sorted out, two were left behind to fly, and the third joined us for the road trek to Perth.

A few miles south of Exmouth lies Learmonth Solar Observatory, which presents as an impressive collection of microwave antennae viewed from the highway. The observatory is run by IPS Radio and Space Services (an Australian government agency) and the U.S. Air Force. Instrumentation consists of three dish antennae ranging from 1 to 8.5 metres in diameter that observe the Sun in eight frequencies, from 245 to 15,400 MHz. A 25-cm vacuum refractor observes in white light and H-alpha wavelengths, and feeds a spectrograph with a Zeeman magnetograph. The observatory also hosts one of six Global Oscillation Network Organization (GONG) solar velocity



Figure 8 – Learmonth Solar Observatory from the highway.

imagers that are used to determine the internal structure of the Sun. Learmonth Observatory is one of the sites where the space environment is monitored, contributing to the solar activity reports that are found on [www.spaceweather.com](http://www.spaceweather.com).

Travelling south along the coast, we picked evening stops to try for the green flash. We managed to capture nice images twice in three days; Terry even managed to see a brief last-minute blue flash when an exhausted battery in his camera forced him to observe visually. The flashes were not spectacularly bright, as the stratification of the atmosphere was barely sufficient to create the mirage necessary for the phenomenon. Green flashes are far more common than is generally credited, and, in ocean settings, seem to be limited more by cloud along the horizon than atmospheric thermodynamics.

On the route south, we managed to squeeze in two more nights of astro-imaging before the lights of Perth appeared. The best of these was in Nambung National Park, where we set up in a limestone formation known as “The Pinnacles.”

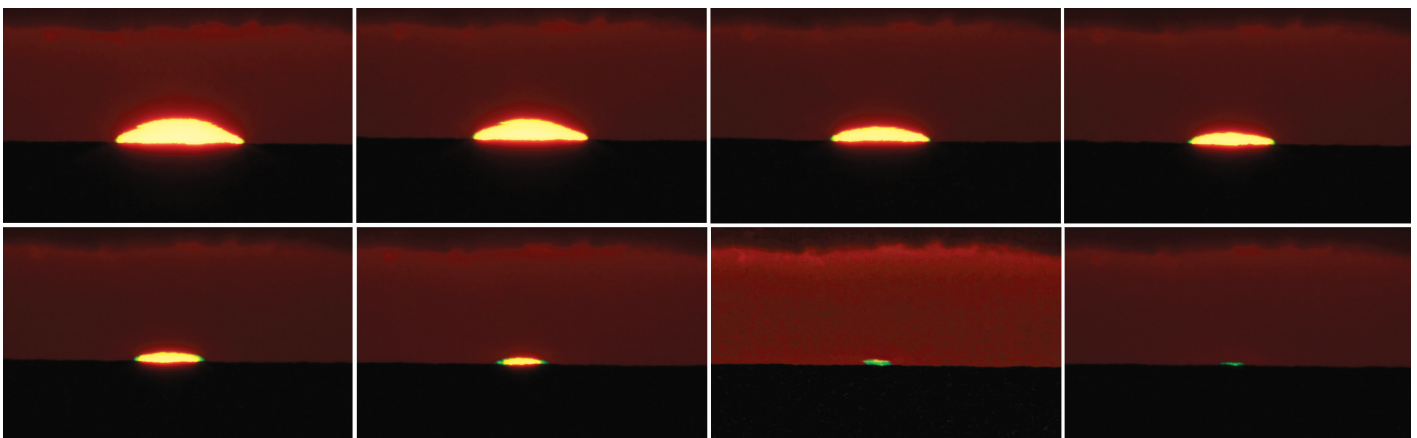


Figure 9 – The final stages of the setting Sun and a small green flash. Notice how the green segment builds inward from the edge as the Sun sinks into the thermal anomaly along the horizon.



Figure 10 – The Emu over the Pinnacles, with illumination by the crescent Moon. The green glow on the horizon is the town of Cervantes.

The Moon was up for a decent interval in the evening by then, so we were able to use the light from the setting crescent to illuminate the unusual rock formations. By now, we had come far enough south that the Small Magellanic Cloud stood well above the south horizon instead of being buried in the low-altitude murk.

Australia is truly the Land of Oz for those of us raised in the Northern Hemisphere. Nights are *really* dark—almost no lights at all. Campgrounds in the more remote parks are not lighted and camping rules call for silent generators by 10 p.m. Northern and western highways are deserted after twilight—no one goes about when there are so many animals on the road, and there are no bright truck stops to sell fast food and cheap souvenirs. The trip through the Northern Territory and Western Australia was what travelling through North America and Europe used to be a century back, and it will probably disappear in another century. While you still have time, put the Outback on your bucket list, and take your camera and telescope. ★

Jay Anderson is Editor-in-Chief of the Journal.



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# A Light-Pollution Mapping Device

by Sean Dzafovic, Halifax Centre  
(sdzafovic@gmail.com)

## The Basics

Two years ago, I graduated from the Electronics Engineering Technology program at the Nova Scotia Community College. The “highlight” of the second year of the program was a project to design and build an original device. I wanted to do an astronomy-related project and after some discussion with Dave Lane, I had the basis for the Light-Pollution Mapping Device.

The device would act as an interface for two commonly available products, a Global Positioning System (GPS) unit and a Sky Quality Meter (SQM) sensor from Unihedron, specifically the LR model with an RS-232 connection. At the push of a button, my device will take a sky-luminance reading (measured in units of magnitudes per square arcsecond) from the SQM, and combine it with time, date, and location data from the GPS. All of this data gets written to a text file on a thumb drive on the device’s USB port. After the data is gathered, they need to be processed by a custom C#-language program and converted to a KML file. The data can then be displayed on Google Maps or Google Earth.

## Components

### Microcontroller

The firmware for the device is contained on a PIC 16F887 microcontroller, chosen for no better reason than I was using it in my embedded-controller classes at the time. The PIC sends a reading request to the SQM, parses out the data coming from the GPS, and sends it all to the USB port for writing to the output file.

### Multiplexer(74LS153)/Demultiplexer(74LS155)

This pair of chips is used to control signals sent to and from the GPS and SQM. The PIC has only a single pin that is used to receive incoming signals, so these two chips will determine which sensor the PIC will be communicating with at any given time.

### MAX-232

In time-honoured fashion, there are two standards for communicating with microchips and other electronic devices (TTL and RS-232). The MAX 232 acts as a “translator” between the two standards. Data going to and coming from the SQM must first go through this chip in order to be properly configured.

## Power

The device can use either an external 12V DC power supply or a 9V battery. To avoid running down the battery, the power plug in the unit will disconnect the battery if external power is plugged in. The device contains a voltage regulator to reduce the supplied voltage to 5V for the microchips and GPS unit. The SQM runs directly off of the input power.

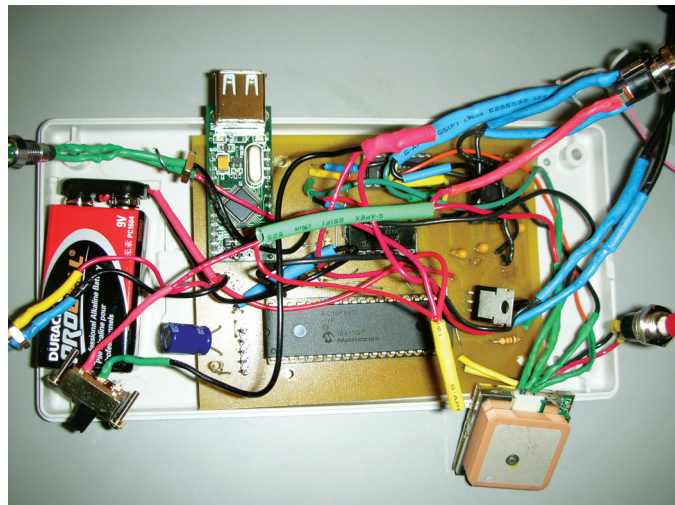


Figure 1 – A view of the interior of the light-pollution mapper.

## SQM

The device uses an SQM-LR with an RS-232 connection port. The SQM is attached to the outside of the device with hook & loop material and has a short ribbon cable that is soldered to the circuit board. This allows the user to point the SQM in any desired direction without having to move the whole device.

## GPS

An EM-406A GPS module is attached to the inside of the box. This module was selected because it has an integral battery pack that allows a fast reacquisition time after it has been turned on. It also had the best accuracy of the GPS units that I looked at, and the physical size of the module was not a great concern. When the unit is first powered up, it takes about 45 to 60 seconds to lock onto available satellites. Subsequent readings take 10 to 15 seconds. The only drawback is that its current draw is about 80 mA, which can drain the power source quickly if a 9V battery is used and the unit is kept on between readings.

## VDIP module

This is a USB port that allows the user to attach a thumb drive to save the data coming from the GPS and SQM. Once it acquires the satellites, the GPS continually streams data in four formats. The PIC extracts data from the GPRMS format, which includes latitude, longitude, and UTC time and date. The PIC also gets the sky luminance reading from the SQM.

This is all combined into a text string that gets written to a text file on the external drive. If for some reason the GPS is unable to get a satellite fix, blank data will be written to the text file with an “Invalid” flag.

### Indicator LEDs

LEDs are used to show when the unit is powered on, as well as when data is being written to the external drive. If the drive is removed while data is being written, it may become corrupted, so I included a LED to show when the USB port is in use.

### Other Programming

In order to be displayed in a widely available format such as Google Maps, there needs to be an additional step. The GPS location data is in the NMEA 0183 data format, while Google uses its own format. I wrote a standalone C# routine to look through the text file, ignoring any lines with invalid flags. For each valid line, it converts the GPS data into the Google format, adds date, time, and luminance information; and then puts it all into a KML format, the version of XML used for Google Maps.

### Google Maps

When the KML file is ready, it’s simply a matter of sharing the file with anyone interested; they will be able view it on Google Maps. On the map, each data point is displayed as a



Figure 2 – The finished product.

white-to-black-shaded luminance value. Mousing over the data point will pop up a bubble that shows the time and date the reading was taken.

### Future Developments

I am working on adding a continuous “survey” mode to the device, which will be started with a button press and will take continuous readings, at intervals, until the unit is powered off.

### Conclusion

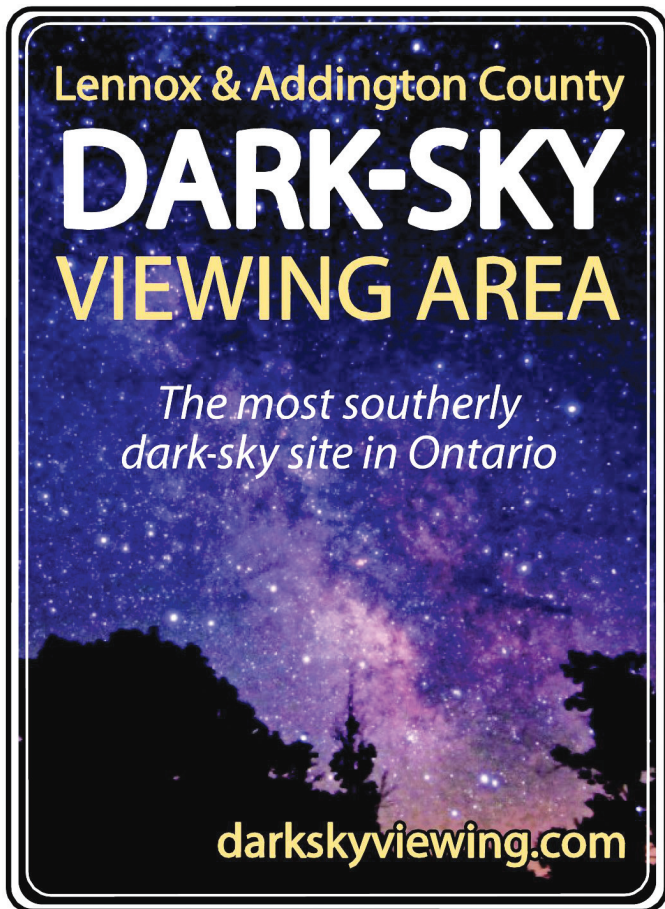
I was able to gather some good data during the initial testing of the device, although I have not done much with it since, besides some small changes to the coding on the microprocessor. I’m looking forward to redesigning it to include the additional mode and seeing what transpires. \*

*Sean Dzafovic lived in Edmonton for several years but returned to Halifax in 2003, where he is a councillor on the executive of the Halifax Centre and the instructor for the local version of the NOVA Program. He is slowly getting into amateur radio astronomy as a means of combining his interests in electronics and astronomy.*

## Solar Eclipse Crossword Answers

by Naomi Pasachoff

S	U	D		F	A	R	M		C	H	O	R	D			
D	O	N	E		A	R	E	A		R	E	R	U	N		
E	V	R	A		L	A	N	D		U	M	B	R	A		
B	A	I	L	Y	S	B	E	A	D	S						
T	I	P	T	O	E			M	A	T		B	R	A		
S	N	E		U	T	E	S		H	Y	B	R	I	D		
				A	T	T	L	E	E			L	E	T	S	
	P	I	N	H	O	L	E	C	A	M	E	R	A			
F	O	N	T			A	I	R	P	O	D					
O	U	T	S	E	T			T	U	R	N		B	A	T	
P	R	O		S	O	B			I	D	I	O	M	S		
				S	O	L	A	R	C	O	R	O	N	A		
L	A	U	R	A			O	R	E	O			A	M	O	R
A	R	R	A	Y			T	I	N	T			N	E	T	S
B	A	N	D	S			S	A	T	S			I	R	A	





# Great Images

## Comet Lemmon Struts Its Stuff

Paul Mortfield captured this sequence of six images showing the evolution of Comet Lemmon over a nine-day period in May. The comet was discovered in March last year by A.R. Gibbs, using a 1.5-m telescope at Mount Lemmon, near Tucson, Arizona. In April this year, it crossed into Northern Hemisphere skies, where it put on a very good show until mid-year, even though its brightness peaked at a relatively faint 5th magnitude.

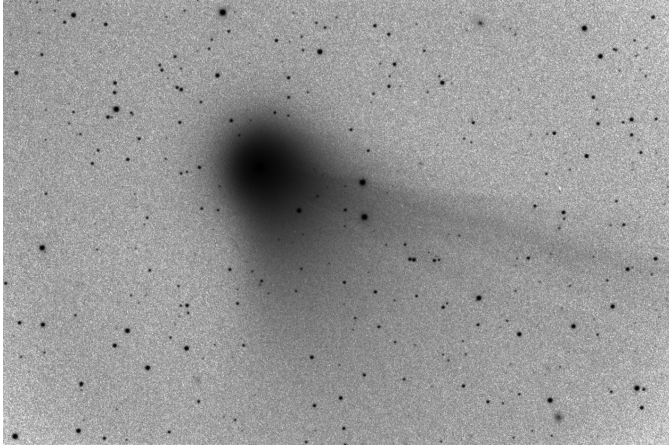


Figure 1

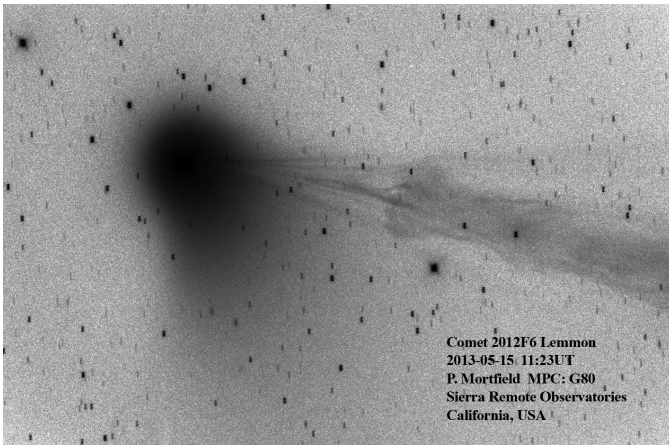


Figure 2

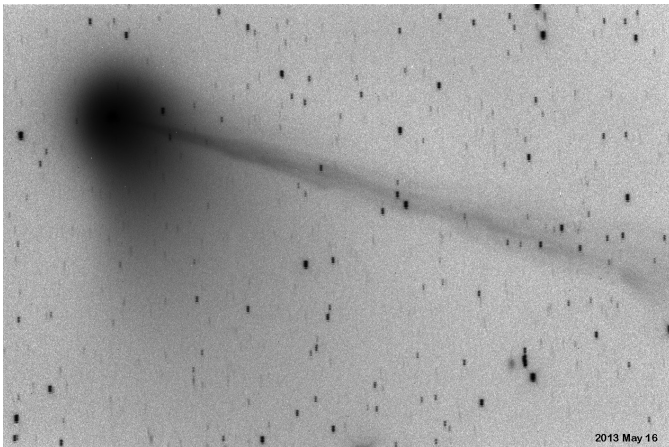


Figure 3

Paul acquired this 1/2-degree-wide sequence from his Sierra Remote Observatory using an RCOS 16-inch  $f/8.9$  telescope. He adds, "What's interesting to note is the difference in the tail over 24 hrs between May 15 and May 16. And then its different shape another 48 hours later." The May 15 image shows a tail disconnection event, in which the solar magnetic field surrounding the tail reconnects across the tail, leaving the down-Sun portion to drift away on its own. Such events are a bit of a mystery, but may be caused by coronal mass ejections or strong flares. ★

*Images by Paul Mortfield.*

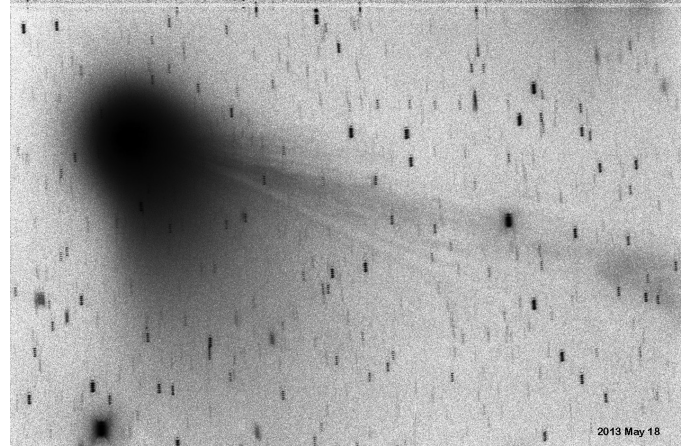


Figure 4

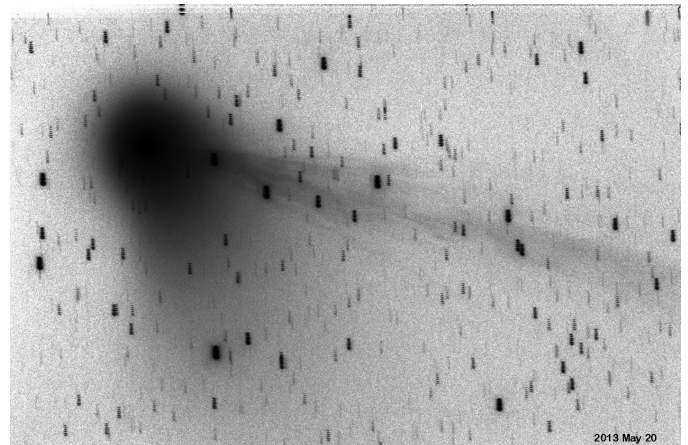


Figure 5

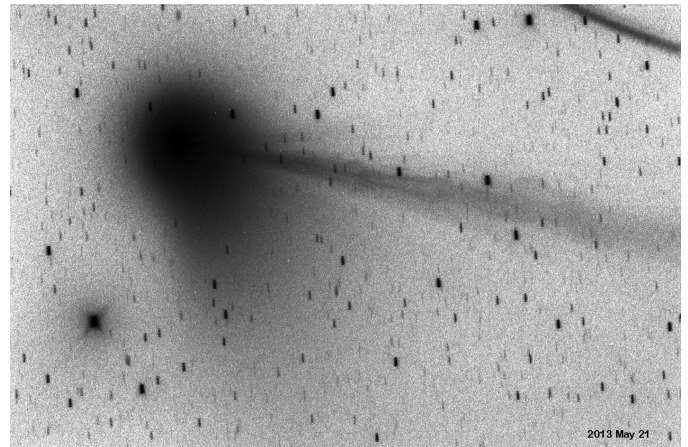


Figure 6

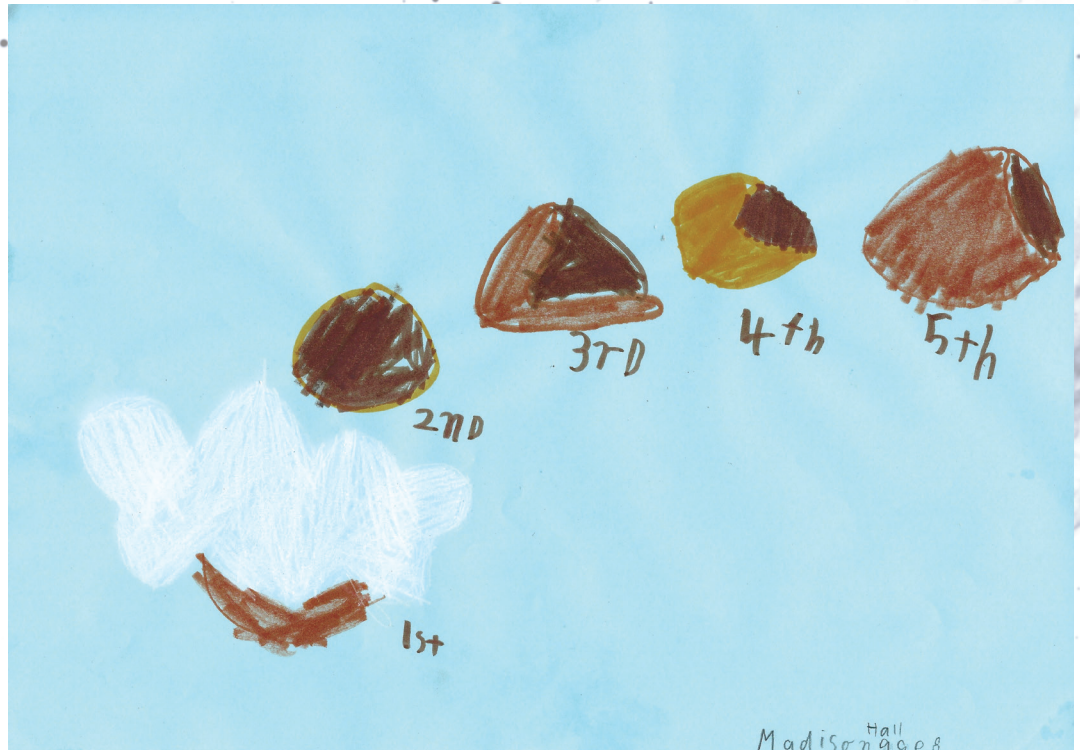




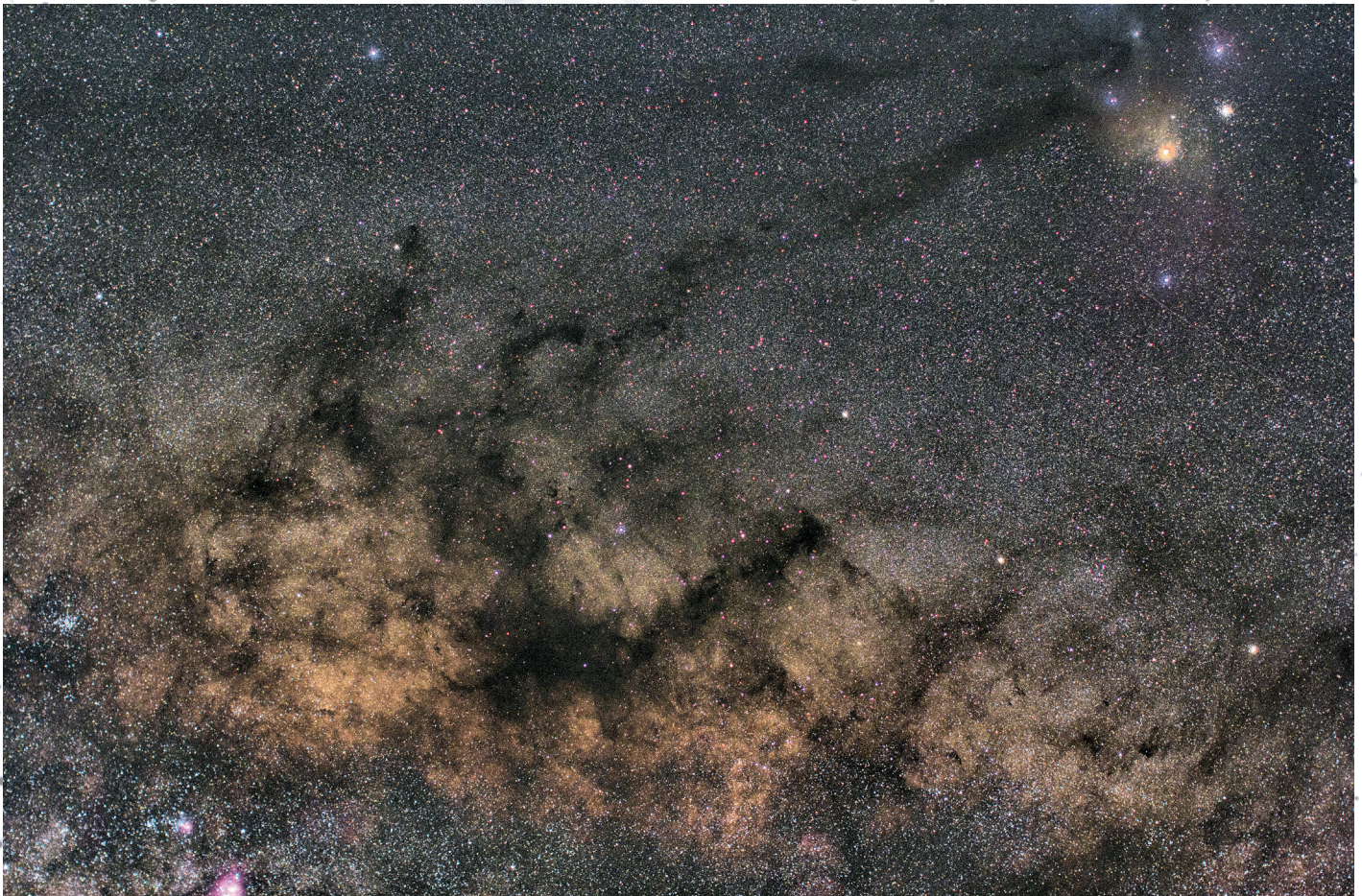
Figures 1 and 2 — Six-year-old Lach and eight-year-old Madi Hall watched the May annular eclipse from their home at Bulloo Downs Station in Western Australia.

From their unique location, the Sun rose while in central eclipse, climbing above the horizon as a circle of light and turning into a downward-pointing crescent a few minutes after clearing the horizon.

These images capture their impressions of the eclipse.







*Figure 3 — The Milky Way's "E" is a favourite wide-angle target for simple astrophotography and is especially easy to photograph from southern latitudes. This image by the Winnipeg Centre's Jay Anderson was taken in Costa Rica in March. The image stretches from Sagittarius in the lower left to Antares in the upper right. Exposure was 16 × 60 s using a Canon 60Da at ISO 1600 with a 50-mm lens set at f/2.5 on a Vixen Polaris mount.*



*Figure 4 — Lynn Hilborn had to remove aircraft trails in four of the seven images in this composite of Comet PanSTARRS when his WhistleStop Observatory turned out to be under the eastern flight path out of Toronto on June 3. Exposure is 7 × 3 min on a modified Canon 60D using a 200mm f/2.8 lens at ISO 1600. This image is taken the day after that by Paul Mortfield on the inside cover.*



## The Society's "Royal" Charter



by R.A. Rosenfeld, RASC Archivist  
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### Abstract

Since early in the last century, the Society's "Royal" Charter has figured large in the consciousness of many members. The fact that we are in the select company of institutions enjoying the privilege of using the adjective Royal has been and continues to be a source of pride. This paper recounts the story of how we achieved that distinction, and reproduces our "Royal" charter for the first time in these pages. Given the momentous changes in Society governance currently underway, the present is an opportune time to place our royal appellation in its true context.

### I know a fellow who knows a bloke who saw it

The Archives have received more than a few requests for information on our "Royal" Charter, the most frequent of which is "why have I never seen the original?" or "why is such an important and symbolic document not posted in a prominent place on our Web site?" These requests seem reasonable, and the mystery surrounding the "Royal" Charter all the less fathomable given the references to it in various RASC publications, both print and electronic.

Dr. A.D. Watson (1859-1926), RASC President in 1916-1917 (Broughton 1994, 101), expressed sadness that long-time member Mungo Turnbull (1817/1825-1902) "...died before the incorporation of the Society under its present *royal charter*" (emphasis mine, as throughout; Watson 1917, 52; Broughton 1994, 101; on Turnbull, see Rosenfeld 2012, and Rosenfeld & Luton 2012).

At the dedication ceremony for the historic Miller-Brydon refractor after its transport to British Columbia, Eluned Williams recalled to his audience "...that our Society is almost as old as the Dominion of Canada...under Dr. C.A. Chant's fostering aegis it received a *Royal Charter*" (Williams 1950, 182).

The late Jim Low, addressing the 1965 General Assembly, stated that "...the society decided to petition the government for permission to prefix...the word "Royal"...King Edward VII was pleased to grant the request, and on March 3, 1903, the *Royal Charter* was granted" (Low 1965, 267).



Figure 1 — The Society's "Royal" Charter is a document of almost mythic properties. Its wording offers unique scope to the imagination.

In 1990, *Minor Planet Circular 16247* announced that asteroid 1982 BQ, discovered by Dr. Edward Bowell, had been named 4113 Rascana (1982 BQ) by the IAU's Committee for Small-Body Nomenclature to honour the RASC, and mark the centenary of the 1890 revival of the Society (Dr. Bowell is now Emeritus Astronomer at the Lowell Observatory, and former director of the highly productive LONEOS project [Lowell Observatory Near-Earth-Object Search]). The citation "prepared by the Council of the RASC at the request of the discoverer," stated that "the RASC received the *Royal Charter* in March 1903" (Schmadel 2012, 330; Tatum 1990a, 233-234; rasc.ca rascana). In relation to that propitious naming, the respected and capable *Journal* editor of the time published a note on the "Royal" Charter (Tatum 1990b, 356-357).

In *Astronomy Canada*, a supplement to the *Journal* published toward the end of 1995, one could read that the Society "received its *Royal Charter* in 1903" (RASC 1995, 40).<sup>1</sup>

The "Royal" Charter statement with the rest of the Rascana citation was reprinted in Dave Lane's excellent observing proposal to secure more observations of the Society's asteroid in an effort to improve its ephemeris (Lane 1997, 176 — note that Dave highlights Chris Spratt's efforts in achieving the honour, a fact hidden in earlier publications).

The subject of all these references can be found reproduced in Figure 1. This is the first appearance of the Society's actual "Royal" Charter in the pages of the *Journal*, or anywhere. RASC members are entitled to print one (1) copy of the charter from the electronic publication, or to cut out the image from the print copy for framing and display. Any RASC member wishing to examine the original in person is welcome to make arrangements to visit for that purpose.



## Seeing is believing, or so they say

When the author became RASC Archivist, one of the things he looked forward to was finally setting his eyes on the “Royal” Charter. He vowed that he would see it published, and proudly placed on [rasc.ca](http://rasc.ca) for all to see.

It soon became evident that there was a minor problem. It is indeed obvious from even the most cursory glance at Figure 1.

There is no “Royal” Charter. In fact, there never was one.

We are, nonetheless, The Royal Astronomical Society of Canada, and have been legally entitled to that name since 1903. No charter was issued by the Dominion’s monarch that year, because it was not necessary. Royal assent was (and is) the crucial act bestowing the status. Charters do not create a legal act; rather, they are a way of recording and remembrancing that an act has happened.

In the list of publications referring to the “Royal” Charter, the names of two authorities are missing. Their silence should have been a clue for those who wrote as if the “Royal” Charter was a reality, that they themselves required a reality check — as did the present writer when he became Archivist. Neither C.A. Chant in his manuscript autobiography, nor R. Peter Broughton in the authorized history of the Society, make any reference to a “Royal” Charter (Chant 1950, 289; Broughton 1994, 5). The wonder is that A.D. Watson, a man who was prominent in the Society when it became Royal, and who ascended to the Presidency 13 years later, should have fallen under the spell of the desire for a “Royal” Charter (Harvey 1904, ix). That a Society member (Williams) three decades later would refer to Chant as the man who made the “Royal” Charter happen is highly ironic, particularly given Chant’s scrupulousness in that regard, and the fact that he was still very much alive in 1950!

## The true story, please

On 1907 January 3, a petition was redacted addressed to “His Excellency [Lord Minto<sup>2</sup>] the Governor General of the Dominion of Canada” by The Astronomical Society of Canada, which

*...has instructed its Council to solicit from His Majesty the King [Edward VII] the privilege of prefixing to that new name the word “Royal;” for your Petitioner believes that such gracious permission would strongly stimulate its efforts in the promotion and diffusion of Astronomical Science and that its influence in this direction would be greatly extended thereby throughout His Majesty’s Dominions, ¶ YOUR PETITIONER [i.e., the Astronomical Society of Canada] THEREFORE PRAYS that Your Excellency may be pleased to lay at the foot of the Throne this its humble prayer for the privilege of prefixing the word “Royal” to its name” (Harvey 1904, xiii).*

At the time Robert Frederick Stupart (1857-1940, knighted 1916), director of the Toronto Magnetic and Meteorological Observatory, was Society President, and John Robinette Collins (1865-1957) was Secretary (Broughton 1994, 3, 71).

Their prayer was answered with considerable dispatch by a letter addressed to Stupart:

*OTTAWA, 27th February, 1903. Sir, ¶ Referring to the recent petition of the Toronto Astronomical Society of Toronto to be allowed to use the prefix “Royal,” I have now the honour to inform you that the Governor General has received a despatch from the Secretary of State for the Colonies [the Rt. Hon. Joseph Chamberlain<sup>3</sup>] acquainting His Excellency that His Majesty the King has been graciously pleased to grant permission to the Toronto Astronomical Society to adopt the title of the Royal Astronomical Society of Canada. ¶ I have the honor [sic] to be, Sir, Your obedient servant, JOSEPH POPE, UNDER-SECRETARY OF STATE (Harvey 1904, xiii).*

It was the King’s assent to our petition that made it possible for us to call ourselves “Royal,” rather than the issuing of any document, and that act was signalled, not through a formal Royal charter, but rather by a letter addressed to the Governor General from the Secretary of State for the Colonies. It was not a letter the RASC was to see. The King’s will was conveyed to us in a further letter from the Dominion of Canada’s Under-Secretary of State, Joseph Pope (1854-1926, knighted 1912).

It is possible that the influence of that particular civil servant was crucial to the success of our petition, for Joseph Pope was a long-time amateur astronomer and member of the Society (Pope 1960, 18, 120, 289; Waite, Pope). And, Pope was influential. From 1882 (the year of the transit of Venus) to the death of Sir John A. Macdonald in 1891, he was the Prime Minister’s Private Secretary and afterwards became his official biographer. Serving as Under Secretary of State, Deputy Registrar General, and Assistant Secretary to the Alaska Boundary Tribunal at the time of the Society’s petition, he was arguably the most capable and experienced senior civil servant in the Dominion.

Unfortunately, the original of his letter does not appear to be extant in our Archives. That we know its exact content is due to the fact that it was published in the contemporary predecessor to the *Journal*.

One further step was necessary to give the new name, the Royal Astronomical Society of Canada, legal force: “Application was thereupon made to the Hon. the Chief Justice of the Common Pleas Division of the High Court of Justice for Ontario [Sir William Ralph Meredith, 1840-1923], to sanction the change of the title of the Society” (Harvey 1904, xiii; Dembski, Meredith). This was duly done on 1903 March 3.

1903 March 3 was also the night of the regular meeting of the Society, at which the successful completion of the business was formally reported to the membership:

*The President [Stupart] announced that the petition to his Majesty the King praying that this Society be granted the privilege of using the prefix "Royal" to its name had been graciously //// acceded to acceded to and that the Society will now be known as "the Royal Astronomical Society of Canada.["] ¶Official Letters conveying this information were read from the Hon[.] R.W. Scott[,1825–1913, knighted 1909] Secretary of State[,] and Joseph Pope[,] Under Secretary of State[,] Ottawa[;] also the necessary legal confirmation of the same by his Lordship Chief Justice Meredith[.]” (RASC 1903, n.p.; Clarke, Scott).*

This provides the only evidence that a letter from Pope’s superior Scott was also received by the Society, but as it too is no longer extant, its exact wording is unknown. It is curious that Scott’s letter is not referred to in the published account (Harvey 1904, xi-xiv).

The account in *Looking Up* of what actually took place is succinct, highly accurate, and definitive (Broughton 1994, 5). Upon publication, it ought to have put an end to any misapprehensions that we had received a “Royal” Charter. It didn’t, though. This attempt will prove no more successful. The RASC “Royal” Charter is fully analogous to the fictitious knighting of the Rev’d Dr. Edmund Halley (Rosenfeld & Edgar 2010). Expectation, nescience, and desire will undoubtedly ensure that the myth of the RASC “Royal” Charter will never die.

## Acknowledgements

The author wishes to thank Peter Broughton for useful discussion of some of the issues raised here, and President Glenn Hawley for raising the issue of the “Royal” Charter, and Past-President Mary Lou Whitehorne for the suggestion that this article be written. This research has made use of NASA’s Astrophysics Data System. Any errors remaining are the author’s sole responsibility.

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## Endnotes

- 1 For those unaware of this shard of Society history, *Astronomy Canada* was floated as a rebranding and reformatting of the *Journal*. It was one of the sequellae of the revolt of the young Turks crusading under the millenarian name RASC 2000. The millennium has come and gone, the revolutionaries are no longer young, and the *Journal’s* ancient name has endured; *fugit irreparabile tempus, nova dum capti circumvectamur insipientia*.
- 2 Lord Minto does not appear to have had a particular passion for astronomy, although he did support progressive education in Canada and some Canadian scientific endeavours; Miller, 4th Earl of Minto.
- 3 Joseph Chamberlain (1836-1914), was Secretary of State for the Colonies from 1895 June 29 to 1903 September 16. He was the father of British Prime Minister Neville Chamberlain, notorious for his role in the Munich agreement on the eve of WWII.



## Planetary Imaging with DSLRs



by Jim Chung, Toronto Centre  
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I recently had the pleasure of reading Jerry Lodriguss's latest eBook entitled *A Guide to DSLR Planetary Imaging*. Rather than being just a book distributed through a digital format, this eBook attempts to capitalize on the format, with embedded flash animation that recalled the interactive nature of the *Daily Prophet* newspaper in the Harry Potter movies. Jerry is a very well known and early digital astroimager, having published other books on deep-space DSLR imaging and *Photoshop* post-processing.

I had heard about using DSLRs that were capable of taking video to image planets over a year ago, but was initially skeptical about its efficacy, since large sensors and rapid frame rates didn't seem reconcilable. You will recall from previous discussion, that one of the tenets of planetary imaging is rapid frame rates that maximize the chance of freezing moments of good atmospheric seeing and obtaining high-quality, high-resolution images. The idea that a novice astroimager did not have to purchase yet another piece of specialized gear or burst his or her budget was appealing. I attempted my first DSLR images of Jupiter and Saturn recently and was pleasantly impressed at their quality. The process also holds a unique advantage over conventional planetary-imaging techniques.

It may be counterintuitive, but one does not use the DSLR's 1080p HD video mode to shoot planetary movies. This is because the camera has to downscale the image from its native 5xxx by 3xxx pixel array to 1920 × 1080, which results in significant loss in image detail. It's also unlikely the camera could maintain a rapid frame rate with that much 1080p data flowing in without highly compressing the stream. It would prove cumbersome to post-process these massive files on your computer. Fortunate owners of the Canon T2i, 60D, or 60Da are able to take advantage of a video mode known as *640 × 480 crop mode*, whereby the camera shoots video at 60 frames per second (fps) using only that small central patch of pixels. For other Canon models or non-Canon DSLRs, the next best video mode to use is *5 × Live View*. This requires the use of software like *BackyardEOS* (written by Ottawa native Guylain Rochon, who is also preparing to introduce *BackyardNikon*) and a USB connection between your computer and DSLR to capture the *live view* video preview at 5 × magnification, which is typically 1024 × 680 in size and runs at 5-30 fps. There is still some rescaling of the video data, but the loss in resolution appears negligible. Movies are recorded in H.264

*QuickTime* format, which is personally convenient, since I use Macintosh *OSX*, but PC users will need to convert from QT to AVI to process the data.

I choose the slowest shutter speed possible, which is 1/60 s, and adjust the ISO until I achieve the desired image brightness, which also facilitates accurate manual focusing. The DSLR screen is deceptive, because the recorded images are much darker. In *Live View* mode, the shutter speed is simulated, so choosing a slower speed will make the image appear brighter, but the slowest true shutter speed is limited to about 1/30 s. Owners of IR-modified DSLRs (cameras that have improved red or Hydrogen-alpha response) can also rejoice, since the modification typically also removes the anti-aliasing filter, thereby improving resolution, which is more critical in planetary imaging than DSO imaging.

In comparison with images shot at the same time by conventional means, the DSLR appears to be more sensitive to seeing conditions and lacking in colour separation and resolution. This may be attributed to undersampling, since the images should have been shot at closer to *f/30*, which would also compensate for the Bayer layer's intrinsic colour deficiency, but at the time I was limited to *f/15* for technical reasons. The Jupiter results are not as good as the Saturn images, because they were taken shortly after dusk with my mobile 8" SCT, which was not well collimated or temperature equilibrated, as my usual 12" Newtonian setup at home has a tree-obstructed westerly view of setting Jupiter in late April.

The low-noise nature of the Canon DSLR CMOS sensor does allow one to increase ISO or gain without the noise increase one would expect from doing the same with conventional planetary CCDs. This allows the user to image at extreme focal lengths of well over *f/40* and thereby obtain a prodigious image scale with a small-aperture scope, though it is unlikely that the image will resolve any additional detail at *f/40* that can not already be seen at *f/25*. You won't be seeing Encke's Gap with a 4" refractor!

The *Magic Lantern* development team has introduced a firmware hack for the Canon 5D Mark III that allows onboard SD-card recording of raw 14-bit 1080p video data. The dimensions of the region of interest can be adjusted to allow an area as small as 640 × 480 to be recorded, which also aids in boosting frame rates. It's expected that, with time, this firmware hack will be available to other Canon models.

The limited software titles for planetary data processing under *OSX* have not seen new development for several years now, as authors have either lost interest or funding. Mac users can run Windows OS under *Boot Camp* or in an emulator shell such as *Parallels* to run *Registax* or *Autostakkert!*. There is now a third option: *Wineskin* is a tool that makes ports of Windows software for *OSX*, so that you retain the feel of a native application.

In conclusion, planetary imaging is definitely viable with a DSLR and provides results that better those obtained by Webcams and their rebranded brethren (Celestron Neximage and Meade LPI). High frame rates (60 fps), the ability to increase gain (ISO) without equivalent noise increases, and the freedom from being tethered to a laptop for data acquisition (for the Canon T2i, 60D, and 60Da) are unique virtues that can make this the method of choice in certain imaging circumstances. ★

*Jim Chung has degrees in biochemistry and dentistry and has developed a particular interest for astrophotography over the past four years. He is also an avid rider and restorer of vintage motorcycles, which conveniently parlayed into ATM (amateur telescope maker) projects. His dream is to spend a month imaging in New Mexico away from the demands of work and family.*



Figure 1 – (top right) Saturn on the T2i Live View screen.

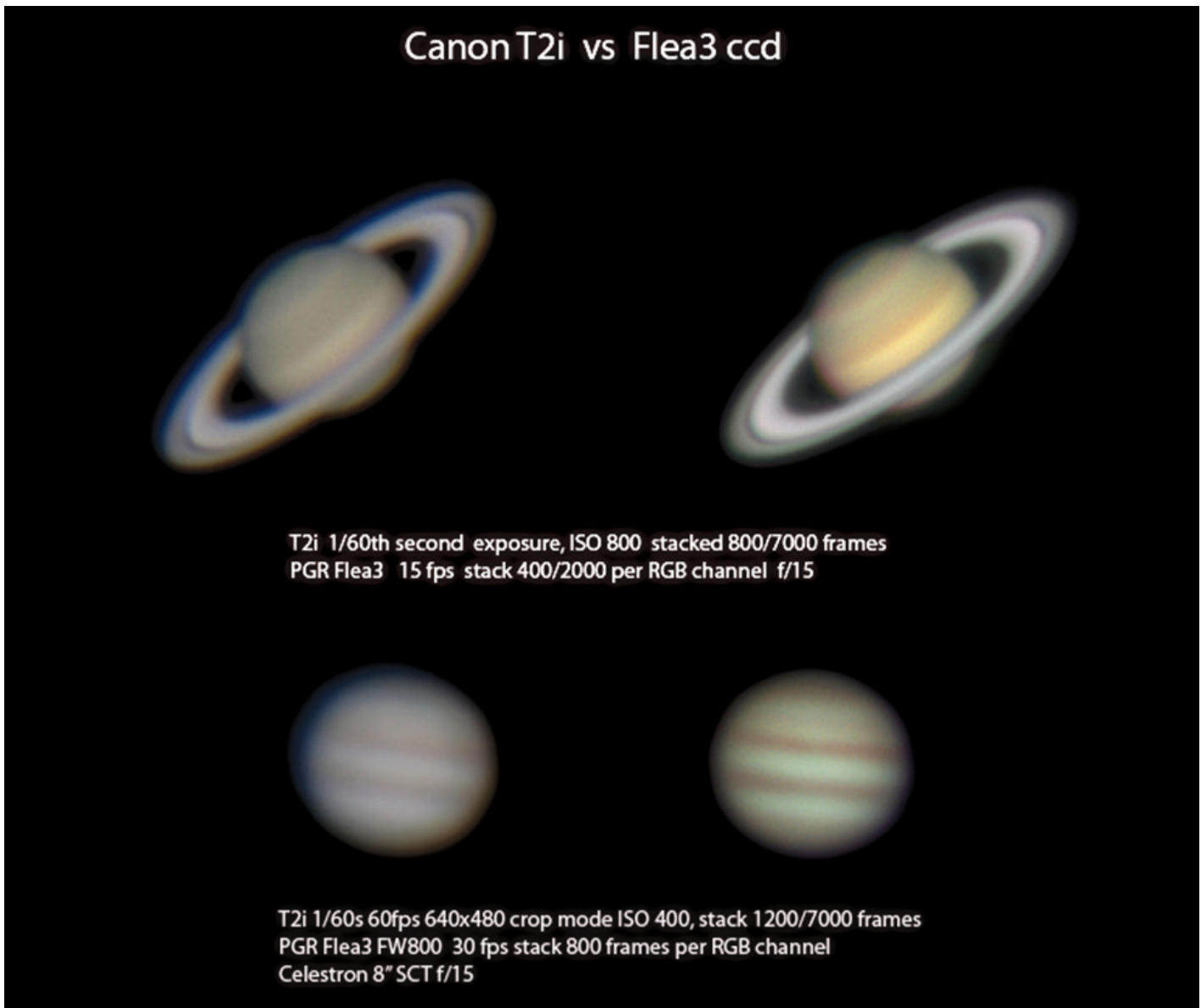


Figure 2 – Final results, comparing the T2i (left) with the Flea3 video camera (right) after stacking and processing.



# Through My Eyepiece

## Questions and Answers



by Geoff Gaherty, Toronto Centre  
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Outreach is an important part of our Society's mission, and can take many forms. One of my major outreach activities in recent years has been answering questions about astronomy from the general public.

I find that answering beginners' questions not only helps them but also benefits me a great deal. By trying to decipher the questions, I have learned how people without much astronomical knowledge perceive the Universe around them. In trying to answer the questions clearly and concisely, I have also learned a lot about astronomy and writing.

### AskRASC

Six or seven years ago, I started answering questions forwarded to me by the Society Office. Eventually we formalized this so that a question form now appears on the national Web site at [www.rasc.ca/rascforms/askrasc](http://www.rasc.ca/rascforms/askrasc). Several of us, primarily Patrick Kelly and me, monitor these submissions and write answers. By far, the most common questions are those about observed fireballs or possible meteorite finds, but overall, the questions cover the gamut of astronomy. We could certainly use more volunteers to help answer these questions; drop me an email at [geoff@gaherty.ca](mailto:geoff@gaherty.ca) if you're interested in participating. We'll add you to the mailing list, and you can answer (or not) as you see fit.

### Yahoo!Answers

I joined this online forum over seven years ago and since then have become an active participant in their "Astronomy & Space" category, along with at least one other well-known RASCal. Most of the questions come from middle-school students trying to cheat on their astronomy homework, but there are often genuine questions hidden among the chaff, spam, and trolls. This is wild and woolly territory, reminiscent of USENET at its worst!

Given the age of most of the questioners, bad jokes about Uranus abound. There is an obsession with blowing things up (asteroids, planets, even the Sun), bodily functions in space, and conspiracy theories. Now that the 2012 "end of the world" fiasco is safely past, the most frequent trolls are these:

*Now that man has walked on the Moon and Mars, when will he walk on the Sun? I know the Sun is hot, but he could go at night or in winter.*

After explaining that the Sun has no surface to walk on, and has a temperature of 5505 °C, I explain that day and night and the seasons are caused by the motions of the Earth, just in case they missed that in kindergarten. It's amazing how many have the misconception that man has walked on Mars.

*What is the speed of dark?*

Here I explain that "light" in the phrase "speed of light" refers to electromagnetic radiation, and is not the opposite of "dark."

One thing that surprises me is how afraid these kids are of just about anything to do with space. They're afraid of asteroids, comets, solar storms, and the Sun going supernova. They worry about how we will deal with the Sun becoming a red giant in five billion years. It's exactly the opposite of what we astronomers experience, where we look forward with excitement to witnessing a beautiful comet, a flare on the Sun, or a brilliant aurora.

Although some of the misconceptions are amusing, overall it is depressing to see how ignorant these poor kids are of even the most basic facts of astronomy and physics. They live in a world full of chaos, inhabited by vampires, ghosts, and aliens, where planets can spin out of their orbits, and black holes abound, swallowing up everything in sight.

I am also amazed that most people do not understand how the phases of the Moon work. I would say that a majority of the population believe that they are caused by the shadow of the Earth falling on the Moon. More alarming still, many

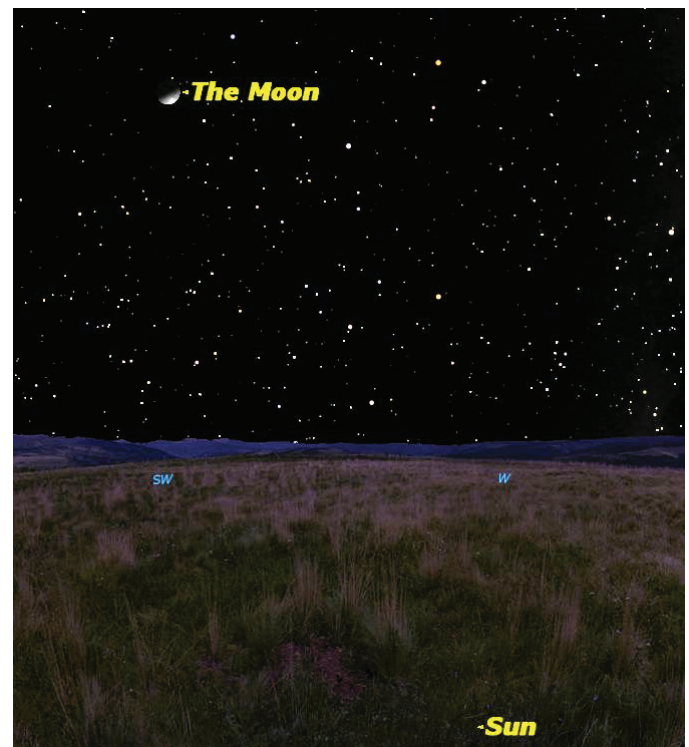


Figure 1 — The "upside-down" Moon courtesy of Starry Night.

of these kids have been taught this by their school teachers. Many people are surprised to see the Moon in the daylight sky, and others are puzzled about how the Moon sometimes appears “upside-down.” I finally figured out that this was their way of describing how the Moon sometimes appears to be illuminated from below, instead of from the side “as we see in books.” (See Figure 1, previous page.)

There is a whole flock of YouTube videos documenting how the Moon has come out of its orbit, all arising from a misunderstanding of the simple motions of the Moon and how the Sun illuminates it.

I sometimes wonder whether our attempts to popularize astronomy do more harm than good. With every meteor shower, there comes a flurry of questions from people expecting spectacular light shows. Factual articles showing that we have a handle on near-Earth asteroids or geomagnetic storms are misinterpreted into doomsday scenarios.

Where I find that I can offer the most help is with questions around telescopes and observing. We see the unrealistic expectations promoted by the glossy photographs on telescope boxes dashed again and again. Many people can't see anything through their telescopes, often because of the crazy two-part lens caps that many manufacturers provide on their small reflectors. I've taken to posting Figure 2 regularly.

In all of this, the principle of Occam's Razor seems forgotten. No one seeks simple physical explanations for observations that they don't understand. Instead they seek complex mystical and magical reasons for simple phenomena that we astronomers take for granted. In some ways, it's disorienting to wander into this alternate Universe of mysterious forces, where



Figure 2 — I use this diagram to show telescope owners which caps to remove to use their telescopes.

good old-fashioned astrology seems sane. Bringing light to these “mysteries” seems an almost endless task, but the rewards come when someone actually sees the light. ★

*Geoff Gaberty received the Toronto Centre's Ostrander-Ramsay Award for excellence in writing, specifically for his JRASC column, Through My Eyepiece. Despite cold in the winter and mosquitoes in the summer, he still manages to pursue a variety of observations. He recently co-authored with Pedro Braganca his first iBook: 2012 Venus Transit.*

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# Cheap Stuff From China

## Putting a Raspberry Pi on your Telescope



by Rick Saunders, London Centre  
(ozzy@bell.net)

Small, credit-card-sized computers are becoming all the rage, with the Raspberry Pi and the various Beagleboards being the best known. This article will cover the Raspberry Pi, for which Wikipedia's description is as follows:

*The Raspberry Pi is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools. The Raspberry Pi is manufactured through licensed manufacturing deals with Element 14/Premier Farnell and RS Components. Both of these companies sell the Raspberry Pi online.*

*The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor (The firmware includes a number of "Turbo" modes so that the user can attempt overclocking, up to 1 GHz, without affecting the warranty), VideoCore IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded to 512MB. It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and long-term storage.*

The small size notwithstanding, the Pi has a very full set of connections. These include:

- 100Mb/s Ethernet connector,
- 2 × USB 2.0 connectors,
- HDMI connector,
- 3.5-mm audio connector,
- RCA Composite video,
- a set of pin-headers breaking out general-purpose IO pins, power, etc.

Power comes into the Pi via a micro-USB port. This is not the normally seen "mini" connector but the micro connector identical to those found on cell phones. Adapters are available at TigerDirect.ca and other outlets for a few dollars.

The Pi ships with no SD card and therefore no operating system, but several operating systems that can be downloaded are available for free as SD card images. The OS that most people use is an optimized version of *Debian Linux* called "*Raspbian*," which is available at [www.raspbian.org/RaspbianImages](http://www.raspbian.org/RaspbianImages). Instructions for installing the system image are given for *Windows*, *Mac*, and *Linux*. Once installed, all of the standard *Debian* package-management tools are available. If you don't like *Linux*, you can install *Android*, *Plan9*, or one of a few flavours of *BSD*.

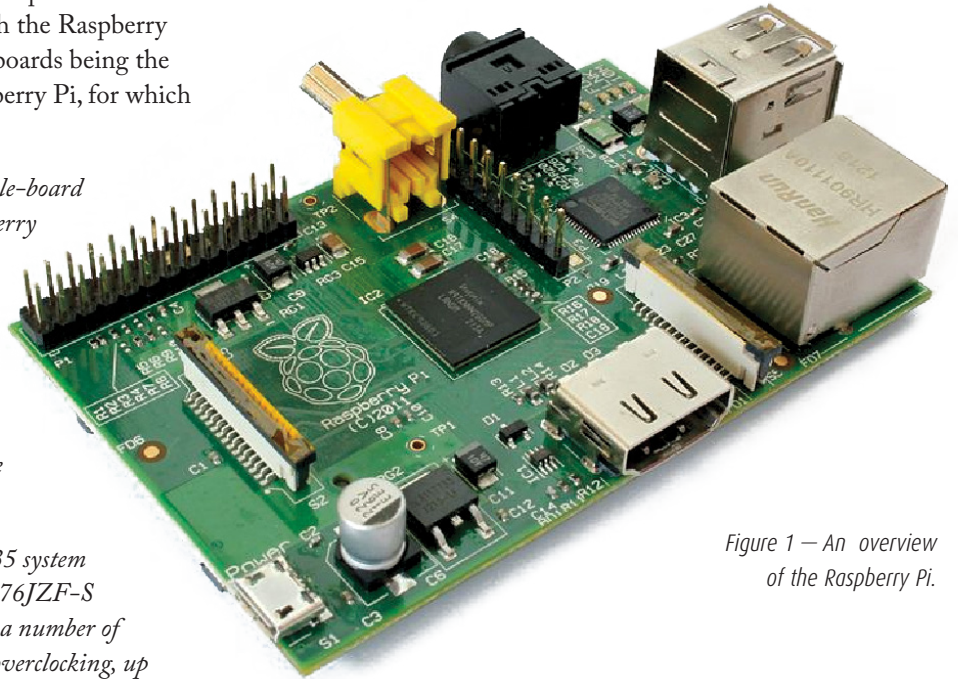


Figure 1 — An overview of the Raspberry Pi.

The Pi ships as a bare board, and if the device is going to be used out in the cold, scary night, then a case of some form is a good idea. There are several styles, ranging from the "click-together" cases available from several sources, to fancy designer cases that look good on a desk. I went with the former, which I sourced from China *via* eBay for half the price of the same thing from European vendors.

If you're going to order a Pi and think that you will want to connect to it wirelessly, you might as well order the network adapter at the same time you order the computer. This will insure that the part you get will work perfectly with the Pi and its operating system. I picked one up from TigerDirect.ca for only a few dollars and, while it works, it took a few hours of head-scratching to get it going.

A word on power: the Pi needs 700mA of relatively clean 5V (actually it likes 5.1V) power. The unit itself draws enough current that only a few hundred mA are available for the two USB ports. This is sufficient to power a keyboard and mouse or an external development board, but will NOT be enough to power USB Webcams, and so on. For higher-current devices, a powered USB hub is needed. For many of us this shouldn't

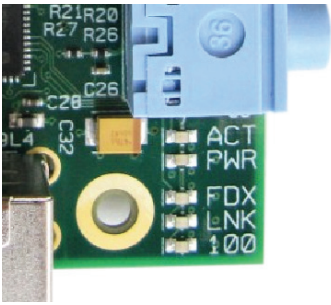


Figure 2 — The on-board LEDs on the Pi.

be an issue, as we imagers generally have a hub at the scope anyway. I power my Pi from the multi-voltage power box I built (see the June *Journal*), which makes 3A of 5.1V power available.

The Pi has no power switch. As soon as you plug in the power cable, the unit starts coming to life. The type-B boards (currently shipping) have a line of LEDs next to the USB connectors. A red LED illuminates to show power, and next to it, a small green LED lights up to show “hard drive” access (the SD card). If you plug in a wired network, three other LEDs (Figure 2) illuminate to show Link, Access, and 100Mb. These are dark when using a wireless adapter.

### So... what can a Pi do?

As a full *Linux* system, just about anything that you can do with a PC you can do with the Pi. The PiAstroHub project [www.raspberrypi.org/phpBB3/viewtopic.php?f=41&t=15723](http://www.raspberrypi.org/phpBB3/viewtopic.php?f=41&t=15723) is working on controlling a telescope (including guiding) from mobile devices. Another interesting Pi project is at [www.brahmand.me/astropi/](http://www.brahmand.me/astropi/). I’ve started writing some *BASH* scripts that turn the Pi into an intervalometer for DSLR cameras and another that will control a powered focuser.

For all this to work, I open up a console on my *Linux* box or run *PuTTY* on my Windows laptop and use SSH (secure shell) to connect to the Pi (Figure 3). From this point, either graphical or text-mode applications can be run. Figure 4 is a screenshot of my *Linux* desktop with an SSH session and a small browser called *Midori* running on the Pi.

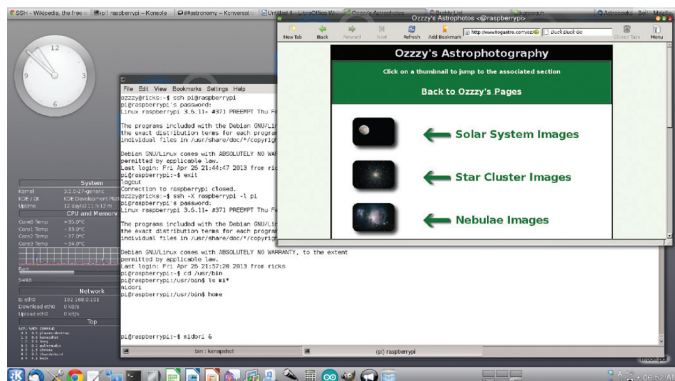


Figure 3 — A Linux desktop with an SSH session and a browser called Midori.

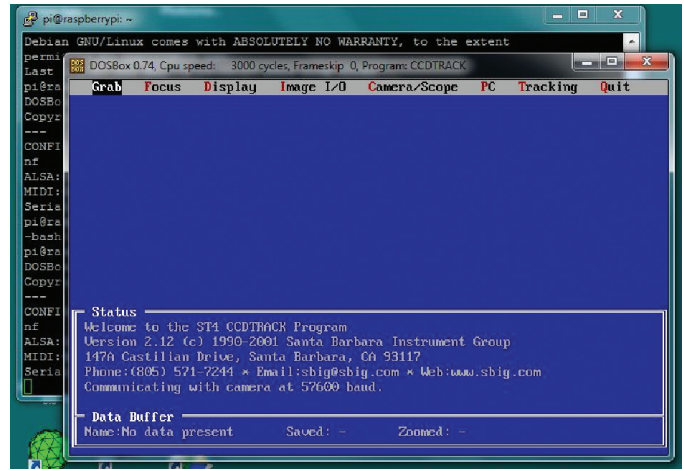


Figure 4 — Screenshot of the connection to the ST4 autoguider.

For Windows, *PuTTY* (which has been around since the Stone Age) handles the connection. It’s available free. The only thing I’ll mention about *PuTTY* is that you have to set “X Forwarding” in your session to run graphical apps (this is what the *-X* switch in *Linux* does).

Additionally, to get X applications running on a Windows machine, there has to be an X-server running. A very good one called *Xming* is available as freeware online.

*PuTTY* is running on my Windows7 machine and is connected to the Pi. The Pi is also running *DOSBox* (yes—a DOS emulator), which in turn is running SBIG’s *CCDTRACK* application for the ST-4 autoguider (Figure 4).

This works just fine, including passing the graphical mode stuff showing the output of the ST-4 camera used to setup guiding. While this isn’t the optimum way of remotely an ST-4, it’s the only one I’ve been able to get working so far. The best way would be to have *MaximDL* connect remotely to the ST-4 controller, but so far this has eluded me.

The Pi will also run the suite of plate-solving utilities from *astrometry.net*, though you would have to provide accurate

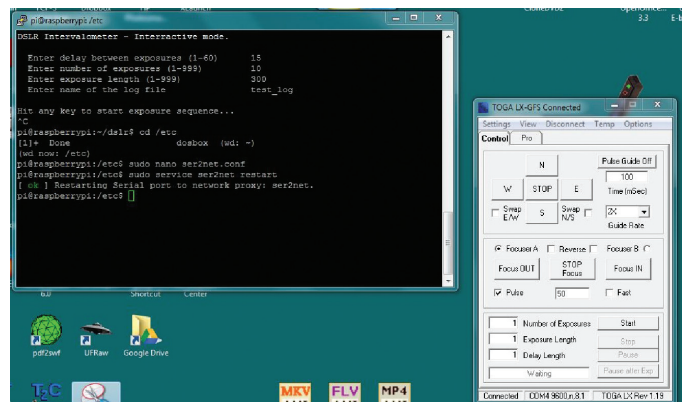


Figure 5 — Screenshot of PuTTY and ToGA running together.



“hints” to the solver. A blind solve would take a long time on the little Pi, but one that has been properly directed doesn’t take long at all.

## Using the Raspberry Pi as a remote serial server

One of the uses of the Pi is as a serial-port server. With a USB hub plugged into the Pi, you could have many serial ports available on a remote machine. For example, on my Pi, I have a TOGA LX device plugged in that has an on-board USB/Serial chip that shows up as `/dev/ttyUSB0` (equivalent to COM1). With packages called *ser2net* or *socat*, you can set the Pi up to send and receive data for that serial port over a network. That takes care of the Pi side of things.

Now on my laptop, I run a utility from AstroGeeks ([www.astrogeeks.com/AstroGeeks/COM2TCP/](http://www.astrogeeks.com/AstroGeeks/COM2TCP/)) called *COM2TCP* that lets me create a COM port on Windows that also sends and receives data from the network. This is pointed at the IP address and TCP port I used on the Pi and *voilà*: the TOGA box sees a serial port to connect to, but it’s actually connecting to a port on the Pi. In Figure 5, *PuTTY* and the TOGA LX software are running. The TOGA software is running locally but connected to the Pi’s serial port *via* the network.

The ability to run software either remotely FROM the Pi or LOCALLY, connecting to resources on the Pi, makes it a very versatile little device.

*COM2TCP* can be set up to run multiple instances by going into “C:/program files” and cloning the *COM2TCP* directory into as many others as you’ll need, *i.e.* *COM2TCP2*, *COM2TCP3* *etc.* And then, when running the program from the new locations, I have redirected three COM ports on my Windows 7 laptop in the same way.

## Installing and configuring ser2net or socat on the Raspberry Pi

In a console type:

```
ser2net
sudo apt-get install ser2net
sudo nano /etc/ser2net.conf
add line - 5555:raw:0:/dev/ttyUSB0:9600
8DATABITS NONE 1STOPBIT:banner
sudo service ser2net restart
socat
sudo apt-get install socat (to install)
```

For *ser2cat* you can add as many lines as you wish for serial ports on the Pi as long as each use their own port number. In the code example above, the line I’ve added reads: `5555:raw:0:/dev/ttyUSB0....` The 5555 can be any port above 1024 that some other program isn’t using. I create three connections on ports 5555 (`/dev/ttyUSB0`), 5556 (`/dev/ttyUSB1`) and 5557



Figure 6 – BackYardEOS and the Live View connection via the Pi.

(`/dev/ttyUSB2`). All of the serial devices I’ve tried have worked except the ST-4 autoguider, which I’m still working on.

To create the redirected port type:

```
sudo socat TCP-LISTEN:5555,reuseaddr,fork /
file:/dev/
TTY,b9600,nonblock,raw,echo=0,crnl,waitlock=/
var/run/tty & 2>&1
```

With *socat* you’d have to run the command several times to redirect more than one port, altering the values to match the serial ports that you’ll be using.

## Remote USB

This section assumes that you’re running Raspbian and that you have the latest firmware running.

It is quite possible to access USB devices connected to the Pi from a remote machine. My testing consisted of plugging my modified Canon T1i into the Pi then running *BackYardEOS* on my Windows 7 laptop to access and control the camera. Future tests will include guiding, using my Celestron NexImage camera and *Metaguide*. For now though, here is a synopsis of how to do it.

First make sure that the Pi has the latest system (3.6.11+) then follow the sequence below:

Download a new kernel and source:  
[wget http://bit.ly/VUPf0k](http://bit.ly/VUPf0k) -O `usbip.tar.gz`

Install the new kernel and source: `sudo tar xzvf usbip.tar.gz -C /`

Reboot the Pi

Load the USBIP driver: `sudo modprobe usbip-host`

Install the USBIP user utilities: `sudo apt-get install usbip`



Figure 7 — The Pi, in place, on the tripod.

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Load the USBIP daemon:	<code>sudo usbipd -D</code>
List the USB devices:	<code>usbip list -l</code>
Bind the device you wish to use:	<code>sudo usbip bind -b &lt;usb id&gt;</code>

You should get a notification that the selected device was bound to *usbip*.

Now, for a Windows machine, you'll need a client. Get one from [http://excogitation.de/projects/berry/usbip\\_win\\_obcd.zip](http://excogitation.de/projects/berry/usbip_win_obcd.zip)

The zipfile has to be extracted to a directory. In the directory, there is a driver that has to be installed with the New Hardware Wizard (search: *hdwviz*, then run it). Go through the "have disk, etc." and navigate to where you extracted the zip file in the directory "driver." Install the USB Enumerator.

When that is done, you can navigate to the program directory and either run the command-line tool or the *pi01* tool. If you use the latter, you'll first need to create the directory `c:\usbippi` and edit the *usbipclient.ini* file to show the correct host and device id. Then just run *usb\_client* from the command line or double-click on the icon (I made a desktop shortcut). Figure 6 shows *BackYardEOS* connected to a Canon T1i over the wireless connection with the LiveView "Frame and Focus" enabled.

If you check the file `/etc/rc.local`, you'll find that *usbip* has already done the work to automatically bind the upper USB port for you on bootup. I've also added the line *usbip-host* to the file `/etc/modules` so that Raspbian automatically loads the kernel driver.

You can see that a Raspberry Pi could be an extremely useful tool for amateur astronomers. Small enough to ride on a telescope tripod (see figure 7, top left), its utility stretches from the already-mentioned remoting of USB and serial data streams to things like pre-processing images, plate solving, autoguiding, and many other repetitive tasks. ★

*Rick Saunders became interested in astronomy after his father brought home a 50-mm refractor and showed him Saturn's rings. Previously a member of both Toronto and Edmonton Centres, he now belongs to the London Centre, and is mostly interested in DSLR astrophotography*

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# Planet Formation inside Dense Clusters of Stars



by Leslie J. Sage  
([l.sage@us.nature.com](mailto:l.sage@us.nature.com))

As far as astronomers can tell, all star formation takes place inside clusters. Almost all clusters have too few stars to remain intact and the stars drift away to become “field” stars within a few hundred million years. The clusters that do survive were “richer” in stars when they were born, with densities of 10–100 times greater than the clusters that dissipate and with stars as massive as B and O types. The higher densities mean that the stars interact more frequently, and the B and O stars can cause mass loss from circumstellar disks through “photo-evaporation,” which raises the question of whether planet formation is suppressed in these clusters. Soren Meibom of the Harvard-Smithsonian Center for Astrophysics, and his colleagues there and around the world, have used data from the *Kepler* mission to determine that in fact planet formation seems to proceed in a rich cluster just as it does in a poor one (see the June 26 online issue of *Nature*, and in print in the July 4 issue).

Stars form inside molecular clouds, which can be up to a 100 or so parsecs in size and contain several million solar masses of molecular hydrogen. The actual cloud material that collapses is in denser clumps within the clouds, typically with about 10,000 solar masses of gas. These are the regions producing the usual open clusters that rapidly dissipate. These particular regions have sufficient material that they collapse under the influence of their own gravity. But, star formation is a rather inefficient process, with only about five to ten percent of the gas going into stars. The rest of the gas gets blown away by winds generated during the formation process, or by winds from massive stars. This leaves the new cluster with insufficient mass to keep it gravitationally bound.

There is evidence that newly born stars, such as in the Orion molecular cloud, can trigger star formation in other regions of the cloud through vigorous winds and outflows. So, in Orion, star formation is marching across the cloud on a timescale of several tens of millions of years. And, in bursts of star formation, such as when clouds collide, the efficiency can be much higher than typical, turning much of the gas into stars. Clusters that form under these circumstances are closer to being bound together gravitationally, and will live for several billion years.

It is easy to see that if a cluster is born with a density of ~100 stars per cubic parsec, the stars are on average farther away from each other than in a cluster with 10,000 stars per cubic parsec. Stars are born with the same velocity through

space as the cores from which they formed, and the cores all had individual motions within the cloud. Each core has a diameter of ~0.1 pc. Therefore, in dense clusters, the cores can pass near enough to each other that the outer regions interact. Even after the cores have collapsed to protostellar disks, out of which the star and its planets form, the disks are several thousand astronomical units across. It certainly seems plausible that if you have 10,000 protostellar disks, each several thousand AU across and packed into a single cubic parsec, there would be interactions that could disrupt the disks and thereby suppress planet formation.

Checking the exoplanet app database, I saw that on May 10 there were 889 planets known, mostly Neptune size or smaller, almost all of which are orbiting field stars. Four planets, all more massive than Jupiter, have been found orbiting cluster stars, lending credence to the idea that rich clusters can suppress planet formation, or at least the formation of small planets.

Fortunately, there is a billion-year-old open cluster—NGC 6811—in the *Kepler* field, so Meibom and his colleagues set out to find if there were smaller planets orbiting its stars. (Sadly, NGC 6811 isn't in the *Observer's Handbook*. But, the “dark nebulae” on page 321 are star-forming clouds.) For it to have survived to an age of about one billion years, its initial density must have been at least that of the Orion Trapezium cluster (13,000 stars per cubic parsec)—M42 or the Orion Nebula for observers.

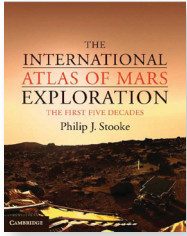
The “Kepler Cluster Study” was set up to determine—among other things—the frequency of small planets around cluster stars. Meibom and his colleagues discovered two planets with sizes of about three Earth radii orbiting the solar-type stars Kepler 66 and 67. They then determined that finding 2 transiting planets among the 377 cluster stars observed by *Kepler* is what should be expected if planets are as numerous as they are among field stars. Therefore, it would appear that planets form normally even in a rich cluster.

We still haven't found a true Earth analogue, but one by one, *Kepler* has been answering the multitude of questions about exoplanets. By the time this column will be in print, we will know whether *Kepler* can be fixed, but a problem with one of its reaction wheels—needed to keep it pointing in the right direction—had shut it down. Here's to crossed fingers that the engineers will get it working again!

*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. ★*

# Reviews / Critiques

**The International Atlas of Mars Exploration: The First Five Decades** by Philip J. Stooke, pages 376, Cambridge University Press, 2012, Price \$142.95, ISBN: 978-0-521-76553-4 (hardcover).



Many books have been written about the exploration of space, but University of Western Ontario geography professor Philip Stooke has carved out his own niche in the literature with two books that provide information that is difficult to find elsewhere about the Moon and Mars.

Instead of telling the story of the spacecraft or people associated with them, as most space exploration books do, Stooke takes the perspective of the objects being explored, in this newest book of Mars and its two moons, Phobos and Deimos.

*The International Atlas of Mars Exploration* catalogues all serious ideas put forward about exploring Mars and its moons, especially the ideas that became reality, starting with German-American rocket pioneer Wernher von Braun's 1953 proposal to send an expedition to the red planet and wrapping up 50 years later with, among other things, the European Space Agency's *Mars Express* orbiter and *Beagle 2* lander. Another decade has gone by since then, so we will have to await a second volume on Mars with Stooke's account of the Spirit, Curiosity and Opportunity rovers, and other spacecraft such as *Mars Phoenix*.

As a planetary cartographer, Stooke is uniquely qualified to tell the story of how our extremely limited knowledge of Mars affected its early exploration, starting with the use of 1960s maps, still showing the imaginary canals of 19th-century observers, to guide *Mariner 4* on its historic encounter in 1965.

As shown in Stooke's maps, that first *Mariner* and two more that followed in 1969 provided scientists with a handful of photos of a cratered terrain, missing out the volcanoes, great valleys, and many other features, including many that would suggest the past presence of water. These first came into view in 1972, after *Mariner 9* entered orbit around Mars and waited out a planetary dust storm. In 1976, two *Viking* spacecraft began circling Mars and each released a lander that provided our first views from the surface of Mars, and the only ones until Mars Pathfinder and its Sojourner Rover landed on the planet in 1997.

Along the way, Stooke's maps and encyclopedic descriptions set out what each spacecraft, including the *Hubble Space Telescope*, revealed of the Martian surface from deep space, orbit, or from the surface. The maps show how our view of Mars became clearer as it evolved with each new wave of robot explorers. The geological explorations carried out by the *Viking* landers and *Pathfinder* are also chronicled in great detail.

Stooke's accounts of these successes and the many missions that never got off the ground or failed en route, go into great detail about where they impacted or where they might have landed. These include discussions of the meetings where decisions were made about where to land each spacecraft, along with photos of each proposed landing site. This book is a particularly valuable resource for those seeking information on the Soviet and Russian spacecraft that were dispatched to Mars, most meeting with failure and none enjoying more than partial success. Here I found photos taken by these probes that I have not seen anywhere else.

This book is not a great read: the many illustrations are all in black and white, and its price will be daunting to many, but it is a unique and important reference for anyone who is interested in the history of our exploration of Mars. It follows on Stooke's 2007 *International Atlas of Lunar Exploration*, also published by Cambridge University Press, which traces the exploration of the Moon up to 2003 in a similar fashion to his Mars atlas.

Stooke, who has been featured in JRASC (Philip Mozel, *A Moment With... Dr. Philip Stooke*. JRASC vol. 98, no. 4 (August 2004) 172-3), has brought together an amazing amount of information about important but rarely publicized aspects of successful Mars spacecraft, as well as those that failed or never got off the drawing board.

Just as importantly, he illustrates the evolution of our knowledge about Mars in a common format using global maps he created himself, using an Azimuthal Equidistant projection that allows for easy comparison of the evolution of our knowledge of the Martian surface over time. Astronomers will be particularly interested in his introduction, which discusses how astronomers mapped Mars, starting with William Herschel in 1784.

Anyone with an interest in space exploration in general or Mars in particular cannot help but learn from this book. I am sometimes called upon to talk about Mars exploration, and now I have one place I can go to when I need to answer questions such as where did the spacecraft go on Mars and why, and once they got there, what did they do?

The exploration of Mars has to a large extent been driven by the hope of finding life. That part of the story is told far better in traditional accounts of Mars exploration that focus on the search for life. As astronomers, we are interested in Mars as a nearby world whether or not life exists there, so *The International Atlas of Mars Exploration* is a book to which we can easily relate. ★

## Chris Gainor

*Dr. Chris Gainor is an author and historian specializing in space exploration. He is 2nd Vice-President of the RASC.*



# Award Nominations

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## Service Award: Larry McNish, Calgary Centre

I would like to nominate Larry McNish for the National Service Award. Larry's contributions to the Calgary Centre of the Royal Astronomical Society of Canada have been outstanding over many years.

Larry has served as President of the Calgary Centre, is now the current 1st V-P. He has also attended almost every council meeting as an informed, contributing guest when not serving an official position. Larry has been the Calgary Centre's Webmaster for most of the last 10 years. His dedication and meticulous care in this role makes the Calgary Centre's Web site a superb, quality site that regularly attracts over 3 million hits per year. He was also involved with helping create the new RASC National Web site.

He is a tireless volunteer at almost every RASC and University of Calgary sponsored event both as a public speaker and with a telescope. He also regularly volunteers at every other public event in the same capacities. He has volunteered consistently in such far away places as Banff, Blackfoot Crossing, Rocky Mountain House, and the Cypress Hills. Indeed, it is rare to attend an event where Larry is not present or has not had some effect on its success. Other observers are also thankful for the doughnuts he remembers to bring and share!

Further, he is active in pursuing new ideas and has frequently taken a leadership role in coordinating and developing astronomy events with other organizations. He was one of the key consultants who helped Banff National Park staff develop an astronomy program for their summer season.

In celebrating the Calgary Centre's 50th anniversary, he, as President, initiated, supervised and helped build a roll-off roof observatory at the Centre's Wilson Coulee Observatory (WCO). In addition, he is the main "go-to" person for technical or mechanical help whether with computers or observing equipment, a role he performs with excellence. His expertise extends beyond the RASC, being sought by the University of Calgary as well as from other organizations or the public on a variety of subject matters related to astronomy.

In his "spare time", Larry creates astronomy-themed music videos from either his own photographs or from the Web and presents these compositions at public star nights. Visitors are treated to a visual and musical extravaganza of the cosmos and many are left impressed and in wonder. One of his creations entitled "The Sun" was accepted by SOHO and is currently hosted on their Web site.

Larry's contributions extend much more than this brief overview can encompass. In summary, Larry has an excellent

follow-through with all his initiatives and has proven to be extremely reliable. His knowledge, expertise, and efforts over the years have greatly benefited the RASC and the Calgary Centre and we extend a big hand of gratitude for his generosity and dedication.

*Andrew Jones*  
*Past-President, RASC Calgary Centre*

## Service Award: Brian McCullough, Ottawa Centre

One of the many rewards of astronomy is sharing the passion of the night sky with others. Whether it is with neighbours down the street, visiting schools or helping at star parties, public outreach is the connection and education to the many celestial wonders. With this in mind, no person sets a finer example than Mr. Brian McCullough of the Ottawa Centre. Over the past couple of decades, Brian's never ending passion of teaching astronomy to children of all ages, as well as adults, has been enjoyed at school workshops, Guides and Scouts nights, or at the Canada Science and Technology Museum here in Ottawa.

A popular part of the monthly Ottawa Centre meetings for many years was the "Ten Minute Moon", in which Brian would describe an interesting surface feature of our nearest celestial neighbor, accompanied by samples of his own talented hand sketches and frequently performed in costume (such as a toga for a Greco-Roman-named crater).

Brian's knowledge, charm and comical wit has opened the eyes and touched the minds of close to 18,000 people. I am sure that some young children attending these special star nights have gone on to pursue science and will someday invent, create or develop the next new whatever. Brian has also been a frequent guest on CBC Radio on an array of astronomy issues and has authored many newspaper articles and other literatures.

Brian has been associated with the Ottawa Centre since 1990 and is a life member. Over this time frame, he has been Astronomer Editor, monthly meeting chair, Vice-President and President. Happily married and a proud father of three wonderful children (two boys and one girl), Brian was able, with the help of his wife Bridget, juggle the never-ending hours between family life and his calling to teach the wonders of the Universe to others. Brian's daughter Emily has pursued planetary geology as a career.

With this said, the Ottawa Centre is pleased to nominate Mr. Brian McCullough for the National Service Award for public outreach and dedication to the passion we all love and enjoy.

*Gary Boyle*  
*President, Ottawa Centre, RASC*

## Service Award: Dietmar Kupke, Toronto Centre

In 2001, after retiring from a career at Digital Equipment Corporation (DEC), Dietmar Kupke joined the Toronto Centre and soon discovered astroimaging and the Centre's E.C. Carr Astronomical Observatory (CAO). He became an enthusiastic volunteer at the CAO, helping to organize work parties and planning the many improvements to the facility since then. After commissioning of the Geoff Brown Observatory at the CAO, Dietmar took on scheduling and training of the site supervisors as well as handling room bookings for CAO pass holders and visitors. This is a huge task when one considers that a site supervisor has to be scheduled for whenever the facility is reserved, and local weather conditions have to be monitored so that a decision to open it can be made in a timely manner. New users have to receive instructions on how to operate the alarm system and keys must be distributed. Dietmar has just relinquished this role after 10 years of service. He also encouraged many members to use the telescope and CCD camera in the GBO for imaging, while he worked on his own equipment both at home and on the CAO observing pad. He was an early supporter of the MODL (My Own Dome Lot) project at the CAO, and was one of the first to occupy a MODL dome.

Dietmar is not only an organizer, but also a participant at the work parties at the CAO. He is often the first to arrive and one of the last to leave, and his quiet friendly approach to new participants has helped to grow our pool of volunteers to over 50 individuals. He continues to be one of our "go-to" people, answering the many questions about operations and maintenance of the CAO.

As Dietmar improved his imaging skills, his interest and passion for this aspect of our hobby led him to organize the Toronto Centre's annual astro-imaging workshops, where he began passing along his knowledge and experience. As members posted their images to the Toronto Centre Yahoo list, Dietmar provided constructive comments and encouragement. Today, interest in astronomical imaging is at an all-time high, and the Toronto Centre has just begun an additional monthly series of Members' Night meetings at the David Dunlap Observatory dedicated to this activity.

In addition to his work at the CAO, Dietmar has served as a Councillor on the Toronto Centre's Council for six years, serving as a member of the CAO Management Committee and Finance Committee, where his business experience at DEC has been put to very good use. He has also been a Toronto Centre representative on the National Council. He has also been an active and enthusiastic participant in the Centre's Strategic Planning Sessions since 2010.

In recognition of his many contributions to its observing and imaging programmes and administration, the Toronto Centre is pleased to nominate Dietmar Kupke as a recipient of the Service Award of the RASC.

*B. Ralph Chou, Past President*

*M. Anthony Horvatin, Past President*

*Charles Darrow, President*

## Simon Newcomb Award: Alan Whitman, Okanagan Centre

Few members of The Royal Astronomical Society of Canada have contributed so much to international and national astronomical journalism as has Alan Whitman. As a recognized author of books and published articles, his work has ranged from historical material to instructive treatises, and particularly to authoritative, in-depth observational guides drawing on his lifetime of astronomical experiences, which have been observed with his naked eye, as well as through the eyepieces of all sizes and types of telescopes.

Alan's ongoing journalistic activity includes regularly featured "Going Deep" articles in *Sky & Telescope* magazine, which, after his second published article in 2012, now recognizes him as a Contributing Editor. In fact, Alan's association with *Sky & Telescope* goes back many years and includes featured articles ranging from an early definitive treatise on the use of eyepiece filters to a book review of "Star Clusters" (2003) by Brent A. Archinal and Steven J. Hynes. Alan's article "Digging Deep in M33" was chosen by *Sky & Telescope* as one of 70 representative articles in celebration of 70 years of publication for the magazine.

From 1998 forward, *Sky & Telescope* published articles by Alan exploring some of the many fields of his expertise, which include dark nebulae, globular clusters, the southern sky, planetary observing, and in-depth exploration of extended objects such as M33 and the Lagoon Nebula. His work included no fewer than ten featured articles in *Sky & Telescope's* "Deep Sky Notebook" department from 1999 to 2004. Alan Whitman's journalism has not been confined to *Sky & Telescope* magazine. His work has also appeared in *Astronomy* magazine as well as *Astronomie Heute*, a short-lived German version of *Sky & Telescope*. One of Alan's most noteworthy accomplishments was made as a contributing author for about one-fifth of the 576-page book *Astronomica* for Australian publisher Millennium House in 2007, which met with reviews such as "amazing" and "comprehensive" and "superb", words which equally apply to Alan's many other literary accomplishments.

As well as in his educational role, Alan has contributed work for scientific papers, most notably the paper he co-authored



with Tony George titled “A new double star from an asteroid occultation: TYC 4677-00696-1” for the International Occultation Timing Association (IOTA) in 2009. The paper reported on Alan’s personal discovery of a previously unidentified double star arising from his astute observation of a stepped dimming of the star by asteroid 1048, Feodosia.

On the national front, Alan authored a regular *RASC Journal* column titled “At The Eyepiece” for two years, in which he discussed a wide range of topics from observing challenges to eclipse chasing. In addition, Alan has played a role in expanding the horizons of the *RASC Observer’s Handbook* with the “Southern Hemisphere Splendours” observing list. For a time he also contributed to the *Observer’s Handbook* through “The Sky Month by Month” section.

As the founding President of Okanagan Centre RASC, Alan has continued to be very active in the Centre, reprising his presidential role in 2010. In the Centre he has contributed ongoing literary work through our *Focus* newsletter and email communications loop, providing members with in-depth updates and explanations of astronomical events, as well as providing seasoned observational advice drawing on his long experience.

All of Alan’s work displays a comprehensive and detailed writing style, which allows the reader to feel his presence at their shoulder while following the path of his observational conquests. Alan has played an important part of astronomical journalism for many years, extending from his local Centre to the national stage, and significantly in the international astronomical community. It is with great pleasure that we nominate Alan Whitman for the Simon Newcomb Award, which would help recognize the exemplary literary role he has played, and continues to play.

*Guy Mackie and Dave Gamble, on behalf of the Okanagan Centre*

## **Qilak Award: Robert Duff, London Centre**

The RASC London Centre Executive nominates London Centre member Robert Duff for the 2011/2012 Qilak Award. Bob is no stranger to the Awards Committee, having won a Service Award in 2009 for his contributions up to the end of 2008. One component of Bob’s service to the London Centre was his meticulous work as coordinator of all outreach events, beginning in 2006. This activity has not only continued since the citation was written for Bob’s Service Award, but has reached such proportions that the London Centre Executive feels no Society member can have accomplished more than Bob did in 2011–2012.

Bob’s work begins with encouraging groups such as boy scouts or school classes to contact London Centre. Bob keeps in

touch with science coordinators for the school boards, with the public library, and most importantly with the University of Western Ontario. Whether Bob personally makes the arrangements for an event or not, he attends almost every one of them. His personal role at outreach events usually involves direct contact with the public or group members, whether at his own telescope or assisting others. Bob’s patience and thoroughness in answering questions and encouraging visitors on an individual basis is legendary. Bob is also completely reliable when it comes to set-up and upkeep of the many telescopes used. Finally, Bob writes detailed, accurate reports summarizing each activity. Thanks to these reports, London Centre members have a concrete sense of the club’s involvement in public outreach. These reports are then shared with the University, and this is important because the University programs do not have the resources or the continuity to demonstrate their own long-term outreach impact. Because of Bob’s work, London Centre fills this role for the University. Grant proposals and internal evaluations done by the University utilize Bob’s statistics.

Here are the facts, broken down into five meaningful categories and summed over the two calendar years 2011 and 2012. First, London Centre’s own events consisted of 44 star nights and school presentations, which reached a total of 2428 audience members. Bob helped coordinate the participation of 37 London Centre members to operate these events. Second is the “Exploring the Stars” (ETS) program at the University of Western Ontario, which is arranged by paid staff, primarily graduate students. Of 106 ETS events reaching a total of 2832 persons, London Centre members, again coordinated by Bob, participated in 99. Third are the open-house events at the Cronyn Observatory on Saturday nights, held monthly during school semesters and weekly during the four summer months, as well as a few special open houses on weeknights. Bob coordinated London Centre members’ participation in 55 of 56 events, where 2182 visitors were welcomed in total. Fourth, the University asked for London Centre to assist with student projects in the fall semester 2011, and again Bob answered the call, helping out with 9 events that involved 403 students. Last but certainly not least, the Transit of Venus event on 2012-06-05 deserves to be mentioned separately. Bob helped lead the team of 27 Centre members and about 15 University of Western Ontario personnel who organized events at 5 separate locations, and 2309 visitors saw the transit because of this effort.

Bob was personally committed to 191 events in 2011–2012, and thus made it possible for a total of 10,154 members of the public to be introduced to astronomy in a close and personal way. All of this was done purely on a volunteer basis, in precisely the spirit recognized by the Qilak Award.

*Peter Jedicke, London Centre*

# Great Images



Chris Hadfield and the crew of Expedition 34/35 travelled almost 99.8 million kilometres with the RASC sticker while completing 2336 orbits of Earth. The trio spent 146 days in space, 144 of which were aboard the station. That sticker made it onto the International Space Station by the efforts of Katrina Ince-Lum of the Toronto Centre. Katrina writes “For a couple of years now, since Summer 2011, I was trying to find a way to get a RASC sticker to the ISS. I had the pleasure of seeing Col. Hadfield about a year before he launched into space last year. I had asked him if he could take this sticker (which had many Toronto RASCAl fingerprints on it!) to space with him. At that time he demurred—I’m sure he was getting many such requests. However, the Canadian Space Agency person with him agreed to take it just in case “... there was room.” After much pestering and begging, it turns out, as you can see, that it made it up there after all.

Many of us watch the ISS flying overhead — and now there is a little bit of the RASC up there too.

Image courtesy of the Canadian Space Agency.



# Letter to the Editor

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I am glad to see the article by Randall Rosenfeld and colleagues about “The Venus Aureole Effect” (JRASC, February, pp. 29–34), in which they succeeded in seeing Venus’s atmosphere as an arc above the solar limb at ingress during the 2012 transit of Venus. They showed that the atmospheric arc was visible even in a telescope as small as 50.8 mm (2 inches) of aperture.

They mentioned my paper with Bill Sheehan (2012, in the *Journal for the Journal of Astronomical History and Heritage*, 15, 1, 3–14) in which we showed that the great Russian astronomer Lomonosov did not see Venus’s atmosphere in 1761, in spite of universal credit given to him for the discovery of Venus’s atmosphere. Rosenfeld *et al.* erred, however, in writing “The presumed limitations of 18th-century equipment play a significant role in the authors’ questioning of the Enlightenment detection of the Cytherean atmosphere.” The quality of the equipment actually played no role in our evaluation of what Lomonosov saw or didn’t see, and we mentioned the idea of telescope aperture only in passing as a throw-in.

We deduced that Lomonosov didn’t see the Cytherean atmosphere because his descriptions in his published paper of what he saw doesn’t match what we ourselves saw at the 2004 transit with data from NASA’s *Transition Region and Coronal Explorer*. (Newer spacecraft imaged it again during the 2012 transit of Venus.) Lomonosov saw a flash of something for a second, and saw a blurriness just before ingress. He nowhere says anything about an arc, and neither does his diagram show anything that resembles what we saw with the 2004 spacecraft or what Rosenfeld and colleagues saw from Regina and what my colleagues and I saw with our own eyes from Haleakala and from Flagstaff in 2012. Further, Enlightenment scientists “knew” that the planets and the Moon had atmospheres, to support the people on them, so it was natural for Lomonosov, when he saw some non-obvious effect on Venus, to (mistakenly) attribute it to an atmosphere.

Michel Duval and his colleagues explained in JRASC (2012) about visible distortions known as the black-drop effect that they observed from Montreal. They related them to optical effects, and not to the Cytherean atmosphere.

We concluded that what Lomonosov saw was a phenomenon related to the black-drop effect, and Rosenfeld’s Figure 4 drawing shows a similar distortion that also does not result from Venus’s atmosphere. Rosenfeld *et al.* write “Whether any did [see the aureole] will have to be judged through careful analysis of their observational records alone.” And that is just what we did; our judgment of the observational report showed that Lomonosov didn’t see Venus’s atmosphere or any effect caused by it.

Jay M. Pasachoff  
Honorary Member, RASC  
Field Memorial Professor of Astronomy  
Williams College  
Williamstown, MA 01267

## Reference

Duval, M., Brault, M., Gendron A., *et al.* (2012). Size of the Black-Drop Effect versus Telescope Resolution During the 2004 and 2012 Transits of Venus. *JRASC*, 106 (6), 227–229.

## Response

We wish to warmly thank Prof. Pasachoff for his comments about our observations of the transit of Venus (ToV).

Regarding the weight of Prof. Pasachoff’s evaluation of the capabilities of 18th-century optics in the argument presented in his paper on Lomonosoff’s ToV observations, we encourage *Journal* readers to judge for themselves. The paper can be found online at:

<http://adsabs.harvard.edu/abs/2012JAHH...15....3P>.

We note that Prof. Pasachoff’s interpretation of Figure 4 from our paper cannot be correct, for the phenomenon depicted occurred in the moments after first contact, ruling out any connection with the black-drop effect.

Given the interesting responses to Prof. Pasachoff’s call to re-examine the nature of Lomonosov’s purported discovery of the atmosphere of Venus, it is unlikely that we have heard the last word on this intriguing issue. It is clear that further source criticism is needed, particularly to establish:

- 1) the range of graphic conventions for portraying astronomical phenomena in the 1760s;
- 2) the regional lexical dialects of natural philosophic terms; and
- 3) the rhetorical strategies for presenting scientific material.

R.A. Rosenfeld, M.A., M.S.L.  
Archivist  
Royal Astronomical Society of Canada  
203-4920 Dundas Street West  
Toronto ON M9A 1B7

# Society News



by James Edgar  
(james@jamesedgar.ca)

We're on the verge of a new beginning, as the RASC Board of Directors, operating under a new By-Law and Policy Manual, and guided by the Advisory Council, takes up the challenge to implement our refreshed governance structure. This has been a long process, with input and consideration by many of the best minds in our Society. We encourage you to congratulate those who put in long hours of extra-curricular effort, when they would have much rather been out under the stars.

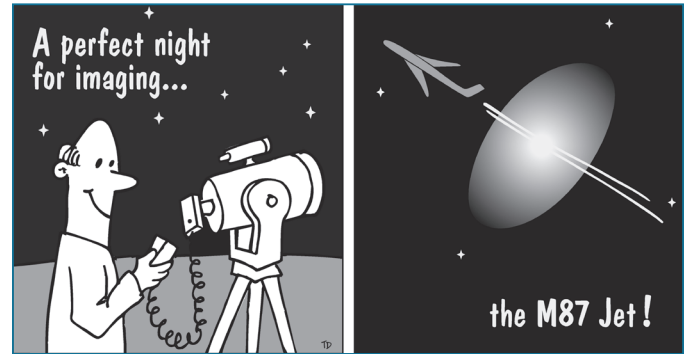
To ensure as many people as possible fully understand the reasons for the governance renewal underway, the five Executive officers, plus the two immediate Past Presidents, Dave Lane and Mary Lou Whitehorne, travelled to, or contacted through electronic means, each of the 29 Centres. This so-called "By-Law Roadshow" aimed to improve peoples' knowledge of where we are now, where we need to go, plus how we're going to get there.

A couple of major changes to our membership types are part of the outcome of governance renewal—abolishing the term "Associate Member" and introducing an expanded Youth Membership, plus Family Memberships.

Also, at this writing, we have five candidates running for the three positions on the Board Transition Committee—a true election! It is refreshing to see the response from willing volunteers who wish to help improve and guide our Society to new horizons. ✨

# It's Not All Sirius

by Ted Dunphy



# Astrocryptic Answers

by Curt Nason

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# THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

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## 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](http://www.rasc.ca)

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### Calgary Centre

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Calgary AB T2P 4J3

### Charlottetown Centre

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Charlottetown PE C1A 3B5

### Edmonton Centre

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

### Halifax Centre

PO Box 31011, Halifax NS  
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### Hamilton Centre

c/o Andy Blanchard, 2266  
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### Kingston Centre

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### Kitchener-Waterloo Centre

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### London Centre

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### Centre francophone de Montréal

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### Montréal Centre

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### New Brunswick Centre

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### Niagara Centre

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### Québec Centre

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### Vancouver Centre

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Vancouver BC V6K 4R8

### Victoria Centre

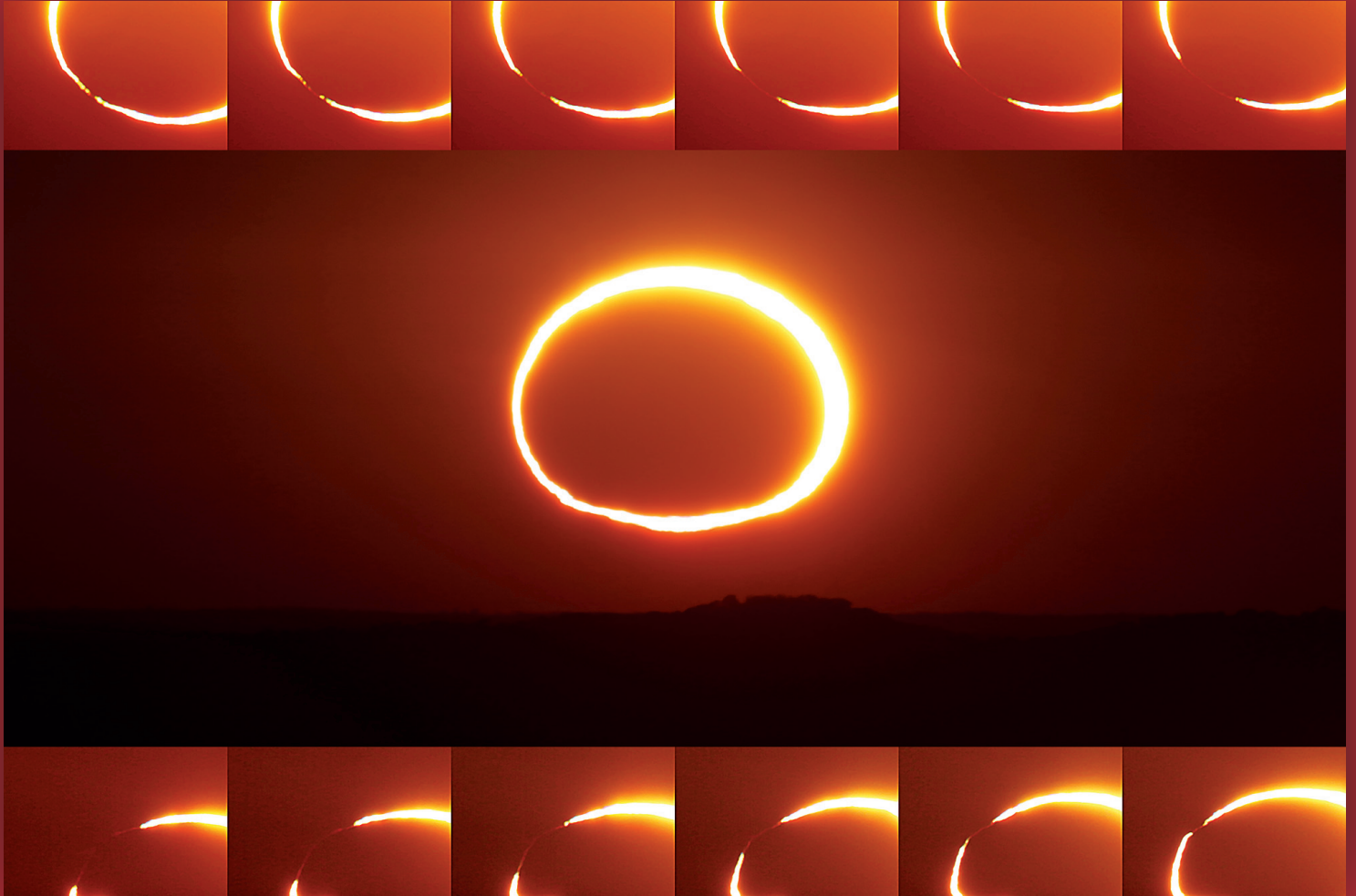
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### Windsor Centre

c/o Greg Mockler  
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Kingsville ON N9V 2V7

### Winnipeg Centre

PO Box 2694  
Winnipeg MB R3C 4B



# Journal

## Great Images

*Australians Geoff Sims and Colin Legg were fortunate to have just about the only cloud-free camera pointed at the rising Sun at the May 10 eclipse and captured this sequence of events as the annular ring climbed over the horizon. The images along the top and bottom show the evolution of the eclipse at second and third contact as the ring closes and then opens again. In these few seconds, waves ripple along the thread of chromosphere that is visible in the dark part of the limb.*