The Journal of The Royal Astronomical Society of Canada

Journal

Le Journal de la Société royale d'astronomie du Canada

PROMOTING ASTRONOMY IN CANADA

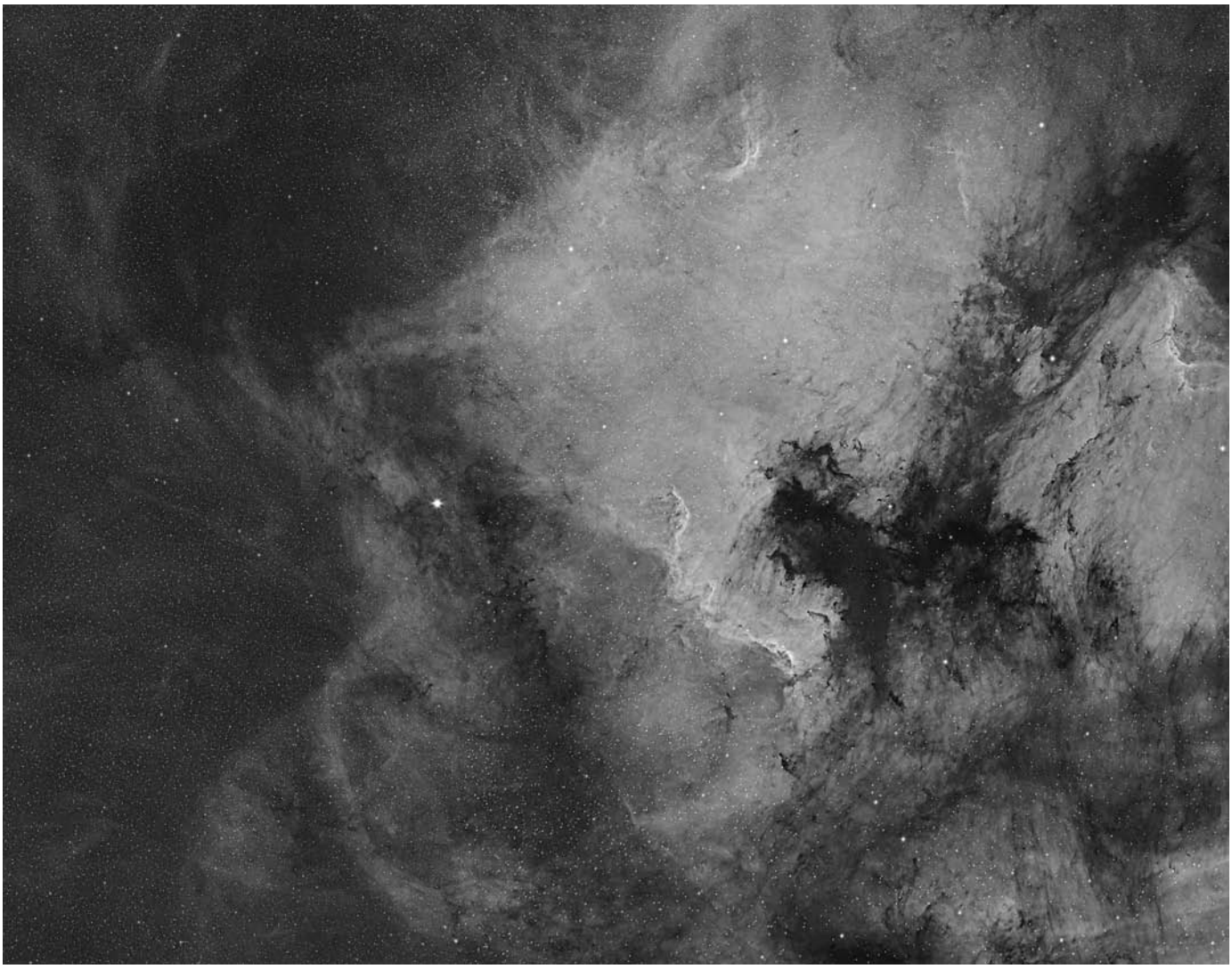
February/février 2012
Volume/volume 106
Number/numéro 1 [752]

Inside this issue:

What's wrong with this picture?

Astrophotographers take note!

This space is reserved for your B&W or greyscale images; a new feature in the *Journal*. Give us your best shots!

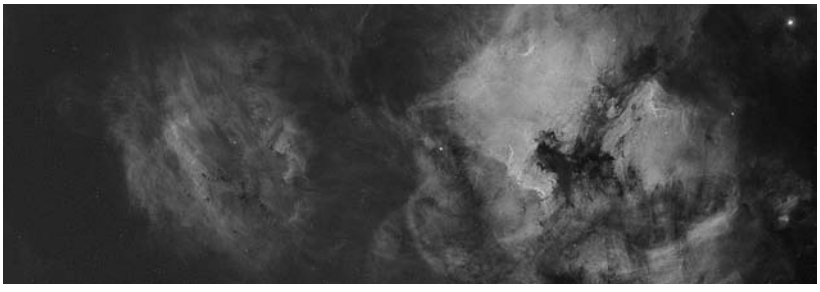


NGC 7000, IC 5070, and SH 2-119 *(detail)*

Taken on 2011 October 14 by Nigel Ball of Cheshire, England (http://nigelaball.com), this is a two-pane mosaic comprising 2 hours per frame (6 x 20 minutes) in H-alpha of the Deneb region in Cygnus—the tail of the Swan. The full image below right shows the famous North America and Pelican Nebulae, with the seldom-seen Sharpless 2-119 at left.

The centre of the region is at RA 21h 06m 23s, Dec +43° 55´ 57´, was taken through a Takahashi FSQ106EDX at f/3.6, using an SBIG STL-11000 CCD camera and Astrodon Hα 5-nm filter, with Maxim DL capture software. Nigel used an IKI 80-mm guidescope and an Orion Starshoot Autoguider on an EQ6 Pro mounting. Stacked in CCDStack*, and processed using* PixInsight v1.7

See the ***incredible*** *full-res image here:*
www.nigelaball.com/Images/NGC7000+SH119.jpg



Journal

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Royal Astronomical Society of Canada

Société Royale d'Astronomie du Canada

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Front cover — *Ian Cameron and Jennifer West used a combination of PTGui and Panorama Tools to reconstruct a fish-eye view of the cosmos "backwards." Instead of placing the horizon on the outer edge of the view, they have wrapped the panorama so that the horizon is in the centre. This image combines five 60-second exposures taken with a modified Canon 5D Mark II using a 15-mm f/2.8 full-frame fisheye lens at ISO 1600. This image was taken at "Bob Hill" in Manitoba's Riding Mountain National Park while surveying the skies of the park for an upcoming application to be considered as a new Dark-Sky Preserve. The skies at this location registered 21.50 on the SQM. The glow you see is the result of thin clouds scattering light over Bob Hill Lake. For further information about the Dark-Sky Preserve application, please contact the information desk at Riding Mountain National Park at*

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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Canada

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President's Corner

Mary Lou Whitehorne
President, RASC

It gives me great pleasure to report in the pages of the *Journal* that on 2011 October 29, National Council officially recognized Fundy National Park, New Brunswick, as Canada's newest and 14th RASC Dark-Sky Preserve (DSP). On behalf of the entire membership, I extend our warmest congratulations to Fundy National Park!

Enhancing public appreciation and enjoyment of a star-filled sky is one goal of our DSP program. Parks Canada is charged with protecting and presenting Canada's natural and cultural heritage, and fostering understanding, appreciation, and enjoyment of that heritage into the future. RASC's DSP program fits perfectly with Parks Canada's mandate of protection, education, outreach, and visitor experience.

The nighttime environment is a critical resource for flora and fauna. Working together, Parks Canada and the RASC can help all Canadians become aware of the adverse effects of artificial light at night, and how it may be used effectively while minimizing its negative impact on the environment. Together, we are leading the way by taking a proactive approach to protecting the ecology of the night and preserving our cultural landscapes and heritage.

Partnerships like the one we enjoy with Parks Canada are on the rise in the Society. Many of our Centres work collegially with provincial, municipal, and private parks, conservation areas, and other community- and natural-history-oriented organizations as part of an extraordinarily vibrant and growing education and public outreach (EPO) program throughout Canada. The energy, commitment, and creativity of RASC members and Centres are simply remarkable. I salute each and every one of you!

Because we are so active in so many ways, I feel compelled to dust off an old saying, "An ounce of prevention is worth a pound of cure!" What has this got to do with EPO? Plenty, as it turns out.

We live, work, and volunteer in an increasingly litigious environment. Insurance has become a large factor in the activities and budgets of the Society and its Centres. Insurance issues have occupied more of our time in the last couple of years than ever before. Every Centre is unique in its activities and insurance needs. National Office staff and the Executive Committee have been busy communicating with Centres and our insurance provider, listening to questions and concerns, and compiling information to try to meet the needs of our Centres.

At present, the RASC has a national commercial general liability (CGL) insurance policy. This is a third-party-liability policy. Its purpose is to protect RASC Centres and members from accident and/or injury claims made against them by members of the public (*i.e.* non-RASC members who attend public RASC events). It is impossible to predict all situations and potential outcomes, but this policy covers:

> "*Astronomy activities including meetings, observing sessions, astronomy day activities and other similar astronomy public outreach events.*"

I strongly recommend that every Centre executive member, and regular members, too, familiarize themselves with the insurance information placed on our Web site to help you be fully prepared for any and all public events you might undertake. Download them, and keep them handy for reference whenever a question comes up. At the very least, please read the *Liability Insurance FAQs* document.

The insurance information files are posted in the members-only area, under "policy and procedures," at www.rasc.ca/private/policy.shtml

Our staff, the Executive Committee, and National Council have done the best they can to provide the Society with the most comprehensive insurance we can afford within our budget. **It does not cover everything!** If your Centre is considering activities that may fall outside the scope of the existing policy (see the FAQs!), contact National Office for more information. You may need additional coverage. This can be arranged for a fee. Also, if your Centre is a registered charity, or is lucky enough to have significant assets, your Centre could benefit from directors and officers (D&O) insurance, also available for an additional fee.

When it comes to insurance and public events, due diligence is key. Have you done everything in your power to reduce risks? Have you assessed your situation carefully and determined that you have adequate insurance coverage for your Centre's assets and activities? Recent experience in several Centres underscores the value of expecting the unexpected, planning ahead, and being fully prepared. Please take some time to consider where and how your Centre might benefit from "an ounce of prevention" **before** you need to apply "a pound of cure."

Then go out and share the stars with a light heart!

Quo Ducit Urania! ✶

News Notes / En Manchettes

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

Honorary astrobiology chair created, evolutionary biologist mourned

Two major public institutions in the United States—NASA and the Library of Congress—announced at the end of November 2011 the establishment of the Baruch S. Blumberg NASA-Library of Congress chair in Astrobiology at the Library's scholarly research organization, the John W. Kluge Center in Washington.

The astrobiology chair is named for the late Nobel Laureate and founding director of the NASA Astrobiology Institute, Baruch "Barry" Blumberg.

Astrobiology is the study of the origins, evolution, distribution, and future of life in the Universe. A multidisciplinary field, it encompasses the search for habitable environments in our Solar System and habitable planets outside our Solar System.

Astrobiology also includes the search for evidence of prebiotic chemistry and life on Mars and other bodies in the Solar System, as well as laboratory and field research into the origins and early evolution of life on Earth. It also studies the potential for life to adapt to challenges on Earth and in space.

The research field addresses three fundamental questions: How did life begin and evolve? Is there life elsewhere? What is the future of life on Earth and beyond?

Blumberg, who was awarded the 1976 Nobel Prize for discovery of the Hepatitis B virus and development of a vaccine to prevent Hepatitis B infection, served as the NASA Astrobiology Institute director from 1999 to 2002.

The institute's mission is to promote interdisciplinary research in astrobiology, train the next generation of astrobiologists, provide scientific and technical leadership for NASA space missions, and share astrobiology's discoveries with learners of all ages.

According to a NASA spokesperson, the collaboration between NASA and the Library of Congress is seen as an opportunity to broaden public discourse on the intersection of astrobiology and its societal implications. This research discipline uses the tools of modern science to address questions with philosophical, ethical, and theological implications.

The Astrobiology Chair will be selected through an annual international competition. He or she will serve in-residence at the Kluge Center for up to one year, beginning in fall 2012.

Some of the likely research topics include the societal implications of discovering life beyond Earth, exploring whether life is rare in the Universe, or the ways astrobiology influences and is influenced by culture.

Meanwhile, a week prior to the astrobiology chair announcement, evolutionary biologist Lynn Margulis, a long-time member of the astrobiology community and the first female principal investigator of NASA's Exobiology Program (the predecessor of Astrobiology), died on November 22. She was 73.

Margulis established a Planetary Biology Internship (PBI) program in 1980, which the Exobiology/Astrobiology program has supported since. PBI enables graduate students to work in the laboratories of scientists at NASA facilities and of NASA-supported scientists at universities.

Born in Chicago, Margulis entered the University of Chicago at age 14, receiving her A.B. there in 1957. She earned her M.S. from the University of Wisconsin in 1960 and her Ph.D. from the University of California, Berkeley, in 1963.

Margulis was best known for both her work on the theory of symbiogenesis, which describes how microbes evolve by means of long-lasting interactions between organisms, and her collaboration with friend and colleague James Lovelock (also an early Exobiology Principal Investigator) on the Gaia hypothesis.

Up until her death, Margulis served as Distinguished University Professor with the Department of Geosciences at the University of Massachusetts, Amherst. Her other distinguished appointments included:

- Elected to the National Academy of Sciences in 1983;
- Awarded the National Medal of Science in 1999;
- One of thirteen recipients in 2008 of the prestigious Darwin-Wallace Medal—traditionally bestowed every 50 years by the Linnean Society of London;
- Inducted into the World Academy of Art and Science, the Russian Academy of Natural Sciences, and the American Academy of Arts and Sciences; and
- Her papers permanently archived in the Library of Congress in Washington, D.C.

Margulis's most recent books were *Symbiotic Planet: A new look at evolution* (1998) and *Acquiring Genomes: A theory of the origins of species* (2002), co-written with Dorion Sagan, among others.

Voyager travelling through new region at Solar System edge

In early December 2011, NASA reported that *Voyager 1* had entered a new region between our Solar System and interstellar space.

Data from *Voyager* show that in this new region the wind of charged particles streaming out from the Sun has calmed, with the Solar System's magnetic field piling up and higher-energy particles from inside the Solar System leaking out into interstellar space.

Scientists interpret this area as "a stagnation region in the outermost layer of the bubble" around the Solar System, showing that what is outside is pushing back. They will soon be able to tell what the space between stars is really like.

Voyager 1 is about 18 billion kilometres (11 billion miles) from the Sun, just shy (relatively) of finding itself in interstellar space. According to scientists, it is plying the celestial seas in a region similar to Earth's doldrums, where there is very little wind (Figure 1).

Data still indicate that the direction of the magnetic field lines has not changed, which means *Voyager* remains within the heliosphere, the bubble of charged particles the Sun blows around itself. But it is not known yet when *Voyager 1* will make it past the edge of the solar atmosphere into interstellar space—it could be in a few months to a few years.

Voyager's magnetometer has detected a doubling in the intensity of the magnetic field in the stagnation region. Scientists liken this effect to cars piling up at a clogged freeway off-ramp—the increased intensity of the magnetic field shows that inward pressure from interstellar space is compacting it.

Until mid-2010, the intensity of particles originating from inside the Solar System had been holding steady. But, during the past year, the intensity of these energetic particles has been declining, as though they are leaking out into interstellar space.

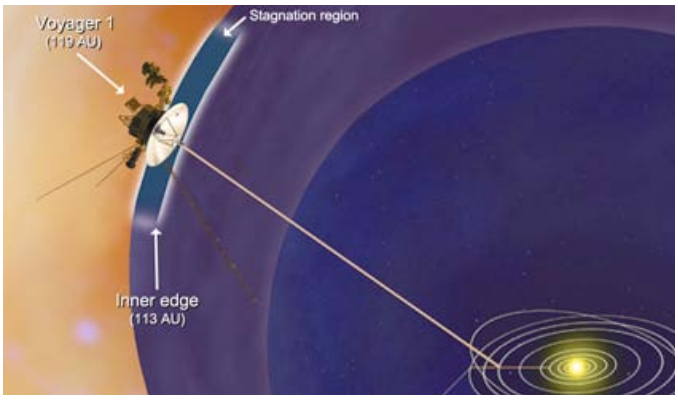

Figure 1 — An artist's concept—NASA's Voyager 1 *spacecraft finds itself in a new region between the Solar System and interstellar space, which scientists call the stagnation region. Image credit: NASA/JPL-Caltech*

The particles are now half as abundant as they were during the previous five years.

Meanwhile, *Voyager* has detected a 100-fold increase in the intensity of high-energy electrons from elsewhere in the galaxy diffusing into the Solar System from outside, another indication of the approaching boundary.

Both *Voyager 1* and its sister ship, *Voyager 2*, were launched in 1977. They remain active spacecraft with *Voyager 2* now some 15 billion kilometres (9 billion miles) away from the Sun.

Built by NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, the JPL operates both spacecraft. JPL is a division of the California Institute of Technology.

The *Voyager* missions are a part of the NASA Heliophysics System Observatory, sponsored by the Heliophysics Division of the Science Mission Directorate in Washington.

Curiosity heading to Mars, veins of mineral found, Canada participates

The Mars Science Laboratory (MSL) also known as the Curiosity rover (the next-generation, car-sized Mars rover) is on its way to Mars for an August 2012 arrival.

Loaded onto an Atlas V rocket, the payload blasted off from Cape Canaveral Air Force Station in Florida on 2011 November 26, and successfully separated from the Atlas V Centaur stage at 44 minutes 6 seconds after launch (Figure 3).

When Curiosity arrives and enters orbit around the planet, it will then make a careful and dramatic touchdown by being lowered out of the Martian sky via precision landing technology and a sky-crane system.

The rover's selected landing site is the Gale Crater. Once ready to journey, Curiosity will begin a nearly two-year prime mission to investigate whether the region has ever offered conditions favourable for microbial life, including the chemical ingredients for life.

During its current 8-month journey from Earth to Mars, the Curiosity rover has already begun monitoring space radiation via the onboard Radiation Assessment Detector (RAD). The objective of this research task is to aid in planning for future human missions to the Red Planet.

RAD monitors high-energy atomic and subatomic particles from the Sun, distant supernovae, and other sources—particles that constitute radiation, and that could be harmful to any microbes or astronauts in space or on Mars.

Figure 2 — Colour view of a mineral vein called "Homestake" captured by Opportunity's panoramic camera, which the rover examined in November 2011 and found it to be rich in calcium and sulfur, possibly the calcium-sulfate mineral gypsum. Image credit: NASA/JPL-Caltech/Cornell/ASU

According to RAD's principal investigator, the instrument is serving as a proxy for an astronaut inside a spacecraft on the way to Mars. It is deep inside the spacecraft, the way an astronaut would be, and is shielded by other components of MSL, including the aeroshell that will protect the rover during descent through the upper atmosphere of Mars.

The rover will also monitor radiation on the surface of Mars after its August 2012 landing.

Meanwhile, NASA's Mars Exploration Rover, Opportunity, has found bright veins of a mineral, apparently gypsum, deposited by water near the rim of Endeavour Crater (Figure 2).

The discovery, presented at a December 2011 American Geophysical Union conference in San Francisco, indicates that water flowed through underground fractures in the rock. The mineral is a fairly pure chemical deposit that formed in place right where it is seen.

According to NASA scientists, the vein examined most closely by Opportunity is about the width of a human thumb (1 to 2 cm), 16 to 20 cm long, and protrudes slightly higher than the bedrock on either side of it.

In November 2011, researchers used the Microscopic Imager and Alpha Particle X-ray Spectrometer (see reference below) on the rover's arm and multiple filters of the Panoramic Camera on the rover's mast to examine the vein, which is informally named "Homestake."

The spectrometer identified plentiful calcium and sulfur, in a ratio pointing to relatively pure calcium sulfate.

The Homestake deposit, whether gypsum or another form of calcium sulfate, likely formed from water dissolving calcium out of volcanic rocks. The minerals combined with sulfur either leached from the rocks or introduced as volcanic gas, and was deposited as calcium sulfate into an underground fracture that later became exposed at the surface.

Researchers note that calcium sulfate can exist in many forms, varying by how much water is bound into the minerals' crystalline structure. The multi-filter data from the Opportunity's camera suggest gypsum, a hydrated calcium sulfate. On Earth, gypsum is used for making drywall and plaster of Paris.

Canadian Contribution

The Mars Science Laboratory is equipped with Alpha Particle X-Ray Spectrometer (APXS), which is Canada's contribution to the NASA "Curiosity" rover.

Canadian physicist Ralf Gellert of the University of Guelph is lead scientist on the APXS.

The APXS's sensor, the size of a soup can, works off the end of the rover's robotic arm. It is designed to analyze chemical elements in Martian rocks and soil once it lands in August 2012.

The mission will focus on clay spotted on the surface by *Mars Express*, an orbiting satellite launched by the European Space Agency in 2003.

APXS has flown on two previous Martian missions: Sojourner, a rover that landed on Mars in 1997 on the *Pathfinder* spacecraft, and again on the Mars Explorer Rover mission,

Figure 3 — Curiosity heads towards Mars! The Atlas V cleared tower after lift off from Cape Canaveral. Credit: Air Force Station, Fla. Credit: NASA/JPL

which involved the two small rovers—Spirit and Opportunity—that touched down on the Martian surface in 2003.

First planet in habitable zone confirmed

NASA's *Kepler* mission has confirmed its first planet in the "habitable zone" of a distant sun-like star.

The planet, known as Kepler-22b, is about 2.4 times the radius of Earth. It is not known yet if Kepler-22b has a predominantly rocky, gaseous, or liquid composition. However, its discovery is a step closer to finding Earth-like planets.

The "habitable zone" of a planetary system refers to the band of orbits where liquid water could exist on a planet's surface (Figure 4). *Kepler* has recently discovered more than 1000 new planet candidates.

Ten of these candidates are near-Earth-size and orbit in the habitable zone of their host star. Candidates require follow-up observations to verify they are actual planets.

Scientists consider this discovery a major milestone on the road to eventually finding Earth's twin.

Located 600 light-years from Earth, Kepler-22b has an orbit of 290 days around its sun-like star. The host star belongs to the same class as the Sun, called G-type, although it is slightly smaller and cooler.

The *Kepler* space platform discovers planets and planet candidates by measuring dips in the brightness of more than 150,000 stars, searching for planets that cross in front, or "transit," the stars. It requires at least three transits to verify a signal as being from a planet.

NASA indicated that the first transit of Kepler-22b was captured just three days after support staff declared the spacecraft operationally ready to begin its work. The defining third transit was witnessed over the 2010 holiday season.

Figure 4 — Diagram compares the Solar System we live in to the Kepler-22 star system containing the first "habitable zone" planet discovered by NASA's Kepler mission. (Image credit: NASA/Ames/JPL-Caltech)

The *Kepler* science team uses ground-based telescopes and the Spitzer Space Telescope to review observations on planet candidates the spacecraft finds. The data from these other observations help determine which candidates can be validated as planets.

Of the 54 habitable-zone planet candidates reported in February 2011, Kepler-22b is the first to be confirmed.

Mercury mission gets one more year of science

The *MESSENGER* (MErcury Surface, Space ENvironment, GEochemistry, and Ranging) mission will continue exploring the planet Mercury for yet another year.

NASA has announced it is extending orbital operations for a year beyond the planned end of the primary mission on 2012 March 17.

The *MESSENGER* probe became the first spacecraft to orbit the innermost planet on 2011 March 18.

The spacecraft's orbital science campaign is providing the first global close-up of Mercury. It has revolutionized scientific perceptions of that planet.

The extended mission will allow scientists to learn even more about the planet closest to the Sun.

The plan is to spend more time at close range to the planet than during the primary mission. With a broader range of scientific objectives, scientists will be able to make many more targeted observations with the spacecraft's imaging system and other instruments.

The extended mission has been designed to answer six scientific questions, each of which has arisen only recently as a result of discoveries made from orbit:

- What are the sources of surface volatiles on Mercury?
- How late into Mercury's history did volcanism persist?
- How did Mercury's long-wavelength topography change with time?
- What is the origin of localized regions of enhanced exospheric density at Mercury?
- How does the solar cycle affect Mercury's exosphere and volatile transport?
- What is the origin of Mercury's energetic electrons?

MESSENGER, the first space mission designed to orbit the planet closest to the Sun, launched from Earth on 2004 August 3.

Oldest planetarium in Canada closes and awaits new home

The Montréal Planetarium—formerly known as the Dow Planetarium—closed its doors in October 2011 after more than 45 years of serving Montréalers and visitors from around the world.

Inaugurated on 1966 April 1, by Jean Drapeau, then Montréal's mayor, the planetarium became a reality through the impetus of Dr. Pierre Gendron, who was past professor of chemistry and founding Dean of the Faculty of Science at the University of Ottawa, an avid amateur astronomer, and president of the board of directors of Dow Breweries, which endowed Montréal with a world-class planetarium (Figure 5).

Since 1966, the planetarium produced more than 250 shows, attended by nearly six million spectators. Fifty lecturers gave more than 58,000 presentations in the Star-Theatre.

A new planetarium, called the Rio Tinto Alcan Planetarium, is currently under construction and is expected to open in the spring of 2013.

It will be part of a natural-science museum complex, Space for Life, which will include the new Planetarium, the Biodôme, the Insectarium, and the Botanical Garden. ✶

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

Figure 5 — Montréal's Dow Planetarium circa 1967—The inaugural star show, New Skies for a New City, *premiered on 1966 April 4. Credit: City of Montréal*

An Eclipse of Our Own

by Jay Anderson
Winnipeg Centre (jander@cc.umanitoba.ca)

Overview

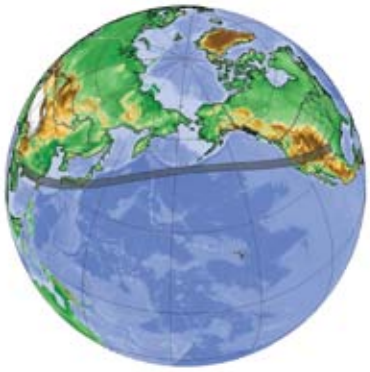

Figure 1 — The track of the annular eclipse across the Pacific.

North America has been in a bit of an eclipse drought since 1994 and, before that, since 1984. Oh sure, there was the annular eclipse over the Arctic Islands in 2008, but that didn't attract much attention south of Cambridge Bay. There were a couple of partials here and there, and an annular that just touched the California coast, but we can't really say we've been over-eclipsed. It comes as a bit of a relief then, that this year, and again in five years, we'll have an annular eclipse and a total eclipse. Well, North America, not Canada.

The first of the pair comes on May 20-21 (May 21 UT in our time zone, but the late afternoon of May 20 in local time) and straddles the Pacific, from its start in southeast China to its ending in Texas (Figure 1). In Asia, the cloudy monsoon season is well underway, while in Arizona, near the end of the track, the midsummer monsoon won't appear for another month; the weather looks pretty good. On the Great Plains, the thunderstorm season is peaking, but the shadow track barely reaches the convective beltway in southern Texas before sunset brings the eclipse to an end. With beginning and middle of the shadow track embedded in regions with a high frequency of cloud (Figure 2), this eclipse is tailor-made for U.S. observers. Canadians too, if they want to travel a bit.

China

In late May, southern China's weather is marked by high humidity, heavy cloudiness, and frequent rainfall. At Guangzhou, the first major city along the shadow track, morning cloudiness averages 78 percent, and daytime sunshine is a challenging 31 percent of the maximum possible (Table 1). Fortunately, the eclipse track straddles the coast for the whole of its passage across China and weather prospects along the shores of the South China Sea seem to be a little better than those inland. Hong Kong, which lies 50 to 80 km from the south limit of the shadow, has an average cloudiness of 65 percent at eclipse time (Figure 2), though only 34 percent of hours in May are sunny (Table 1).

Inland China is a hazy place in the morning light—views toward the rising Sun are often heavily obscured, so a more transparent view across the South China Sea from Hong Kong probably offers a better view of the eclipse—if the weather cooperates. Morning thunderstorms are common in the city in May, but even so, the cloud prospects are better than those farther inland. Hong Kong may be a prime site from which to observe the ring of sunlight, but only because it is the best of a bad lot. However, if the weather is decent, the peaks surrounding the city will offer a spectacular vantage point from which to watch ring of sunlight. At the airport, the annular phase lasts for just under 3½ minutes, about 1 minute less than on the centreline near Guangzhou.

Japan

Japan's wet weather peaks in June and July, but the approaching rainy season is well underway on the date of the eclipse. Monsoon air is still well to the south however, and cloud conditions are a little more promising—about 10 percent lower—than those over China. Climatological averages of cloud cover are fairly uniform all along the Japanese portion of the track, between 60 and 70 percent, but there are a few

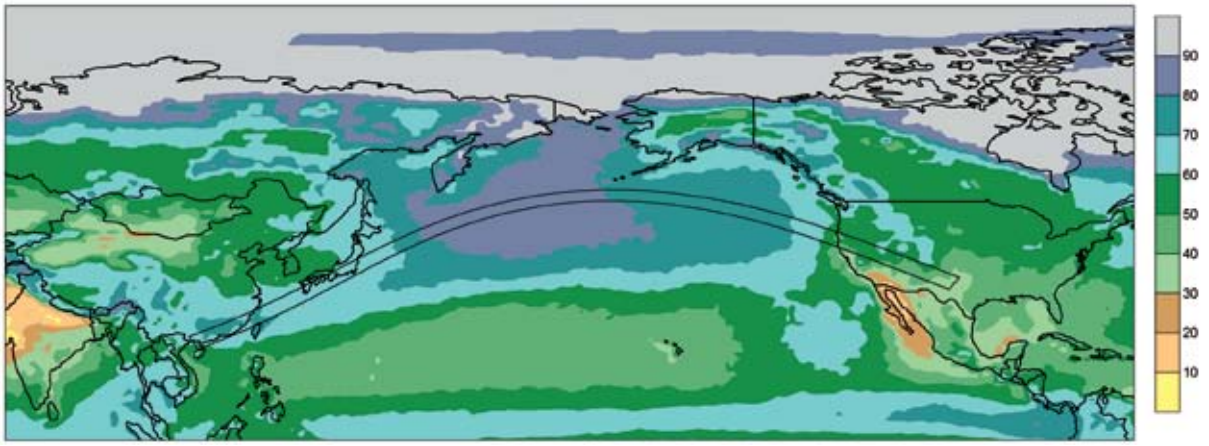

Figure 2 — Average May cloudiness along the eclipse path. Cloud amount is extracted from 26 years of satellite data from 1982 to 2008. Source: Patmos-X.

Figure 3 — Higher resolution track of the eclipse across the United States. For more detailed maps, see www.eclipser.ca.

locations where the statistics are a little more encouraging. The best of these is near Osaka, at Kansai International Airport, which reports an average cloudiness of 61 percent and a 44-percent frequency of sunny hours for the month. Kansai is well off of the centre of the track, so it is a delicate question whether a 6- or 8-percent advantage in climatology is worth the loss of time in annularity. Tokyo, which lies smack under the centreline, sees only 38 percent of the possible sunshine in March.

The USA

As far as cloud cover is concerned, this eclipse belongs to the United States, though viewing locations have to be picked carefully. Where China and Japan can offer no better than a 60-percent average cloud cover, values below 10 percent can be found in several places between California and Texas (Figure 4). It's not a slam dunk however, as eclipse watchers will have to watch for cloud along the coast and over the higher mountain peaks. A big incoming low-pressure system will play havoc with eclipse plans, so a lot of flexibility is required when eclipse day arrives. Weather forecasts will offer several days of warning about incoming cloud, so anyone driving down from the border will be able to adjust the final destination to at least have a chance at good weather.

Mountains have two roles to play in cloud production. By forcing air upward on the windward side, mountain barriers lift the air to saturation, manufacturing mid- and high-level clouds that then flow eastward to torment observers on the downwind side. Depending on the situation, the topographically induced clouds can extend hundreds of kilometres downwind, or dissipate only a short distance east of the high ground. In most cases, the thickness and extend of cloudiness in the mountains waxes and wanes with the presence of upper-level disturbances moving in from the Pacific.

The second cloud-promoting process comes from the heating of the mountain slopes by the Sun under clear or mostly clear skies. Mountains in the southwest and west tend to be heavily treed, and are darker than surrounding light-coloured deserts and plains. The dark areas absorb more solar energy, and the ensuing heating builds convective clouds—particularly thunderstorms—over and along the higher terrain. Fortunately, the Arizona monsoon, a season of moist air flows from the Gulf of California, does not arrive until early July, and cloud buildups are uncommon, especially on the east side of the Rocky Mountain chain. Most of the cloud problems, if there are any, will come from the upper disturbances.

For the eager eclipse seeker, the shadow's centreline makes landfall on the Pacific coast of California and Oregon between Crescent City and Eureka, and shortly thereafter crosses the first of a series of mountain barriers. The exposure to moist Pacific winds brings abundant rainfall to this coast, but even so, the percentage of sunny hours is higher than anywhere on the other side of the Pacific in Japan and China. Crescent City has a well-deserved

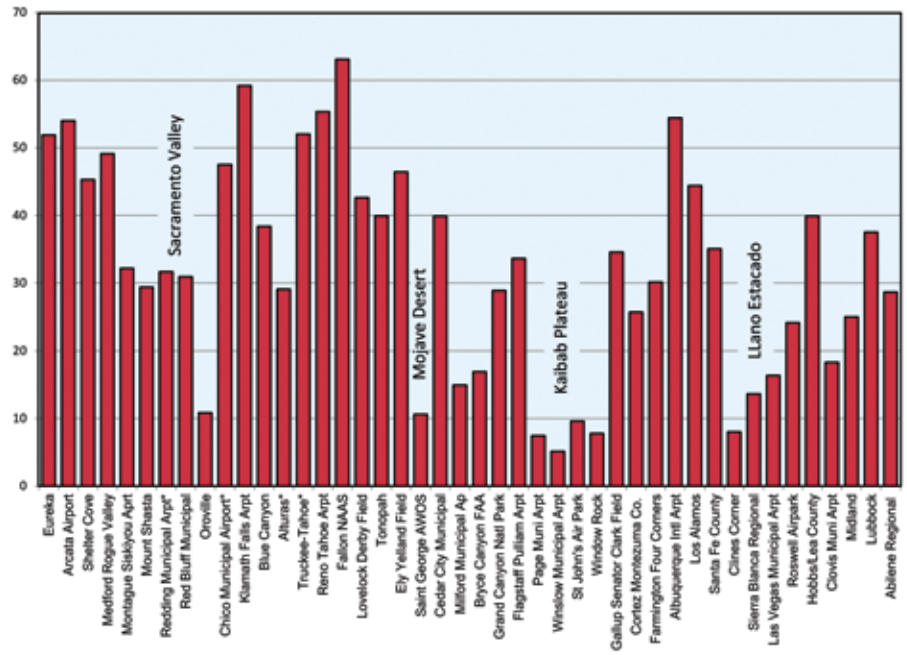

Figure 4 — A graph of average May cloud cover at selected stations along the U.S. portion of the track from 20 years of surface-based observations. Source: NCDC

reputation for fog, a consequence of cold offshore waters, but it's easily avoided by moving a short distance inland.

The ups and downs of average cloud cover over the United States shown in the graph in Figure 4 reflect the influences of terrain more than any other factor. The general downward trend in cloudiness from California to Arizona and New Mexico is a result of the blocking of Pacific Ocean moisture by the mountains. Within this general trend are features associated with more localized topography: lower cloud in the Sacramento Valley (Redding, Red Bluff, and Alturas); east of the Arizona's Kaibab Plateau (at Page); and over the Llano Estacado (Roswell and Clovis). The influence of terrain is also obvious in the satellite image of Figure 5: cloud lingers on the higher peaks but dissipates in the valleys.

By the time the eclipse shadow reaches Arizona and New Mexico, the Sun is low in the sky and there is a risk that the eclipse will be hidden by high ground before the critical 2nd contact arrives. While it is relatively easy to avoid this fate (it is, after all, a sign of very bad planning), eclipse camps should also be selected to avoid any clouds that form above the mountains. The best solution will be the east side of a flat low-altitude valley or plateau with the mountains low down on the west horizon. There are many choices available.

For the eclipsophile who wants to view the solar annulus on the sunset horizon, the only possible destination is the end of the track over Texas between Lubbock and Abilene. This is thunderstorm country, particularly in May, as the region is exposed to the Gulf of Mexico moisture that flows northward onto the Great Plains. The dry desert air from New Mexico ebbs and flows through this part of Texas depending on the daily winds and weather, but the overall cloudiness, at 30 to 40 percent, is still relatively low. The spectacle of a sunset annular eclipse will make some chasers willing to gamble on the storms, which can provide an alternative chase opportunity if the eclipse is clouded out.

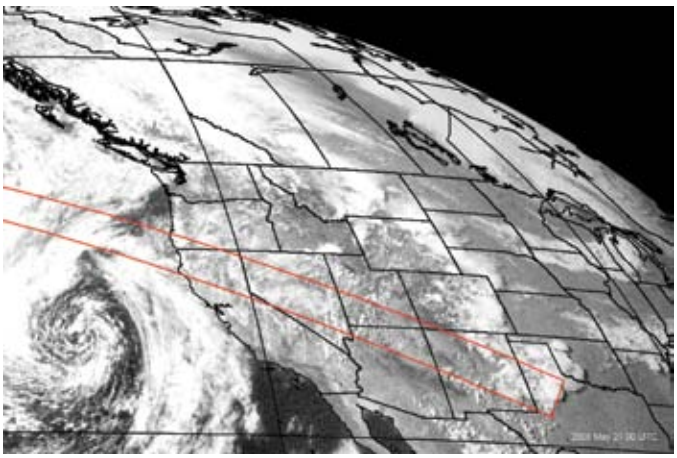

Figure 5 — A GOES West *satellite image of the eclipse track acquired 2006 May 21 at 00 UTC. Note the variable cloud cover as the atmosphere responds to the underlying terrain.*

Ultimately, there is no excuse for missing this eclipse anywhere across the western U.S. for an observer who is willing to plan and travel. Reliable weather forecasts are readily available for a week or more ahead of the eclipse, the transportation network is excellent, and in some parts, the climatological portents are among the best the world can offer. After being short-changed on eclipse tracks for the past 20 years, the U.S. finally has an easy chance to see one without crossing an ocean.

Watching and Photographing the Eclipse

No member of the RASC should be unaware of the need for eye protection when looking at the Sun, so I won't belabour the point here. Because this is an annular eclipse, protection is needed throughout the event. If you can, take along a few spare filter or eclipse glasses to share around with people who might not be so familiar with the hazards of naked-eye solar observations. It's pretty easy to whip up a pinhole projector on site, so come prepared with a bit of cardboard and a hole punch if you want to make a community event out of the spectacle. If everyone else is making one of their own, you won't be guilty about not sharing yours. A bit of mirror covered by cardboard with a small hole in it can be used to project an image of the crescent Sun on a wall. Of course, you only have to find a tree and watch the pinhole images form beneath it between the shadows of the leaves if you want the easiest way out.

One of the major limitations of an annular eclipse is the inability to see prominences and the corona. There isn't much to be done about the corona, but it is possible, with a little daring, to catch the prominences with a camera (you wouldn't want to try this by eye, though I've done it myself). The secret is to track the Sun (accurately), use a long-focal-length (1000-mm or more) telescope, and set the camera's view so that it is just catching the edge of the solar disk at the spot where the Moon will first or last break the Sun's edge. At that instant, the limb of the Moon will be tangent to the edge of the Sun, revealing the structures that lie along the limb; a very-short-exposure photograph at that fleeting moment may catch a prominence or the chromosphere. Several brave photographers were able to do so in May 1984, when a very narrow annular eclipse crossed over the eastern U.S. Of course, in this era of digital cameras, the effect of a telescope-enhanced view of the Sun on the CMOS or CCD sensor may fall in the area of "not recommended by the manufacturer." For safety, you should avoid looking through a DSLR camera viewfinder at the solar crescent if you try this; use "live view" instead or substitute a video camera.

Most eclipse watchers will want to head for the central axis of the track, but that is the least interesting place to go in my opinion. One of the attractions of an annular (and a total) is the evolution of Baily's beads as the last and first traces of the solar disk shine through the mountains on the limb of the Moon. On the central axis, Baily's beads last for only a few

seconds—essentially the time it takes for the Moon to move about 10 km (the approximate height of the mountains on the limb). At the edge of the track, or even better, just outside the edge, the beads will rotate around the limb of the dark lunar curtain, and the observer will see a continually changing light show. Video cameras and a thin solar filter are tailor made for recording the high-resolution bead phenomena.

For those jaded by too many annular eclipses in the past (that is, at least one), the spectacle can be spiced up by heading for the end point, where the annular ring lies on the horizon. Think of the photography: the annular ring behind a person on the horizon, behind a prominent building, behind a telephone wire (well, that will happen without planning). During the sunset annular over southern California in 1992, my wife Judy watched a green flash when the lower arc of the ring touched the ocean, and another when the upper ring reached the horizon. A green flash is unlikely in this eclipse, but a view of a football-shaped Sun sinking below the Texas horizon might get an honourable place in the *Journal* if you submit it to me. ✶

Jay Anderson is a member of the Winnipeg Centre and editor of this Journal. *He has seen a bunch of eclipses.*

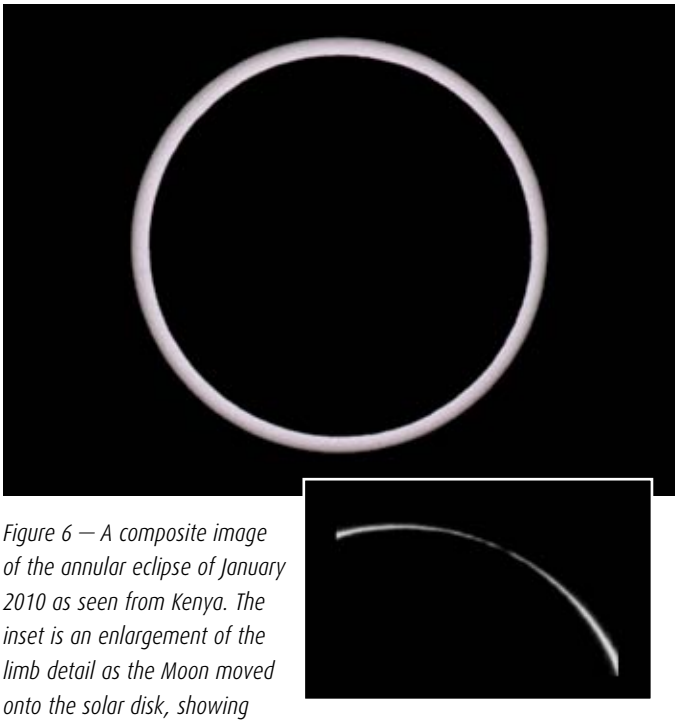

Figure 6 — A composite image of the annular eclipse of January 2010 as seen from Kenya. The inset is an enlargement of the limb detail as the Moon moved onto the solar disk, showing some of the beads.

An Early American Zodiac

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Abstract

This study builds on two previous articles and uses Aztec and Mayan sources to re-assemble an early American zodiac of 13 constellations.

Résumé

Cette étude se base sur deux articles précédents et se sert de sources Aztec et Maya pour reconstituer un zodiac paléoaméricain de 13 constellations.

1. Introduction

In an earlier submission to this journal, "Star Patterns on the Aztec Calendar Stone" (McIvor 2000), I suggested that the dotted pattern at the 7 o'clock position on the stone was a group of stars that straddles the ecliptic in Sagittarius. In a more recent piece, "Aztec Constellations Preserved by Duran" (McIvor 2010), I identified five constellations from Aztec paintings preserved by this Spanish priest in 1579, and I plotted the five figures with stars along the ecliptic. I then had a partial zodiac, but I had exhausted Aztec sources. I now wish to turn to Mayan sources to continue my reconstruction of the zodiac, for there is reason to believe that Maya and Aztec had a similar zodiac, and Mayan sources could add to my list.

The Aztecs of central Mexico and the Mayas of the Yucatan peninsula had a shared history. They also shared a calendar that had 18 "months" of 20 days each, plus 5 "useless" days. Similarity in time-reckoning suggests that they mapped the

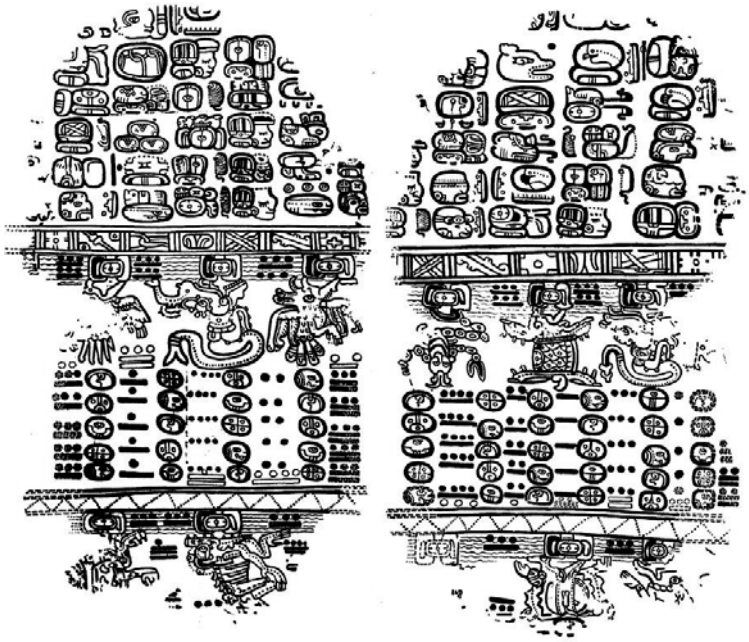

Figure 1 — Pages 21 and 22 from the Paris Codex. The zodiac figures mentioned in the text lie across the middle and bottom of the images (Villacorta & Villacorta, 1976). See http://digital.library.northwestern.edu/codex/codex.html for a larger view.

Figure 2 — Animals carved at the Nunnery at Chichen Itza, with names added.

heavens with similar constellations, as organizing the year and mapping stars along the ecliptic are flip sides of the same coin. The Aztecs and Mayas probably inherited their calendars and constellations from an earlier civilization in Mesoamerica. I am interested in two Mayan sources. One is the pre-conquest manuscript called the Paris Codex (Figure 1) that shows a row of animals hanging from sun symbols below a sky band; the other is the Nunnery at Chichen Itza (Figure 2), which displays a row of animals on the lintel that matches part of the Paris Codex sequence.

These sources offer tantalizing hints of a zodiac, although we need to bear in mind that a parade of animals is not a zodiac in the astronomical sense unless the animals can be matched with star patterns straddling the ecliptic. We are faced with two challenges: the first is to identify the animals on the codex and list them in the right order; the second is to plot each animal against the stars along the ecliptic. We do not come to this challenge empty handed, for we have already plotted five Aztec zodiacal constellations. The additional animals in the Paris Codex will hopefully fill some or all of the empty spaces.

2. The Animals in the Paris Codex

Herbert Spinden first proposed the idea of an early American zodiac in 1916. He realized that the Paris Codex once displayed 13 columns with 13 animals and a few had become effaced over time. He suggested cautiously that "The thirteen animals holding in their mouths the sign of the sun might represent thirteen signs of a zodiac" (1916:77). He thought these constellations appeared in the Mayan sky in the order set out in the codex and he felt the zodiac could have been "an independent invention" (1916:79), American-made, not borrowed or inherited from elsewhere.

Maya scholars tell us that these pages in the Paris Codex read from right to left and the first animal was once painted at the top right of the right page. Most of it is effaced, and only an appendage of some kind remains (Figure 1). It is insufficient to identify the animal. The second animal is a rattlesnake; the third a turtle; the fourth a scorpion; and the fifth is a vulture. The sixth animal is a serpent. I think it is a python that has coiled itself around a tapir and is squeezing the life out of its victim. (A tapir is an animal indigenous to Mexico and it has a distinctive trunk.)

The seventh animal is a bird. The eighth animal at the lower right of the right page is almost completely effaced. Kelley (1976:47, 49-50) identifies it as a peccary on the basis of seeing a hoof on one forelimb. Its flat snout reinforces this identification. The ninth animal is another bird. The tenth animal is totally effaced. The eleventh is largely effaced although Severin (1981:12) suggests the squiggle may be the cloven hoof of a deer. The twelfth animal is a human skeletal ribcage and a fleshless head-death or a death-head. The thirteenth creature is partially effaced. Kelley (1976:49) points to its spotted skin and prominent claws and identifies it as a jaguar. Thus eleven of the thirteen animals can be identified, at least provisionally.

I identified five animals in Aztec cartography as Butterfly (western half of Pisces), Bird (Taurus), Frog (Gemini), Death (Leo +), and Rattlesnake (Scorpius). Four of the five appear on the Paris Codex. The Frog is totally effaced in the Codex. When we add Frog to the Mayan line-up, we have identified 12 of its 13 animals.

The Aztec calendar began on February 2 (February 12, Gregorian) according to Sahagun (1569). The Mayan calendar began on July 16 (July 26, Gregorian) according to Landa (1566). Their zodiacs had the same sequence of animals, but because their calendars began the year in a different season, their zodiacs began with a different constellation. The Aztec zodiac began with Butterfly. The Mayan zodiac began with the only animal we have not identified yet.

The following list names the animals in the Paris Codex. I have underlined the ones we can identify in the Aztec zodiac: Unknown, *Rattlesnake*, Turtle, Scorpion, Vulture, Python, *Bird*, Peccary, *Bird*, *Unknown*, Deer, *Death*, Jaguar. Our five Aztec constellations– Rattlesnake, Butterfly, Bird, Frog, Death– provide a framework that we can use to assign seating for the extra animals in the Paris Codex. For example, it is obvious which animal is located between Butterfly and Bird. It is Peccary.

3. Peccary

The Peccary is wedged between the Butterfly in Pisces and the Bird in Taurus so it must be located in Aries. The stars in Aries, with a few in Triangulum and Cetus, will configure this tail-less pig that is native to the Americas.

4. Deer

The Deer precedes Death on the Paris Codex. We have already placed Death in Leo and part of Virgo, so Deer can be positioned in Cancer.

5. Jaguar

The Jaguar follows Death on the Paris Codex. We have already placed Death in Leo and part of Virgo, so Jaguar can be positioned among the stars in eastern Virgo.

6. Turtle

The Turtle follows Rattlesnake in the Paris Codex. We have already positioned Rattlesnake in Scorpius so the Turtle must be in Sagittarius. The Aztec Sun Stone has a star pattern at the 7 o'clock position shaped like a box or parallelogram and it is matched by the parallelogram joining ψ, ζ, γ, and ε in Sagittarius. These four stars configure the body of this Turtle, which is probably a box turtle. It is swimming in the Milky Way but seems to be held in place by a lasso or a net of some kind. (A box turtle can retract its head and legs within its shell.)

7. Scorpion, Vulture, and Serpent

We placed Rattlesnake and Turtle in Scorpius and Sagittarius. The three animals following Turtle in the Paris Codex are Scorpion, Vulture, and Serpent, so they should be assigned seating in sequence in Capricornus, Aquarius, and Pisces.

The body of the scorpion can be configured with the northern row of stars in our Capricornus. Its head dips below the ecliptic. Its stinger is raised above the ecliptic at a bright star cluster to the west. It hangs by its tail from the ecliptic, like the scorpion in the Paris Codex. The vulture includes many of the stars in Aquarius, but it needs one star from Pegasus for its head. The python is known to wrap itself tighter and tighter around its prey, but I have coiled this python harmlessly around the Circlet of stars in the western half of Pisces.

8. The Missing Constellation

We have insufficient evidence to identify one of the animals. It must have been positioned in our Libra because that is the only space vacant along the ecliptic. I can make an educated guess about its identity. Duran names the 20 days in an Aztec month, and Heyden lists them as Alligator, Wind, House, Lizard, Serpent, Death, Deer, Rabbit, Water, Dog, Monkey, Wild Grass, Reed, Jaguar, Eagle, Buzzard, Motion, Flint Knife, Rain, and Flower (Figure 3). The 20 figures for the 20 days form an inner circle on the Aztec Sun Stone. At least five of them, Rattlesnake, Death, Deer, Jaguar, and Motion (Butterfly) are zodiacal constellations, and the missing constellation may be one of the other animals on the list.

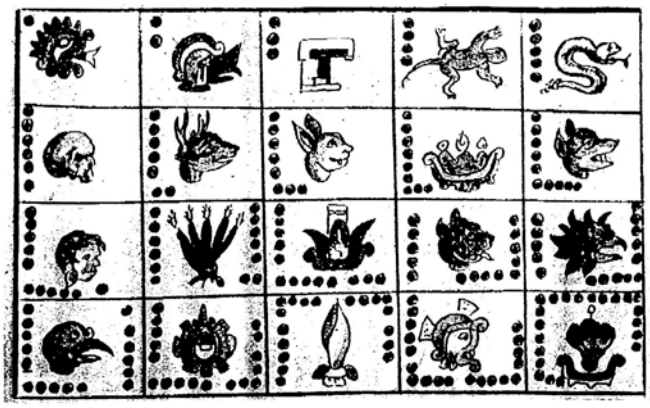

Figure 3 — The 20 Aztec day symbols.

I can choose from Alligator, Lizard, Rabbit, Dog, Monkey, Eagle, and Buzzard. I think Lizard is the best choice because the appendage for the first animal on the Paris Codex could be the right forearm of a Lizard.

9. Animals Carved at Chichen Itza

Coe (1975, Figure 9) describes a sequence of animals on the East Wing of the Monjas at Chichen Itza as "probable asterisms." I have added names for most of them: Turtle, Scorpion, Vulture, Python, Butterfly, Peccary, Unknown, Frog, Unknown, Death (Figure 4). Eight form a sequence that matches a row of animals in the same order in my zodiac, which adds an independent layer of credibility to my scheme.

10. A Complete Zodiac

I have a complete circle of 13 animals and it has a symmetry that is esthetically pleasing. The figures look good up close as well (Figure 5).

I admit my proposal is not free from criticism. I acknowledge that Deer and Lizard barely made the cut (if I can use a term from golf). If archaeology uncovers better candidates in the future, one or both may be replaced. If that becomes necessary, the circle will remain an authentic zodiac of animals.

My arrangement is based on two equations: the first is that the Aztec Bird is our Taurus and the second is that their Rattlesnake is our Scorpius. I equated Bird with Taurus because Duran wrote in 1579 that it was "a star formation that appears in the heavens like a bird pierced with a bone. The imagination of the natives may be compared with that of the poets and the astrologers, who imagined they saw the sign of Taurus, made up of many stars. Thus these people imagined this sign in the sky." Horcasitas and Heyden commented that "The constellation in the form of a bird pierced with a bone can be identified as Taurus." Some Mayan support for equating Bird with Taurus is the Yucatec Maya Dictionaries that ambiguously describe the Pleiades as "a bird" and "a snake rattler star" and "an insect" (Lamb 1981:234).

I equated their Rattlesnake with our Scorpius and there is both direct and indirect evidence for this correlation. Milbrath (1999) suggests that "the White Bone Snake may be an image of Scorpius" and she interprets the sarcophagus at Palenque as showing Lord Pacal entering the Milky Way at our Scorpius. The indirect evidence comes from the Skidi Pawnee Indians of North America who viewed the stars in our Scorpius as "a big snake", according to Chamberlain (1982). This tribe is known to have borrowed ideas from the Aztecs. Several other cultures also viewed the stars in our Scorpius as a snake, including the Kogi of Colombia (de Greiff & Hildebrand, 1987), several tribes in Brazil (Levi-Strauss, 1968), and a number of tribes in Java (Staal, 1988).

11. Comparing Schemes

Since 1976 there have been several attempts to reconstruct a Mayan zodiac. Table 1 compares my proposal with four previous efforts. Three of these earlier schemes assume that the Mayan scorpion is our Scorpius despite criticism from several scholars. Spinden (1916) did not think the assumption was credible. Thompson (1974) thought it was "highly doubtful that the same constellation is involved." And, Love (1994) insisted that "modern researchers should not make the *a priori* assumption that the Maya scorpion is the Western Scorpio."

When different cultures use the same name for a star group, they may not mean the same constellation. There are a number of obvious examples. The Chinese had a Ram constellation like us, but it was located in Cancer the Crab, not in our Aries the Ram (Allen 1963:5). The Inca had a Serpent constellation like us, but it was a "dark cloud" shape in the Milky Way, not our Serpens (Bauer & Dearborn 1995:139). Egypt and Brazil each had a Crocodile constellation, but the Egyptian reptile swims near Polaris (Krupp 1983:107), while the Brazilian version was configured by stars in Orion (Staal 1988). It is unlikely that the Mayan scorpion was our Scorpius.

Researchers agree that five of the animals in the Paris Codex can be identified in sequence as Rattlesnake, Tortoise (Turtle), Scorpion, Bat (Vulture), and Snake (Python). I think a sequence of animals in the Paris Codex demands a sequence of constellations in our zodiac. I therefore show their Western equivalents as Scorpius, Sagittarius, Capricornus, Aquarius, and Pisces, that form an uninterrupted sequence. However, the earlier efforts to reconstruct a Mayan zodiac propose five equivalents that are literally all over the place. None of them forms a sequence, and I consider this failure a serious flaw.

Bishop Landa (1566) recorded that the Mayas paid close attention to Venus, the Pleiades, and Gemini. I therefore began with the Pleiades, and I came to recognize it as the eye of the Bird pierced with a bone, which Duran equated with our Taurus in 1579. Trejo tells us that "Tianquiztli, meaning crowd or market, corresponded to the Pleiades" (2002:3).

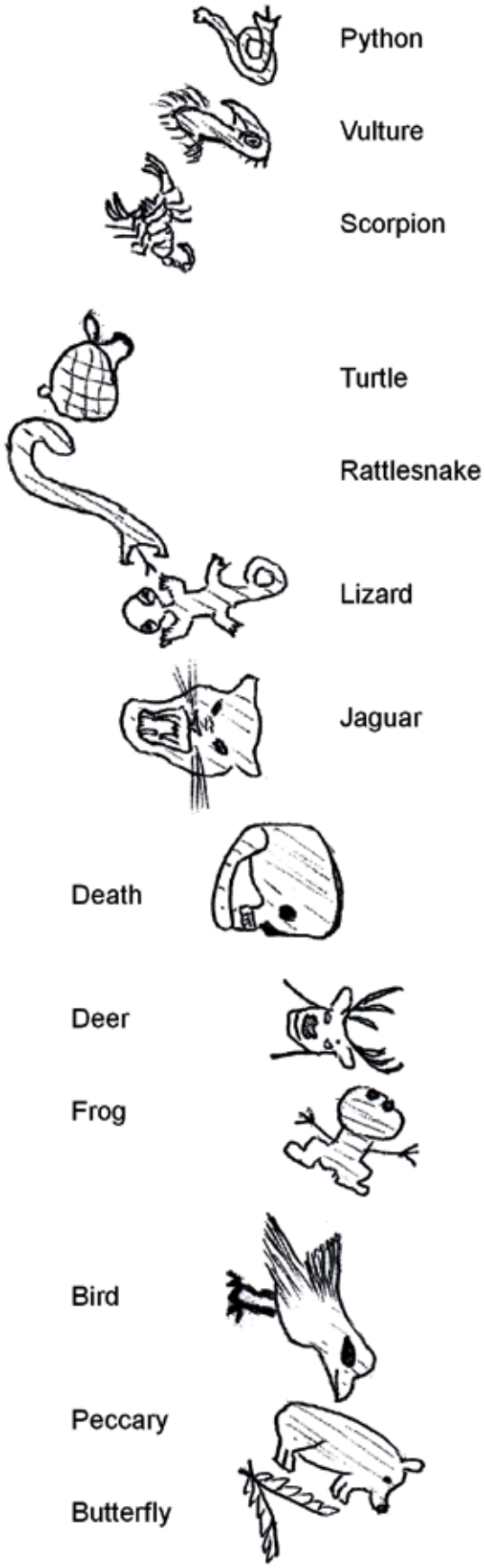

Figure 4 — A complete zodiac of 13 animals. The five added by the author from previous work are Rattlesnake, Death, Frog, Bird, and Butterfly.

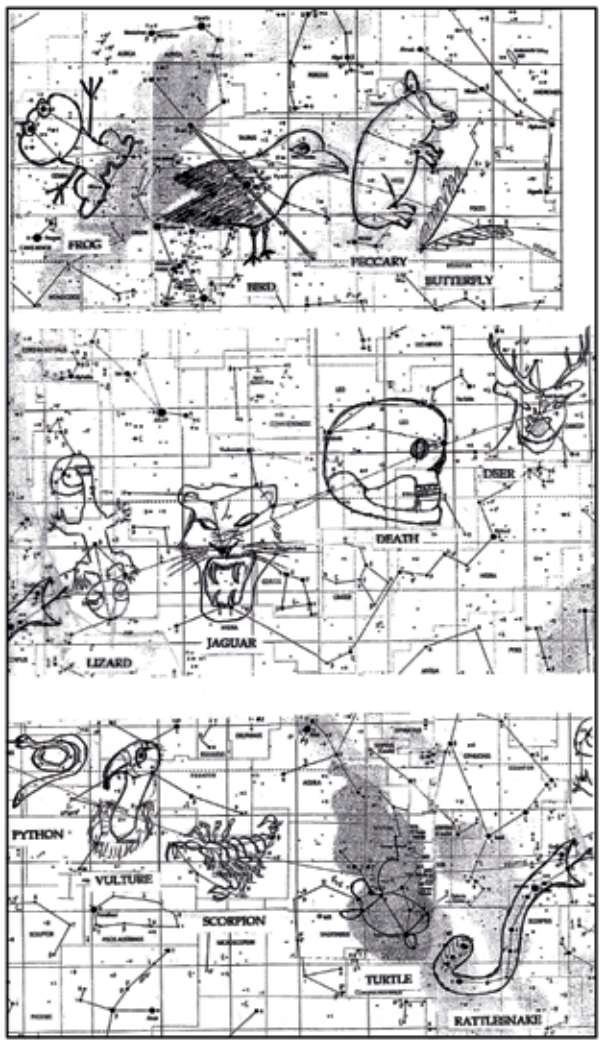

Figure 5 — Thirteen constellations, up close. Four of the constellations can be matched with Greek equivalents: Bird=Taurus; Frog=Gemini; Rattlesnake=Scorpius; Scorpion=Capricorn.

Anthony Aveni agrees it "likely represents the Pleiades" and he describes the Aztec depiction as "arrowhead-shaped" (2001:34). In my article of 2010, I suggested it resembles the sideview of an eye for it is oval-shaped on one side and pointed at the other. It is interesting that the Inca called this star cluster *eyes* (Aveni 2001:311) and the Maori in New Zealand called it *little eyes*.

In *The Golden Bough* (1912), Frazer describes how "the Pleiades plays an important part in the calendars of primitive peoples, both in the northern and in the southern hemisphere. They have commonly timed the various operations of the agricultural year by observation of its heliacal rising or setting." I took great care in positioning the Bird on the ecliptic to make sure its eye coincided with the position of the Pleiades. Then I secured the Bird firmly in place by piercing it with a bone (actually, a straight line) from β Tauri through α Tauri to 10 Tauri. I think positioning the Pleiades correctly is the most critical first step in trying to reconstruct the early American zodiac, because this star cluster must have been as prominent in their zodiac as it was in their calendar and observations.

12. Foreign or American?

Did early Americans compose this zodiac or was it brought here from elsewhere? There are two good reasons for thinking that this zodiac was invented in America.

The first reason is that the animals are native to the Americas. Bishop Landa (1566) described the animals in Mexico at the time of the Conquest. He listed turtles, lizards, deer, tail-less pigs (peccaries), scorpions, and tigers (jaguars), and went on to describe snakes, including rattlesnakes and pythons, and a spectacular variety of birds. Every animal in this zodiac can be found in the Americas. Whoever invented this zodiac was familiar with all these creatures. Donald Menzel (1943) used the same line of argument when discussing the origin of our Western constellations in *The Heavens Above*: "Most of the animals shown among the constellation figures are those familiar to the people of the Old Testament who lived in Mesopotamia. This fact leads us to believe that the figures originated in that part of the world." So, too, the animals in the early American zodiac suggest their constellations originated with people familiar with these animals, that is the early Americans themselves.

The second reason is that the ecliptic in this arrangement accommodates the unique American calendar of 18 months of 20 days. We learned from Duran that some Aztec figures (*i.e.* Bird) spanned two months while others (*i.e.* Butterfly) spanned only one month. Theoretically, this early American zodiac divides the ecliptic longitudinally into eight constellations of 20 degrees and five constellations of 40 degrees. Eight constellations spanned one month, five spanned two months, and altogether they composed a zodiac of 13 constellations that supported a calendar of 18 months of 20 days. This arrangement differs from the zodiac we have inherited from Greece that theoretically divides the ecliptic longitudinally into 12 segments of 30 degrees. It differs from the ancient Egyptian division of the ecliptic into 36 segments of 10 degrees that supported a calendar of 36 "weeks" of 10 days. And, it differs from Chinese cartography, copied by Korea and Japan, where a lunar zodiac divides the sky longitudinally into 28 segments of unequal widths. This early American zodiac resonates with the early American calendar. The 5 wide segments of 40 degrees I assigned to Bird, Frog, Death, Rattlesnake, and Turtle.

13. Reassembling an Early Zodiac

I never set out originally to assemble a zodiac. It happened more by accident than design. My initial interest in early cartography was sparked a decade ago by the dotted patterns on the Aztec Sun Stone. I like "joining the dots," so I tried my hand at identifying these patterns with stars in the real sky. Years later, my reading of Duran's manuscript offered up several more constellations. When I realized I had assembled five constellations along the ecliptic, it seemed logical to use

this framework to impose order on the row of animals on the Paris Codex.

Over the years, my views about an early American zodiac have changed. A decade ago, I thought their zodiac could have been brought to America from elsewhere. But, I cannot hold that view anymore because it has animals native to America and its division of the ecliptic is consistent with time-reckoning on this continent.

I have assembled 13 animals: Lizard, Rattlesnake, Turtle, Scorpion, Vulture, Python, Butterfly, Peccary, Bird, Frog, Deer, Death, and Jaguar. This arrangement vindicates the proposal made by Spinden in 1916 for 13 constellations in the order set out in the Paris Codex in a zodiac composed by sky observers in early America.

14. Is It Worth the Effort?

At a symposium of the IAU in 2009 on *The Role of Astronomy in Society and Culture*, Ivan Sprajc (2011) referred to efforts to reconstruct an early American zodiac: "The most interesting data concerning Maya constellations are contained in the prehispanic manuscript known as the Paris Codex. The images on pages 23 and 24 have been interpreted by various researchers as a Maya zodiac, even if there is no agreement about the functioning of the table and the identity of constellations." He failed to mention the reason for these disagreements. I think McKillop (2004) described the situation much better when she emphasized that "researchers agree about the existence of a Maya zodiac" and she recognized that their disagreements are due to the "information from the codices [that] provide a fragmentary and sometimes contradictory picture of the Maya zodiac."

F.R. Stephenson reminds us that "Charting the stars is an undertaking entirely different from delineating terrestrial features such as the continents and islands. Since the stars appear as scattered points of light, any attempt to divide them into groups must necessarily be subjective. The arbitrariness of such an exercise is increased by the wide range in brightness among the roughly six thousand stars that are estimated to be visible to the average unaided eye over the whole of the celestial sphere. It is thus remarkable that throughout history only two distinct schemes of astral cartography have enjoyed widespread usage. These are of Babylonian-Greek and of Chinese origin." (1994:511)

Are there only *two* schemes of cartography that have enjoyed widespread usage, or was there a third scheme that originated in early America? We know a great deal about Babylonian-Greek and Chinese cartography because their records were preserved intact. It was entirely different in the Americas, where native culture was devastated in the Conquest in the 16th century. Some bishops burned thousands of codices and left us impoverished. The few bits and pieces of evidence for native astronomy are scattered and fragmented, and the challenge is to reassemble them as best we can. Disagreements are inevitable in these circumstances. The question of a zodiac in America is an archaeological as well as an intellectual quest. It is time consuming but worth the effort if we can conceive that the history of cartography will be re-written and a future author will write that "*three* distinct schemes of cartography have enjoyed widespread usage." When that happens, the zodiac of early America will take its rightful place in the history of cartography.

	Paris Codex	**McIvor 2012**	**Kelley 1976**	**Severin 1981**	**Bricker 1992**	**Milbrath 1999**
1	Lizard (Serpent)	Libra	?	Sagittarius	?	?
2	Rattlesnake	Scorpius	Sagittarius	Taurus	Pleiades	Pleiades
3	Turtle (Tortoise)	Sagittarius	Gemini	Orion	Orion	Orion
4	Scorpion	Capricornus	Scorpius	Gemini	Scorpius	Scorpius
5	Vulture (Bat)	Aquarius	Aquarius	Virgo	Virgo	Aquarius
6	Python (Snake)	Pisces (E)	Libra	?	Sagittarius	Sagittarius
7	Butterfly (Bird)	Pisces (W)	Aries	Cancer	Capricornus	Capricornus
8	Peccary	Aries	Leo	Sagittarius	Leo	Leo
9	Bird	Taurus	Taurus	Scorpius	Gemini	Libra
10	Frog	Gemini	Virgo	Libra	Leo	Cancer
11	Deer (Bat)	Cancer	Pisces	Capricornus	Aquarius	Virgo
12	Death	Leo	Cancer	Aquarius	Pisces	Pisces
13	Jaguar	Virgo	Capricornus	Pisces	Aries	Aries

Table References: Milbrath (1999) Table 7.3, Aveni (2001) Table 23

References

Allen, R.H. (1963). *Star Names: Their Lore and Meaning.* New York: Dover Publications.

Aveni, Anthony F. (2001). *Skywatchers*. Austin: University of Texas Press.

Bauer, B. & Dearborn, D.S.P. (1995). *Astronomy and Empire in the Ancient Andes*. Austin: University of Texas Press.

Bricker, H.M. & Bricker, V.R. (1992). Zodiacal References in the Mayan Codices. In A.F. Aveni (Ed.), *The Sky in Mayan Literature.* New York: Oxford University Press.

Carlson, John B. (1990). America's Ancient Skywatchers. *National Geographic, March 1990, Volume 177, No. 3.*

Chamberlain, Von Del (1982). *When Stars came down to Earth: Cosmology of the Skidi Pawnee Indians of North America*. Los Altos: Ballina Press.

Coe, Michael D. (1975). Native Astronomy in Mesoamerica. In A.F. Aveni (Ed.), *Archaeoastronomy in Pre-Columbian America*. Austin: University of Texas Press.

de Greiff, J. Arias. & Reichel, E. (1987). *Etno-astronomias Americanas*. Bogota, Columbia: University of the Andes.

Duran, Fray Diego (1579). *Book of the Gods and Rites and The Ancient Calendar*. Translated by F. Horcasitas & D. Heyden (1971). Norman: University of Oklahoma Press.

Frazer, James George (1912). The Pleiades in Primitive calendars. In *The Golden Bough: A Study in Magic and Religion, VII, (5),* 307-319. London: MacMillan & Co.

Kelley, David H. (1976). *Deciphering the Maya Script*. Austin & London: University of Texas Press.

Krupp, E.C. (1983). *Echoes of the Ancient Sky: The Astronomy of Lost Civilizations*. New York: New American Library.

Lamb, Weldon W. (1981). Star Lore in the Yucatec Maya Dictionaries. In R. Williamson (Ed.), *Archaeo-astronomy in the Americas*. Los Altos: Ballina Press.

Landa, Fray Diego de (1566). *Yucatan Before and After the Conquest*. Translated with Notes by William Gates (1978). New York: Dover Publications.

Levi-Strauss, Claude (1968). *Lo Crudo y Lo Cocido*. Mexico, D.F.: Fondo de Culture Economica.

Love, Bruce (1994). *The Paris Codex: Handbook for a Maya Priest*. Austin: University of Texas Press.

McIvor, R.S. (2000). Star Patterns on the Aztec Calendar Stone. *JRASC, 94*, (2).

McIvor, R.S. (2010), Aztec Constellations Preserved by Duran. *JRASC, 104*, (2).

McKillop, Heather I. (2004). *The Ancient Maya: New Perspectives*. New York: W.W. Norton & Co.

Menzel, Donald H. (1943). *The Heavens Above*. National Geographic, August, 1943, Vol. LXXXIV, No. 2.

Milbrath, Susan (1999). *Star Gods of the Maya: Astronomy in Art, Folklore, and Calendars*. Austin: University of Texas Press.

Sahagun, Fray Bernardino de (1569). *General History of the Things of New Spain. Book 2: The Ceremonies*. The Florentine Codex.

Severin, Gregory M. (1981). *The Paris Codex: Decoding an Astronomical Ephemeris*. Philadelphia: American Philosophical Society.

Sprajc, Ivan (2011). Astronomy and its role in ancient Mesoamerica. *The Role of Astronomy in Society & Culture, IAU Symposium, No. 260*, 2009.

Spinden, Herbert J. (1916). The Question of the Zodiac in America. *American Anthropologist 18* (1), 53-80.

Staal, Julius D.W. (1988). *The New Patterns in the Sky: Myths and Legends of the Stars*. Blackburg, VA: McDonald & Woodward.

Stephenson, F. Richard (1994). Cartography in the Traditional East and Southeast Asian Societies. In J.B. Harley & David Woodward (Eds.), *The History of Cartography, Vol. 2, Book 2*. Chicago: University of Chicago Press.

Thompson, J.E.S. (1974). Maya Astronomy. In *The Place of Astronomy in the Ancient World*, a joint symposium of the Royal Society & the British Academy. London: Oxford University Press. (83)

Trejo, J. Galindo (2002). *The Astronomy in the Mexican Prehispanic Past*. Astronomical Society of the Pacific Conference Series, Volume 282, 2002.

Villacorta, C.J.A. & Villacorta, C.S.A. (1976). *Codices Mayas* (Second Edition of 1930 Publication). Guatemala: Tipografia Nacional.

Science Marches Quietly Forward at Trent University's Department of Physics and Astronomy

by John Crossen, Kingston Centre
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Revolutionary scientific breakthroughs are usually the culmination of numerous years of work by a great number of dedicated individuals. The data they gather and the host of small discoveries they make while pursuing the "bigger answer" may only come to light long after they are gone. But the foundation they lay, with both their successes and failures, is essential to the progress of science and humanity.

Dr. David Patton of Trent University and a group of colleagues in British Columbia are researching how the interaction between galaxies influences the activation of black holes within the galaxies. In this research, they have discovered what appears to be a relationship between galactic interaction and an increase in star formation within the companion galaxies—not just in the outer arms of the galaxies, but within their core regions.

The study, called *The Role of Galaxy-Galaxy Interactions in Galaxy Evolution* has resulted in their publication of six papers on the subject over the past four years. Starting with a million galaxies gleaned from the Sloan Digital Sky Survey, Dr. Patton developed a technique for shaving that figure down to 10,000 more-interesting galaxy pairs. With this rich database, the project began to pick up speed—and collaborators.

In late 2011, the Natural Sciences and Engineering Research Council (NSERC) awarded Dr. Patton a $140,000 grant to fund his research for the next five years. The grant will help offset the cost of seminars, travel, and a host of additional expenses related to the study.

To paraphrase Dr. Patton, this is the kind of research that is curiosity driven. Understanding galaxy formation is just a small portion of the story of where human beings came from, where we are going, and whether there might be other civilizations in our galaxy or the Universe. As humans, it's just something we want to know.

Most, if not all, massive galaxies have a black hole at their core. However, not all black holes are active. Some are quiescent, just sipping a bit of "star stuff" occasionally. That can change as massive galaxies come closer to each other and begin to interact. The proximity of another galaxy can activate a near-dormant black hole. When activation occurs, the infall of gasses and star material will eventually result in an accretion disk whose radiation can be detected by an X-ray telescope.

Figure 1 — Dr. David Patton

While this fits the textbook definition of a black hole, something unique can also take place—new star formation, not just in the outer arms of the galaxy, but within its core.

In effect, the result of galaxy-galaxy interaction can be a death sentence for some stars, while in other circumstances, that interaction triggers the birth of new ones.

Collaborating with Dr. Patton are Drs. Sara Ellison and Trevor Mendel from the University of Victoria; a third collaborator, Dr. Luc Simard, is with the Herzberg Institute of Astrophysics in Victoria.

Dr. Patton is a graduate of the University of Victoria and is known for his previous work with the *Hubble Space Telescope* Survey of Distant Galaxy Pairs, Close Pairs of Galaxies in the SSSR2 Redshift Survey, and The CNOC2 Field Galaxy Redshift Survey.

For Dr. Patton, progress marches quietly on, in between the beat of the astronomy, astrobiology, and physics courses he teaches as an Associate Professor at Trent University. The answers he and his colleagues seek may not be unravelled in their lifetimes, but the foundations they lay will help others build in the future. ✶

John Crossen has been interested in astronomy since growing up with a telescope in a small town. His public-outreach facility, www.buckhornobservatory.com is just north of Buckhorn, Ontario.

On Another Wavelength

The Galaxies of Pegasus

by David Garner, Kitchener-Waterloo Centre
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The Greeks described it as a divine winged horse. Ptolemy included it in his *Almagest* around AD 150 as one of 48 constellations, but it was probably known to the Babylonians before 2000 BC. Today, Pegasus, commonly called the "Square of Pegasus," is one of the 88 modern constellations recognized by the IAU. The square shape of this northern constellation (Figure 1) is formed by the bright stars α Pegasi (Markab), β Pegasi (Scheat), γ Pegasi (Algenib), and α Andromedae (Alpheratz**)**.

Even though it has the alpha designation, Markab is not the brightest star in Pegasus. Epsilon Pegasi (ε Pegasi) has that honour; Markab is an average star similar to our Sun. It is thought that Markab will soon enter the final phases of its evolution, during which it will expand into a red giant and eventually end its life as a white dwarf.

Scheat is a bright star with a relatively cool surface temperature of 3700 K, compared to a star like our Sun, whose surface temperature is 5800 K. Scheat is a red giant nearly 100 times larger than the Sun.

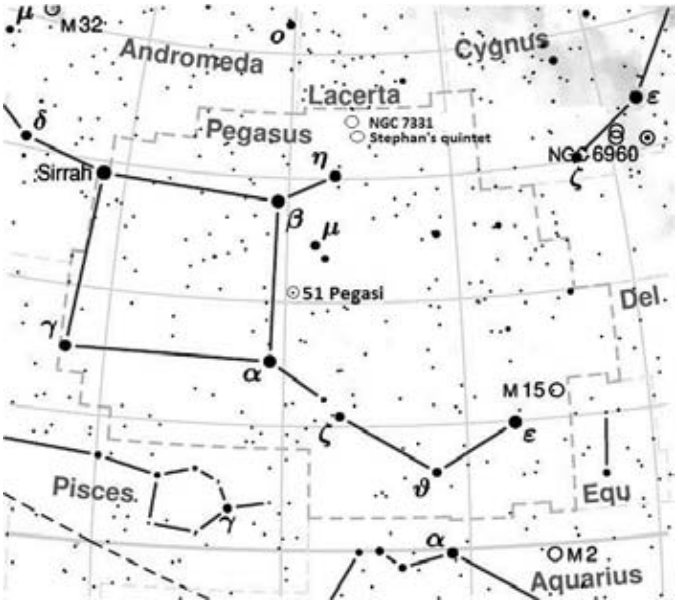

Figure 1 — A map of the constellation Pegasus.

Algenib is a Cepheid variable. Its magnitude varies approximately between +2.78 and +2.89 with a period of 3.6 hours.

Alpheratz is the brightest star in Andromeda. It used to be known as delta Pegasi, but this name is no longer used. Alpheratz is actually a binary system of two stars in close orbit.

Figure 2 — Stephan's Quintet. Credits: X-ray: NASA/CXC/CfA/E. O'Sullivan. Optical: Canada-France-Hawaii Telescope.

Pegasus is a great constellation with several interesting objects to check out (Figure 1). One of the best-known objects in the constellation is Messier 15 (M15), a globular cluster estimated to be 13.2 billion years old. It can be found near the head of the horse. Also interesting is the star 51 Pegasi, a 6- to 8-billion-year-old yellow-dwarf star with a rotational period of 37 days. 51 Pegasi, at a distance of 50.9 light-years, was the first Sun-like star discovered to have a planet (Didier Queloz & Michael Mayor 1995).

Figure 3 — NGC 7331 and Stephan's Quintet (upper right), courtesy of Ron Brecher. Ron shot the image from his SkyShed POD in Guelph, Ontario, using a 10-inch f/3.6 ASA astrograph with Astrodon LRGB filters and a MI-250 mount. Guiding was done with an SX-Lodestar camera.

Pegasus is home to few faint galaxies such as NGC 7742, a face-on unbarred spiral galaxy. This galaxy is unusual in that it contains a ring around its central core that has caused some to describe its appearance as that of a fried egg.

The better-known cluster "Stephan's Quintet" is a group of five galaxies, four of which form the first compact galaxy group ever discovered. These galaxies are 280 million light-years away and, with magnitudes between +14 and +16, are a visual challenge for amateur astronomers. Radio observations have revealed a mysterious emission filament that stretches across the space between the members of the group. The galaxies also have surrounding X-ray halos of hot, emitting gas. They seem to be on a violent collision course that most likely will end with them merging into one large elliptical galaxy (Figure 2).

The NGC 7331 Group (also called the Deer Lick Group) contains several faint galaxies: NGC 7335, NGC 7336, NGC 7337, NGC 7340, and NGC 7331. The galaxies NGC 7335 to NGC 7340 in this group are all magnitude 14 or dimmer. NGC 7331 (Figure 3) is a spiral galaxy about 50 million light-years away and has been compared in size and structure to our Milky Way. An interesting feature of this galaxy is its central bulge, which rotates in the opposite direction to the rest of the disk. Although difficult to explain, this feature of NGC 7331 is not unique among spiral galaxies.

NGC 7331 is a magnitude 10 object. With a small telescope, it appears as a faint fuzzy spot, but with enough patience can be imaged quite well. It is contained in the RASC's Finest NGC list. If you would like to go hunting for it, try looking toward RA $22^{h}\ 37^{m}\ 04.1^{s}$ and Dec $+34^{\circ}\ 24'\ 56''$. All-in-all, the galaxies of Pegasus are a great place to spend an evening. ✶

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

Cosmic Contemplations

The Mod Dob Job and the Rat Dob

by Jim Chung, Toronto Centre
(jim_chung@sunshine.net)

It must be wintertime because, instead of imaging, I've been having too much fun in my man cave. Now, my cave doesn't have a beer fridge, a foosball table, or a large plasma screen with one of each of the big-three gaming systems. It is a crowded, unheated garage within which I toil and writhe like a contortionist to avoid all the usual suspects, in addition to having a motorcycle, a car, and several swinging overhead bicycles suspended from the rafters. This month, we're makin' Dobs!

Figure 1 — The Sky-Watcher Dob, as it comes from the manufacturer.

Two years ago, I was trying to find a large-aperture scope to further my planetary imaging. The Celestron C14—a 14-inch Schmidt-Cassegrain Telescope (SCT)—was a very popular choice, but its price was above my budget, I didn't have a large enough German equatorial mount, it's very difficult to mount single-handedly, and SCTs typically require star collimation (although the new Hutech SCT laser-collimation system obviates this requirement). I realized that a large reflector, mounted in the simple altazimuth (alt/az) fashion popularized by John Dobson, fits my needs the best. Meade, Orion, and Sky-Watcher were all marketing truss-type Dobsonians (Dobs), but the collapsible nature of the three-pole system of the Sky-Watcher design means effortless storage and setup (Figure 1). I require motorized tracking in order to perform long-focal-length planetary imaging, so I would have to implement that myself (Sky-Watcher has a fully motorized GOTO version now).

I was fortunate to find a 12-inch example secondhand from another amateur who wanted to move up to an Obsession Ultracompact Dob.

I've taken it upon myself to introduce the official rules of telescope *modding*, namely:

1. The mod must not look like a mod (it must retain a stock appearance).
2. The mod must be as simple as possible (so that anyone can perform it with simple tools).
3. The mod must be as inexpensive as possible (to encourage re-use of telescope parts and the use of found household items).

I decided that the simplest way to confer motor-drive capability was to use the Meade Autostar system. This system was very popular, because the Autostar software on the 497 handset allows the user to change the gear-ratio values for both the azimuth and altitude axes. This meant that Meade drive motors could be used with any size of worm and ring gear, while maintaining tracking and GOTO accuracy (Figure 4-12). There were two main engineering obstacles. The Dob rotating surfaces are designed with friction in mind so that the tube stays where you aim it. I needed to redesign the azimuth and altitude bearing surfaces to reduce friction in order to reduce strain on the drive motors and to improve the smoothness of movements. As for the rest of the conversion, a fellow amateur kindly and generously donated an unwanted Meade DS-114 telescope (Figure 2) that allowed me to cannibalize a pair of DS drive motors and the alt/az axis shafts and clutches, making the mod even easier to accomplish.

The original particle-board mount before the mod can be seen in Figure 4-1. The previous owner had removed the original

Figure 2 — The cannibalized Meade DS-114 telescope.

Figure 3 — The completed telescopes, ready for use.

circular array of roller bearings (Figure 4-2) on the azimuth surface, presumably because there was not enough *stiction*. Stiction is a term amalgamating the concepts of stickiness and static friction, whereby the threshold of friction is low enough to allow movement with the gentlest of nudges, while enough stickiness remains to immediately stop the scope once the force of the nudge is removed. To achieve this, I simply upgraded the mount by the installation of a Lazy Susan ball bearing (Figure 4-3).

The original altitude bearing was similarly rudimentary, with the metal hub of the optical tube assembly (OTA) sliding over some plastic dowels (Figure 4-6). The four dowels were replaced with plastic-covered ball bearings, allowing the OTA to pitch up and down with zero effort (Figure 4-7). The new bearings were also the same diameter as the dowels, allowing the use of all the original drilled holes in the mount.

Re-using the shorter of the two shafts from the Meade mount, I attached it to the cover plate of an electrical junction box and epoxied it to prevent it from working loose (Figure 4-4). This was screwed onto the base of the Dob mount where it would maintain rigidity, while the upper section rotated around it.

The azimuth drive system is shown Figure 4-5, where a ring gear sits on top of the protruding azimuth shaft from Figure 4-4. The altitude ring gear and worm are shown in Figures 4-8 and 4-9. The clutch system is a series of non-rotating washers indexed to a longitudinal keyway cut into the ring-gear shaft. A nut squeezes the washers against the ring gear so that the shaft turns with the ring gear. The altitude shaft happens to have the exact same thread size and pitch as found on the hub of the OTA.

The cooling fan is just a computer fan mounted on rubber plumbing washers to help isolate the mirror cell from potential vibrations (Figure 4-11). It's connected via telephone extension cable to the AUX port of the Autostar panel, which happens to also carry 12 VDC (Figure 4-10). The fan draws air out of the tube through the bottom of the mirror cell. The completed telescope can be seen in Figure 3.

Recently, I picked up the optical components (Figure 5-a) from an Orion 12-inch conventional-tube Dob that prompted me to build what I term a *rat Dob*. This is a concept carried over from my automotive endeavours, where a "rat rod" is a modified car with such design purity that it favours function completely over form. Hence it is often minimalistic and unfinished in appearance. In fact, it is sometimes intentionally ugly to further delineate its execution from those who are all show but no go. I couldn't bring myself to make an ugly telescope, but my goal was to make one that was as simple as possible.

(continues on page 26)

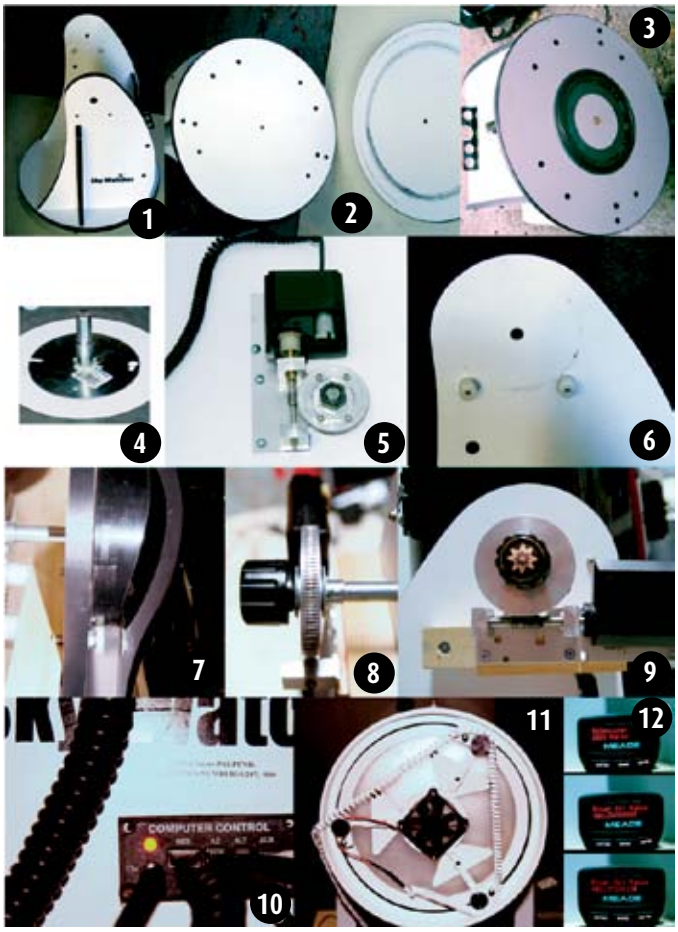

Figure 4 — Stages in the modification of the Sky-Watcher Dob. See text for explanations.

Figure 1 — Dalton Wilson joins the list of Journal *contributors with this image of Messier 22 in Sagittarius. Dalton used a C14 with a Hyperstar conversion, a QSI540 camera, and an exposure of 3×60s in LRGB from Rusty RV Ranch Rodeo in New Mexico. M22 lies at a distance of 10 kly and is 100 ly across, making it one of the larger globular clusters in the night sky. The variable stars in M22 have provided a fertile field of research for several RASC stalwarts.*

Figure 2 — Two of the RASC's prominent astrophotographers, Stef Cancelli and Kerry-Ann Lecky Hepburn, teamed up to get this spectacular image of M106. According to their description "We call it our Franken-Galaxy because of the varied gear at different focal lengths used and shot from two different locations. In total, there are 19 hours and 40 minutes of data collected." Kerry-Ann used a C6 and a QHY-8 camera; Stef used a Vixen VC200L telescope at f/9 with an SBIG ST10XME camera. This image is the longest exposure published in the Journal *to date.*

Figure 3 — This is February, and Stuart Heggie has an eye-catching image of the Valentine Nebula; of course, we had to publish it. Stuart used his STL11000 camera and Takahashi FSQ telescope with Astronomik RGB and 6-nm Hα filter; exposure was 15 x 20 minutes in Hα and 6x5 min in RGB from Flesherton, Ontario. Also known as the Heart Nebula and IC 1848, this attractive nebula lies in Cassiopeia adjacent to the Soul Nebula.

Figure 4 — Stephen McIntyre of the Ottawa Centre used a modified Canon XS (IR filter removed) with an Astronomik UV/IR filter and 4.5 hours of exposure to catch this view of NGC 7331 in Pegasus. The smaller surrounding galaxies are known as "The Deer Lick Group"; NGC 7331 is one of the RASC's Finest NGC Objects. Compare this image with a wider-field view in Dave Garner's column "On Another Wavelength" on page 21.

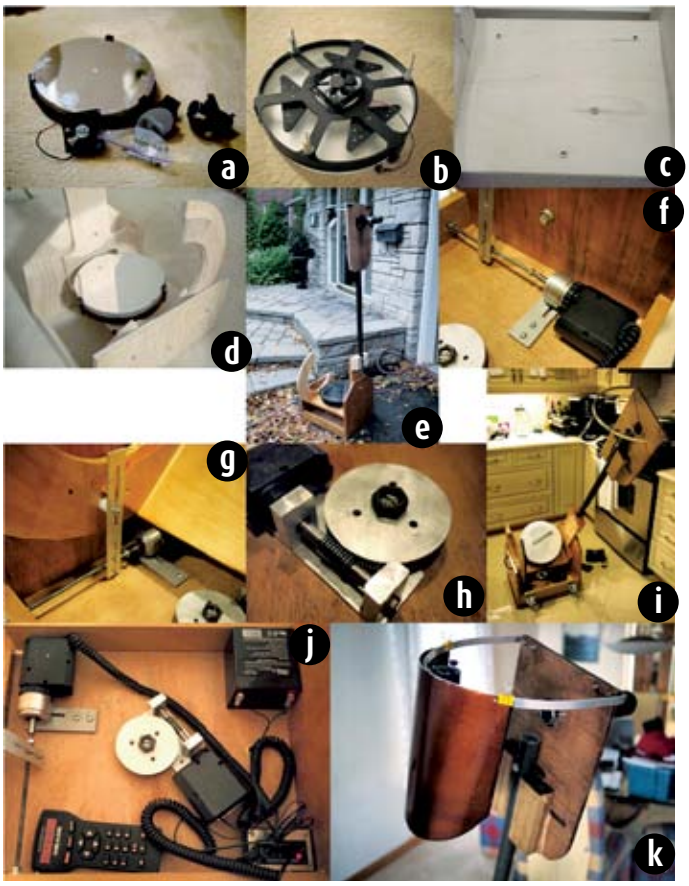

Figure 5 — Stages in the conversion of the Orion Dob. See text for explanations.

Instead of a tube or truss system to support the secondary mirror and focuser, a single pole was used. Instead of 3 or 4 vanes, only one curved spider vane was used. Instead of two altitude bearings, one was deleted and replaced with a simple pivot joint. The mirror box was made very low profile, and despite the appearance of a manual push-to Dob, there is a hidden motor-drive system with some go under the hood. To complete the conversion and maintain conformity with the "official" rules, old and re-used materials are used. The plywood was liberated from the dumpster bin of one of my neighbours who was undertaking a major home renovation.

The computer fan was fastened to the back of the mirror cell, and the cell itself rides on springs centered by machine bolts (Figure 5-b). These three bolts run through brass bushings attached to the wooden structure and secured by wingnuts. This permits the mirror cell to be precision tilted during collimation (Figure 5-c).

The altitude bearing is a partial circular arc cut from plywood that runs on three bearings (Figures 5-d & 5-e) re-used from a recent overhaul of an EQ6 mount. My original design involved attaching a flexible nylon rack on the circumference of the altitude bearing (seen in blue in Figure 5-i) and driving it directly with a worm or gear. That didn't work out because I also wanted to hide all the motors in the bottom of the Dob. The solution is shown in Figures 5-f & g. The azimuth drive system is more standard in Figure 5-h. The mirror is protected with a cut-down plastic cake cover and the single pole is from a retired patio umbrella (Figure 5-i). A 12 VDC lead-acid gel battery powers the unit (Figure 5-j) and a light shade was cut from a piece of aluminum dryer exhaust ducting (Figure 5-k).

The scope works well, and I was able to observe Jupiter one night for long periods without adjusting the field of view. The affixed wheels allow easy maneuvering of the fully set-up scope (Figure 3) and the single pole seems remarkably resistant to vibration and loss of collimation. With the pole removed (it's attached with wingnuts), the scope is so compact it can fit in the back of any car trunk. ✶

Jim Chung has degrees in biochemistry and dentistry and has developed a particular interest for astroimaging over the past four years. He is also an avid rider and restorer of vintage motorcycles, which conveniently parlayed into ATM projects, such as giving his Sky-Watcher collapsible Dobsonian the Meade Autostar GOTO capability. His dream is to spend a month imaging in New Mexico away from the demands of work and family.

A Transit of Venus Dream Unfulfilled: Mungo Turnbull and Sir John A. Macdonald

by R.A. Rosenfeld, RASC Archivist
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Abstract

This paper presents a hitherto unedited letter in the Sir John A. Macdonald papers regarding the potential participation of a neglected founder of the RASC in the 1882 Canadian Transit of Venus Campaign.

Transits then and now

In early June of 2012, mere months from penning these words, the last of the 21st-century transits of Venus (ToV) will unfold in the diurnal heavens, over what one fervently hopes will be clear Canadian skies (Eclipser). The earlier ToV of this century's pair in 2004 was notable for the level of public interest it elicited here and abroad. A ToV is a rare Solar System event, with a striking intellectual-visual impact (a happy coining I owe to Roy Bishop). "Intellectual-visual impact" can be defined as the aesthetic and emotional force of a phenomenon experienced through the filter of knowledge of its place in human culture, the cumulative scientific achievement won through harvesting its data and theorizing its meaning, and the possibility there may be unsuspected data to be grasped and understanding wrung from its spectacle. Remove that filter, and the eyepiece experience of many a famous DSO diminishes to a bore, close planetary conjunctions are less effective than cheap Christmas lights, and a ToV offers all the stimulation of drying paint closely observed.[1] This filter is more valuable than any light-pollution reduction, planetary, or nebular sieve for photons. Pasteur's famous dictum ought to apply to *astronomical* observers: "In the fields of observation, chance only favours the mind which is prepared" (Vallery-Radot 1906, 79; 76). Part of being prepared for the ToV in June is knowing what happened during past ToVs. That history is a substantial part of the filter through which the intellectual-visual impact is experienced. No observer will be able to view Venus on the Sun intelligently without it.

The story told here is part of that history. It involves Mungo Turnbull, a member of our Society in its earliest days, Sir John A. Macdonald, the founding Prime Minister of Canada, Charles Carpmael, the "lead investigator" of Canada's ToV efforts in 1882, and, as a final character, the vestigial Toronto

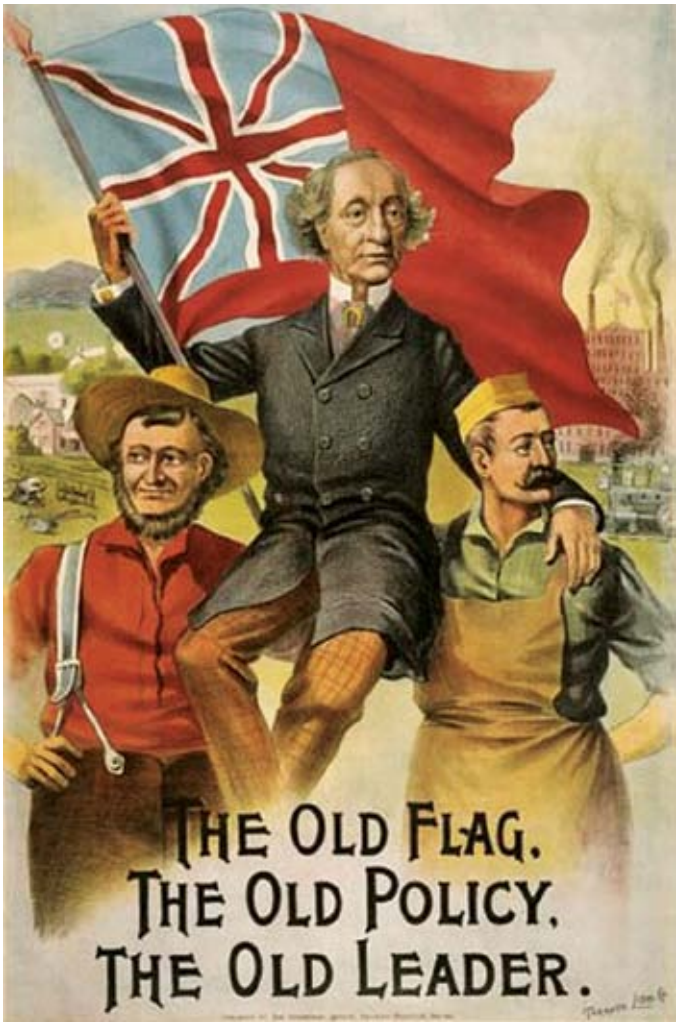


Figure 1 — Sir John A. Macdonald and supporters. It is not generally recognized that Canada's first Prime Minister proved a good patron of the sciences.

Astronomical Society (TAS) (proto-RASC) itself during the shadowy years of the 1880s. For the amateur it was a story of personal desire ending in probable disappointment, and possibly disdain from both the over-worked Prime Minister and the busy professional scientist. For us it is a tale in which we may discern traces of division in the fledgling astronomical community in Canada, and deficiencies in the scientific communication network in Toronto.

The Amateur

Very little is known about the TAS during the ToV years of Victoria's reign; even less is known about her subject, the avocational astronomer, Mungo Turnbull.

Turnbull emigrated from somewhere in Scotland to Canada, perhaps about mid century, or a little after.[2] In 1870 his profession is given as carpenter (Anon. 1870), and from other reports it is known that he was active in Toronto by 1868, and in 1869 was living at 25 Nassau Street (RASC Archives, Council Minutes 1868 December 1; Regular Meeting Minutes 1869

May 4). It is curious that no "Mungo Turnbull" is recorded in the Canadian Census of either 1871 or 1881; it is only with the Census of 1891 that an "M. Turnbull" appears (*Census of Canada*, 1891, 41). In the 1871 and 1881 enumerations one can find a carpenter named Turnbull from Scotland listed in the ward in which M. Turnbull is resident in 1891 (*Census of Canada*, 1871 71; 1881 125). That man's Christian name is George. In default of other information, there is a strong presumption that Mungo Turnbull is the M. Turnbull of the 1891 census who is identical with the George Turnbull of the earlier enumerations—Mungo was not an uncommon nickname for Scotsmen.[3] It would seem that Turnbull was unsure of his own date of birth; in 1871 he gave it as 1832, in 1881 it became 1838, and by 1891 he had settled on 1825! I have thus far not uncovered a death date, but he was seemingly still alive in 1898 (Turnbull 1898).

Turnbull was very active in the earliest years of what was to become the RASC. He was one of the original seven founders in 1868, and during 1868-1869 was energetically voting on motions, delivering papers (he gave the first ever in the Society's history), co-drafting our first By-laws, declining the nomination for Society Vice-President, hosting the Society at his home, building his telescopes, and leading and organizing eclipse work (RASC Archives, Council and Regular Meeting Minutes 1868-1869). Fuller details on his telescopes are found in a popular press report from this time. It is worth quoting *in extenso* for the light it casts on late-19th-century evaluations of instruments in Toronto:

> *A few years ago astronomical telescopes were rarely to be seen among us. Now both refractors and reflectors are in constant use. Two of the reflector class, we are glad to state, have been made in Toronto, by Mr. Mungo Turnbull, during his spare hours after his daily toil as a cabinet-maker. One of them is a metallic speculum, of the Herschelian kind, and of 7 inches aperture; the other is a Newtonian reflector, of nearly 12 inches aperture, with silvered glass specula. This latter instrument was shown at our late Provincial Exhibition, but could not be tested or judged of under the circumstances. Such tests, however, have since been applied as proves that it is an exceedingly powerful instrument. Practical observers know that there are certain objects which afford good tests of the optical qualities of an instrument, such as the small blue attendant of Vega; the debilissima of Sir John Herschel in the constellation Lyra [a 13th-mag. pair between ε1 and ε2]; the components of Gamma Andromedæ; the four stars forming the trapezium in the nebula of Orion, the Moon, Jupiter, &c. A few gentlemen, familiar with these objects, last week tested Mr. Turnbull's reflector, and the results were of the most satisfactory character. The different colours on the belts of Jupiter were seen distinctly; as were also the four stars of the trapezium, and all the others we have mentioned. The construction of such an instrument reflects the very highest credit upon Mr. Turnbull's ingenuity and perseverance. It contains all the latest improvements, and from the particular way in which they are silvered, its mirrors were found to give about one-third more light than the old kind. We have no doubt that Mr. Turnbull would be very happy to see any who take a lively interest in his favourite science; and would be happy to allow experts to test his instrument in any reasonable manner. (Anon. 1870)*

Turnbull's involvement in astronomy demonstrates personal interest, motivation, and ambition. The construction of a 0.3 m-class telescope in Canada around the time of confederation is earnest evidence of the latter. Turnbull, however, wanted to be more than just a telescope-making carpenter. He desired to derive his livelihood from astronomy, if not as a professional astronomer, then by dealing in astronomical dry goods, and better yet, as an inventor of apparatus. Most reputable developers, manufacturers, and retailers of astronomical gear today have trod a similar path, one of reward but also risk.

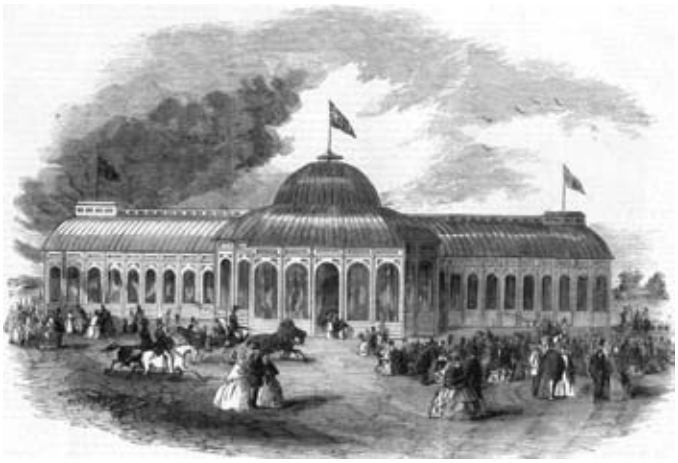


Figure 2 — Where's Mungo? Can you spot Mungo? It's not just Mungo Turnbull's documentary record that is elusive. There are no known images of this early founder of the Society. Perhaps he is lurking in a 19th-century crowd scene.

By the time of the 1891 census, Turnbull gave his profession as purveyor of "scientific supplies" (*Census of Canada*, 1891 41). In the 1880s and 1890s, he was chiefly known, or wished to be known, for his scientific inventions, the "Improved Newtonian Globe," the "Heliocentric Sun Views," and the "Dynamical Arranged Celestial Sphere" (Turnbull 1881; 1898; Anon. 1898). He secured patents for the globes, and enjoyed the "free" advertising of the occasional patent notice in *Scientific American* (Commissioners of Patents 1879, 1300; Anon. 1893; Anon. 1898). He wrote small treatises (manuals) to explain the use of his inventions, and further publicize them, engaging in a tradition with a continuous history stretching back to the 17th century, if not earlier (Taylor 1954, 311-431).

Turnbull clearly intended his inventions to appeal to those imparting elementary geographical and astronomical instruction. As apparatus they are rather pedestrian for their time, and in those parts that are not misconceived, can lay scant claim to originality in design. The texts of his treatises reveal an author with no sure grasp of his material, and with occasional notions that would cause his better informed colleagues to arch their brows. These are not competent productions.

How well-educated was Turnbull, and how competent an astronomer can he be said to have been? Peter Broughton, basing his opinion on the report of Turnbull's eclipse lecture to the TAS on 1869 June 1 (which includes circumstances of the Solar Eclipse of 1869 August 7), wrote that Turnbull was the beneficiary of a "Good Scottish education," a wholly reasonable conclusion based on that report (Broughton 1994, 21—the actual text of the lecture has disappeared from our Archives). Turnbull's later inventions, and particularly the treatises accompanying them, suggest otherwise. His letter "advising" Sir John A. Macdonald of the imminence of the 1882 ToV, and begging to be allowed an official scientific role in the Canadian Government efforts (see the edition below), is the work of someone with an insufficient mastery of functional literacy, and an inexpert grasp of the science of his day. While he did manage to have himself elected a member of the American Association for the Advancement of Science, sections A (mathematics and astronomy) and E (geology and geography) at its Toronto meeting on 1889 August 30, it was well known that the AAAS rarely turned anyone down (American Association for the Advancement of Science 1889, 147). The seeming contrast in ability between the author of the 1869 lecture as reported and the writer of the 1882 letter is striking—and disturbing. It is not a contrast that augured success for an amateur astronomer seeking Prime Ministerial patronage.

The Prime Minister and the Professional Scientist

In his letter to Macdonald, Turnbull advises the Prime Minister as Minister of the Interior to sponsor a Canadian ToV campaign for the prestige and good of the country. According to Turnbull, the chief advantage for Canada would be geographical rather than astronomical; precise determinations of the longitude and latitude of the ToV observing stations could provide the backbone of improved meridian determinations for the rest of the country.

Turnbull ends with a plea to be allowed some role in the official ToV campaign (should Macdonald be wise enough to take his advice!), citing two figures with political connections who could "testify to my long devotion to practical Astronomy and the use of the telescope in Toronto, Of which I have one of the largest in Canada." The reader cannot escape the impression that the plea for some official ToV role for the writer is the real motivation for his letter.

Figure 3 — Which necessity was the mother of this invention? Mungo Turnbull's "Improved Newtonian Globe" (1881). In its chief features it appears indistinguishable from other such globes.

If anyone in Government would have been amenable to a reasonable appeal on behalf of an important scientific enterprise, it would have been Sir John A. Macdonald. Throughout his career he had shown some mild personal interest in science, and his record of promoting science while in office is better than that of most subsequent politicians in our history, a fact one would not know from the standard biographical treatments (Creighton 1998; Gwyn 2011). While Attorney General in the 1850s, he was instrumental in securing decent funding for the nascent Geological Survey of Canada; in the 1860s, he was a member of the Botanical Society of Canada, and scientists of various stripes did not find him difficult of access (Zeller 1987, 93, 233, 236). Given the nature of Victorian politics, requests for patronage were not unusual, so even a personal appeal such as Turnbull's was not out of place. There is no evidence, however, that his letter was ever answered, or that his request was granted. Why?

Unbeknownst to Turnbull, Canadian plans for an official ToV campaign were well in hand before he wrote to Macdonald, and indeed they had been underway since the fall of 1881, and a government grant of $5,000 had been voted by Parliament for that purpose two days before Turnbull's ToV letter to the *Toronto Daily Mail* of 1882 May 20 appeared arguing for the utility of official Canadian participation (Jarrell 1988, 48, 207 n. 89)! The "lead investigator" of Canada's ToV efforts, indeed their instigator, was the well-connected Cambridge-trained Charles Carpmael, FRAS (1846-1894), the top government meteorologist, and "Superintendent of the Transit of Venus Observations for the Government of Canada" (see note 8). Carpmael's office and observatory were based in Toronto, the same city in which Turnbull lived, he was the leading professional scientist with astronomical responsibilities there, and was the first president of the Society when it was revived in the 1890s (Broughton 1994, 23). The scientific community in Toronto in the 1880s was not large. It seems likely both men shared astronomical acquaintances. How could Turnbull not know what was going on?

Carpmael published two full accounts of the results of the Canadian ToV campaign, including details of instrument procurement, training of personnel, and the reports from the heads of each of the ToV stations (Carpmael 1883a; 1883b). Turnbull is not named anywhere among the official ToV personnel. The published evidence strongly suggests that Turnbull's request to Macdonald was either officially turned down, or unofficially ignored. Why?

The Society

It is now time to turn to the last of the principal characters in this story, the TAS, which was revived, or refounded as the Astronomical and Physical Society of Toronto (APST), to eventually become the RASC. The documentation being what it is, one can only make the most tentative of suggestions regarding its role in this ToV episode.

It will be recalled that Turnbull was a founding member of the TAS, and quite an active one, who had managed to construct the largest instrument in the possession of any of its members (yet we know nothing of his quality as an observer). He appears a far from negligible figure in the TAS ranks, but the organization withered after a few years. Over two decades after the TAS went dormant, it came back to the land of the living as the APST. One would expect an original TAS member who had kept his astronomical interests alive would have been eager to (re)join, and perhaps resume a leadership role. Andrew Elvins (1823-1918) certainly did, but Turnbull did not, which is odd for someone who attempted to make his living dealing in scientific instruments (Broughton 1994, 20). Turnbull can only be found on the rolls of the APST in the period 1894-1898, but never holding office, rarely appearing in the minutes, and only addressing the Society once, on 1893 September 5 (when not technically a member!) to give "practical illustrations of the method of using the celestial globe recently constructed and patented by him," on which occasion he seems not to have brought his patented globe for the performance, but had to use the Society's Wilson Memorial globe (Rosenfeld 2009, 30)! A decade later, when the Society published an account of "The Astronomical Equipment of Canada," including everything from the soon-to-be operational Brashear 0.38-m O.G. refractor of the new Dominion Observatory to the Society's 2.5" O.G. Todhunter refractor, neither Turnbull nor his 0.30-m primary mirror reflector are mentioned, although Dr. Wadsworth's similar instrument is. There is no obituary for him in the *Journal*, nor even a single line of regret noting his passing. It's as if we are witness to a *damnatio memoriae*, an erasure of all memory of Mungo Turnbull.

Without more documentation, it is impossible to give a certain answer as to why Turnbull did not know a Canadian ToV campaign was happening virtually under his very nose, why his request to take part in that campaign apparently went unanswered or denied, why he seems to have played a marginal role in the revived Society, why his instrumental accomplishments once noted with approval were forgotten, and why his death, the death of one of the founders of the RASC, went by without any acknowledgement.

It may be that Carpmael—even Macdonald—judged Turnbull to be an embarrassing incompetent based on his ToV letter (and if Carpmael had seen Turnbull's elementary treatises, the judgement would have been strengthened), it may be that their negative evaluation became the opinion of the APST leadership, and, as Turnbull withdrew from the Society, what he had once accomplished faded from the collective RASC memory. He may have possessed an abrasive or unpleasantly odd character, rendering social interaction with him an unpopular choice among Society members.[4] Perhaps Macdonald never saw the letter, or, in the press of business, forgot to reply or pass it on to Carpmael. Perhaps channels of scientific communication in the Toronto of the 1880s were so poor that many missed out on developments that would have been of interest to them.

Prominent RASC member Sir Joseph Pope, Sir John A. Macdonald's long-serving secretary and biographer, remarked of his friend that in patronage appointments "Macdonald was after quality—mind...integrity, good health, even address" (DCBO, J.K. Johnson & P.B. Waits, Sir John Alexander Macdonald). Turnbull's was a request for minor patronage, but he may not have been of the quality Sir John would contemplate, even for a voluntary ToV position. "A good carpenter," Macdonald told an associate in 1874, "can work with indifferent tools" (DCBO, J.K. Johnson & P.B. Waits, Sir John Alexander Macdonald). Considered as a potential human component for the Canadian ToV enterprise, the one-time carpenter Mungo Turnbull may not have seemed a particularly good instrument. Sometimes desire is not enough.

Edition of the Letter from Turnbull to Sir John A. Macdonald

This is the *editio princeps*, based on Ottawa, Library and Archives Canada, MG26-A, vol. 386, pp. 182091-182095. The letter does not appear in either Macdonald 1921 or Macdonald 1968-1969. The best discussion of this letter remains Jarrell 1998, 48-49. The text printed here is a diplomatic transcription, retaining Turnbull's vocabulary, orthography, and grammar (while these might strike the reader as highly idiosyncratic, they may in fact be characteristic of Turnbull's class, place of origin, education, and habitual social milieu). Editorial additions are enclosed in square brackets.

75 Arthur Street Toronto, July 15. 1882.[5]
To Sir John A. MacDonald M.P.[6]

Dear Sir,

The Subscriber[7] in taking the liberty to draw your attention to an interesting Modern Scientific Event, which is in a special manner important to the entire [*sic*] of the Dominion of Canada, In Apoligy [*sic*] states that a few days ago I submitted the subject to the Hon. John Carling,[8] as a Member of the Government, who in Reply at once suggested that the matter should be laid direct before the Premier Sir John A MacDonald [*sic*], who is Minister of the Interior, as the Subject is one appertaining to that Department.—

Sir, The Substantitive [*sic*] part of the subject relates to the Value to the whole Dominion of Establishing several Observing stations in widely separate places in Canada, to Observe the Transit of Venus Scientifically accross [*sic*] the sun on the 6t[h] of Dec. Next. In Science the subject Has a double Value especially to the Dominion. But What I principally allude to here in connection with the event is the p. 1/ p. 2 Geographical part of the question and not the Astronomical portion.[9] It is well known that the Dominion geographically is as large as all Europe, and yet we have not a Standard Meridian Established[10] in any place with that Astronomical precision which will be required and must be Obtained at all the stations to observe the Transit, to make the work of any use to future science.— Hence, the importance of the Observations to our Knowledge of the Topography of the Dominion.

All our Latitudes and Longitudes have been as yet obtained through the Common work of land surveyors, and taken from Common Maps, which are all confessedly very imperfect.[11]

The importance of this part of the subject is shown in the history of passing [*sic*] events in the United States; how at great expense through their Coast Surveys,[12] they have completed an extensive network of meridians & latitudes for all their principle City's [*sic*] in the Union—

Now in the Dominion as we have never had an established Astronomical Observatory. proper, we have not a correct standard meridian / p.3 To meet the requirements of Astronomical geography[.][13] Hence the different Observers in Canada, at the transit Must furnish (to be of any real use) a correct Astronomical Meridian at the places of Observation, which will remain as a great geographical standard unit[14] On all our Maps for all time, [*sic*] It may be added that to complete the above work thoroughly by the transit Observer's [*sic*] it will require several weeks of Astronomical labour before the event takes place.[15] It will thus be seen from the above standard Meridians with the use of the Electric Telegraphy now greatly used in Observing the Longitudes of any part of the Dominion can be correctly found.[16]—

Hopeing [*sic*] you will excuse here the foregoing liberty taken.

I remain
Sir,
Yours Most Respectfully
M. Turnbull

/ p.4 P.S. Should the Government who got a grant[17] for the purpose last Session, decide to take any action in this rare scientific interprise [*sic*]; I will be very Much Obliged to the Premier[18] if you will grant the subscriber a place as an Assistant to any of the Observing parties, Both M^{r} Hay & M^{r} Betty [*sic*] our Member's here[19] can testify to my long devotion to practical Astronomy and the use of the telescope in Toronto, Of which I have one of the largest in Canada, M.T.[20]

endorsed: M. Turnbull
July 15/82 ✶

References

Manuscripts, Books, and Articles

American Association for the Advancement of Science (1889). *Programme of the Thirty-Eight Meeting of the American Association for the Advancement of Science, Commencing Tuesday, August 27th, and Closing Tuesday, September 3rd, 1889, at the University Buildings, Toronto*. Toronto: AAAS

Anon. (1870). Astronomy in Toronto, in *Journal of Education: Province of Ontario 23, 12*, 182

Anon. (1893). *American Stationer, 34*, 1000

Anon. (1898). *Scientific American, 69*, 268

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

Carpmael, C. (1883a). *Report of the Canadian Observations of the Transit of Venus. 6th December 1882*. Ottawa(?): Queen's Printer(?)

Carpmael, C. (1883b). Transit of Venus-Arrangements in Canada. *Proceedings and Transactions of the Royal Society of Canada for the Years 1882 and 1883, 1*, sect. III, 87-90

Census of Canada, 1871, Ottawa, Library and Archives Canada, Statistics Canada fonds, R233-34-0-E

Census of Canada, 1881, Ottawa, Library and Archives Canada, Statistics Canada fonds, R233-35-2-E (mfm)

Census of Canada, 1891, Ottawa, Library and Archives Canada, Statistics Canada fonds, R233-36-4-E (mfm)

Chapman, A. (1998). *The Victorian Amateur Astronomer: Independent Astronomical Research in Britain 1820-1920*. Chichester: John Wiley & Sons

Commissioners of Patents (1879). *Commissioners of Patents' Journal 1879 Vol. I.-January to June*. London: Her Majesty's Stationery Office

Creighton, D.G. (1998). *John A. Macdonald: The Young Politician, the Old Chieftain*. Toronto: University of Toronto Press

Dawson, J.W. (1883). The President's Address. *Proceedings and Transactions of the Royal Society of Canada for the Years 1882 and 1883, 1, LII-LVII*

Dennis, J.S. (1892). *A Short History of the Surveys Performed Under the Dominion Lands System 1869 to 1889*, Sessional Papers no. 13. Ottawa

Gwyn, R.J. (2011). *Nation Maker: Sir John A. Macdonald: His Life, Our Times.* Toronto: Random House Canada

Hodgson, J.H. (1989). *The Heavens Above and the Earth Beneath: A History of the Dominion Observatory, Pt. 1: to 1946*. Geological Survey of Canada, Open File 1945. Ottawa: Energy, Mines and Resources Canada

Hogg, H.S. (1982). Two Centenaries: the Royal Society of Canada and the Last Transit of Venus, 1882. *JRASC 76, 6,* 362-370

Jarrell, R.A. (1998). *The Cold Light of Dawn: a History of Canadian Astronomy.* Toronto: University of Toronto Press

Johnson, A. (1883). Preparations at McGill College, Montreal, for Observing the Transit of Venus, December 6th, 1882. *Proceedings and Transactions of the Royal Society of Canada for the Years 1882 and 1883, 1*, sect. III, 83-85

Macdonald, J.A. (1921). J. Pope (Ed.). *Correspondence of Sir John Macdonald. Selections from the Correspondence of the Right Honourable Sir John Alexander Macdonald, G.C.B., First Prime Minister of the Dominion of Canada*. London: Oxford University Press

Macdonald, J.A. (1968-1969). J.K. Johnson & C.B. Stelmack (Ed.). *The Letters of Sir John A. Macdonald*, The Papers of the Prime Ministers. 2 vols. Ottawa: Public Archives of Canada

RASC Archives, Council and Regular Meeting Minutes 1868-1869

Rosenfeld, R.A. (2009). A Tale of Two Globes. *JRASC 103, 1*, 28-31

Taylor, E.G.R. (1954). *The Mathematical Practitioners of Tudor & Stuart England 1485-1714*. Cambridge: Cambridge University Press

Turnbull, M. (1881). *Hand Book of the Improved Newtonian: or, Combined Astronomical and Terrestrial Globe*. Toronto: Willing & Williamson

Turnbull, M. (1882). Letter to Sir John A. Macdonald 1882 July 15. Ottawa, Library and Archives Canada, MG26-A, vol. 386, pp. 182091-182095

Turnbull, M. (1892). *Parlour Lessons on the Study of the Stars and Constellations With the Use of a New 18-inch Astronomically Arranged Sphere.* Toronto: Warwick & Sons

Turnbull, M. (1898). *A Descriptive Manual of the Earth's Daily Heliocentric "Sun Views" of the Eastern and Western Hemispheres Also the Illustrated Structure Employed in the Design to Solve the Annual Motions of the Two Terrestrial Poles Around the Arctic and Antarctic Circles of the Map*. Toronto: M. Turnbull

Vallery-Radot, R. (1906). *The Life of Pasteur*, tr. R.L. Devonshire. London: Archibald Constable & Co. Ltd.

Web sites

CSTM, R. Brooks, Dominion Observatory 100th Anniversary
www.sciencetech.technomuses.ca/english/collection/dominion_observatory.cfm
(accessed 2011 November 30)

DCBO, P.E.P. Dembski, Sir John Carling
www.biographi.ca/009004-119.01-e.php?&id_nbr=7271
(accessed 2011 November 28)

DCBO, J.K. Johnson & P.B. Waits, Sir John Alexander Macdonald
www.biographi.ca/009004-119.01-e.php?&id_nbr=40370
(accessed 2011 December 6)

DCBO, D. McCalla, James Beaty
www.biographi.ca/009004-119.01-e.php?&id_nbr=5955
(accessed 2011 November 30)

DCBO, S. Pollin, Robert Hay
www.biographi.ca/009004-119.01-e.php?&id_nbr=5574
(accessed 2011 November 30)

Eclipser, J. Anderson, The Transit of Venus 2012 June 05-06
www.home.cc.umanitoba.ca/~jander/tov2012/tovintro.htm
(accessed 2011 December 4)

Medieval Source Book, C.W. Green, Jocelyn, a monk of Furness: The Life of Kentigern (Mungo)
www.fordham.edu/halsall/basis/Jocelyn-LifeofKentigern.asp
(accessed 2011 December 5)

RASC, R.P. Broughton, Historic Transits of Venus from a Canadian Perspective www.rasc.ca/system/files/private/transit.pdf
(accessed 2011 November 28)

NOAA, A.E. Theberge, Coast Survey 1807-1867
www.lib.noaa.gov/noaainfo/heritage/coastsurveyvol1/CONTENTS.html
(accessed 2011 November 30)

Endnotes

1 I thank another distinguished History Committee colleague for this banally disturbing simile. He understandably wishes to remain anonymous.

2 For his Scottish origin see *Census of Canada*, 1891, 41.

3 The name Mungo itself originated as a nickname for St. Kentigern; Medieval Source Book.

4 While the present-day RASC can rejoice in the knowledge that it is as welcoming a geek-infested haven for the freakily astronomically obsessed as any similar organization, we cannot assume that our Victorian forbears conceived of the Society in analogous terms.

5 A summary search indicates that Turnbull's residence is no longer extant.

The date is curious; if the government had not been planning a ToV observational campaign by the fall of 1881, they would scarcely have had the time to prepare for one subsequent to Turnbull's appeal, less than half a year in fact. On the fall 1881 planning, see Hogg 1982, 366-367.

6 In addition to being Prime Minister, Macdonald also held the portfolio of Minister of the Interior 1878-1883; DCBO, J.K. Johnson & P.B. Waits, Sir John Alexander Macdonald. Excepting naval concerns, Dominion government patronage of astronomy at the time was largely in the service of geophysics, cartography, and chronometry (the last two in thrall to

Mammon), hence the Interior Ministry seemed a reasonable place to direct Turnbull to submit his letter and request (decades later the Interior Ministry established the Dominion Observatory *ca*. 1905 under the impetus of the Dominion Astronomer W.F. King,1854-1916, and the Minister, the Hon. Sir Clifford Sifton, 1861-1929; Jarrell 1988, 54-55; Hodgson 1989, 10-17—*contra* Brooks DO who assigns the lead to Otto Klotz, 1852-1923, King's prickly subordinate). Turnbull may not have endeared himself to Macdonald from the start (or if not Macdonald, his secretary and other clerks), given that he botched the salutation; Macdonald was entitled to be addressed as "the Right Honourable." As it turned out, the actual Dominion ToV campaign was under the patronage of Macdonald's colleague, the Minister of Marine and Fisheries, the Hon. A.W. McLelan (1824-1890), who was interested enough to observe the ToV from the temporary Meteorological Service's Observatory on Nepean Point with his Deputy Minister; Broughton Historic ToV, 16-17. A similar show of support and interest from an analogous figure is unlikely to be encountered on 2012 June 5.

7 In the sense of "the undersigned," *i.e.* the author.

8 The Hon. John Carling (1828-1911; created KCMG 1893), Tory politician and brewer. Carling was favourably disposed towards the applied sciences, helping to found the Central Experimental Farm in Ottawa, and what eventually became the University of Guelph. He was a good choice for Turnbull to approach; DCBO, P.E.P. Dembski, Sir John Carling.

9 In contrast to the actual Dominion ToV campaign under Charles Carpmael (1846-1894) (Superintendent of the Meteorological Service of Canada appointed "Superintendent of the Transit of Venus Observations for the Government of Canada"), which was undertaken with the astronomical goal uppermost of refining the value for the solar parallax through timings of internal and external contacts of Venus on the Sun. The successful determination of the coordinates of several transit stations—the primary geographical goal Turnbull emphasized—was a by-product of the astronomical end; Carpmael 1883a; Broughton 1994, 2; Broughton Historic ToV, 13-17.

10 There is perhaps more than a touch of nationalism in Turnbull's call for a "standard meridian." It might indeed have seemed a desideratum for both applied and "pure" positional astronomy, but Turnbull was unaware that there existed at least one very functional standard meridian in the Dominion, the Winnipeg meridian, set up (1869-1871) for the Dominion Land Survey at 97°27′28.41″W; Dennis 1892, 1-4. A true prime meridian for Canada was established *ca*. 1908-1911 on the grounds of the Dominion Observatory in Ottawa, where its partially surviving and rather neglected physical remains can be found today; Hodgson 1989, 48-49. Perhaps Turnbull was prophetic, yet the genesis of the prime meridian in Ottawa owed nothing to the 1882 ToV.

11 This is incorrect. Already in the mid-1850s William Brydon Jack (1817/19-1886) and Dr. James Toldervy (floruit 1850-1860) had practiced longitude determination by the more accurate telegraph method; Jarrell 1988, 34-36. Jack and Toldervy's efforts aside, doubtless those who rejoiced in the hard-won qualifications of DLS (Dominion Land Surveyor) and DTS (Dominion Topographical Surveyor) would not have been pleased by Turnbull's characterization of the accuracy of their work as "all confessedly very imperfect." Many of them worked for Macdonald's department.

12 For the Coast Survey, see Theberge Coast Survey. Turnbull may be indulging in some rhetorical exaggeration here, but the Coast Survey's record in longitude and latitude determination was indeed impressive, and the contrast between the American progress and the Canadian reality could not be missed.

13 Presumably Turnbull means something along the lines of a state institution such as the Royal Observatory at Greenwich, the *Observatoire de Paris*, or the United States Naval Observatory. He seems to have conveniently forgotten the Dominion Meteorological Service's Toronto Magnetic and Meteorological Observatory, operational since 1840, with astronomical capacity since 1850 (according to Jarrell 1988, 192). An unfortunate omission on Turnbull's part, as it was the Meteorological Service that was entrusted with the superintendence of the actual Dominion ToV campaign.

14 Turnbull appears to be confused. It is difficult to see how the determination of the accurate meridians of ToV observing stations could contribute to the establishment of a "geographical standard unit." Perhaps he meant to write that it would establish "accurate reference points"?

15 The Canadian observers under Carpmael, following the British ToV training model, went to considerable effort and some expense to prepare themselves; Carpmael 1883a, 1-3; Carpmael 1883b, 87; Johnson 1883, 84-85

16 See note 11. Turnbull's "advice" would hardly be news to the staff of the Meteorological Service, or to the surveyors in government employ.

17 The grant, unopposed in parliament, was for $5,000, a not inconsiderable sum; Carpmael 1883b, 87; Johnson 1883, 84; Jarrell 1988, 49. It proved, however, insufficient for the purpose: "The sum granted by the government was not sufficient...and had to be supplemented by private subscriptions and gratuitous labour;" Dawson 1883, LV.

18 Turnbull's sudden switch from second to third person when addressing Macdonald is odd. Provided it is not simply a botched attempt at rhetorical subservience, it could indicate that Turnbull expected someone other than Macdonald to read his *post scriptum*.

19 Robert Hay (1808-1890) was a liberal member of parliament sitting from 1878-1886 for Toronto Centre. Like Turnbull, he emigrated from Scotland, and was a cabinetmaker in his adopted country. By the time Turnbull wrote this letter to Macdonald, Robert Hay and Co. Ltd. was the most prosperous industrial manufacturer of decent quality furniture in Ontario, and had been so for decades; DCBO, S. Pollin, Robert Hay. James Beaty (1798-1892), was a Tory member of parliament sitting from 1867-1873 for Toronto East. He emigrated from Ireland, and went from the respectable craft of shoemaker to being a successful and wealthy publisher with both reform and Orange sympathies; DCBO, D. McCalla, James Beaty. I have been unable to discover whether Hay and Beaty had strong scientific interests, or any scientific interests.

20 This claim was in fact correct; around 1870, Turnbull was among the earliest telescope makers in Canada to produce a Newtonian reflector with a silver-on-glass primary mirror of *ca*. 30-cm diameter; Anon. 1870. He had earlier produced a Herschelian off-axis reflector with a speculum-metal mirror of 18-cm diameter. He may have been the first in Canada with workshop experience of both speculum-metal and silver-on-glass technologies, and *the* Canadian pioneer in the making of 0.3-m-class telescopes. He belongs to the category of the "modest master-craftsman astronomer" in Allan Chapman's typology of Victorian amateurs; Chapman 1998, 181-203.

Imager's Corner

Noise Reduction

by Blair MacDonald, Halifax Centre
(b.macdonald@ns.sympatico.ca)

This edition continues a group of Imager's Corner articles focussing on a few techniques that are useful in processing astrophotos. Over the next several editions, I'll attempt to give further guides to image-processing techniques that I happen to find useful. All the techniques discussed will be useable with nothing more than a standard image processor that supports layers and masks. No special astro-image software is required.

This month, I'll deal with noise reduction. Noise is one of those things that seem simple at first blush, but in reality, is a very complex topic. I have a 683-page textbook that gets well used in my day job—signal processing and electrical engineering—that only begins to scratch the surface of the topic. For purposes of this discussion, let's define noise as the random fluctuation in the value of a pixel not caused by the incoming signal. Again for the purpose of this article, this includes photon noise.

Now this is where things get a little complicated, as we have to dive into the realm of spatial frequencies. That just amounts to a fancy way of saying how fast the value of the pixels change. Let's assume that five pixels in a row in an image have the following values: 1, 2, 3, 2 and 1. In this case the values vary by two over five pixels so it is not a fast change and can be thought of as a medium-frequency variation. Now let's consider five pixels with different values: 1, 5, 1, 30 and 5. Now the value goes up and down rapidly over two pixels, so it is a higher-frequency variation.

The more annoying noise in many images resides at higher spatial frequencies, while the image detail varies over many pixels. When taken through a telescope, a single star typically occupies many pixels and generally represents the smallest visible detail in an image. As a result, it is possible to use a filter that removes the higher-frequency signal, the noise, while leaving the signal, the stars, unaffected. As with most of the techniques you will see in this column, this is best done with layers and a mask to fine tune the effect. Take the Pelican Nebula image shown in Figure 1.

Figure 1

It has a lot of noise as can easily be seen in this crop of the top right of the "pelican's" head.

Figure 2

Now let's look at a way to reduce the impact of the noise in an otherwise reasonable image. First duplicate the image on another layer, then blur the upper layer with a Gaussian filter of about 1.5 pixels. If your image-processing software has noise-reduction functions, use them, as they will work better than a simple filter. Overdo the noise reduction a bit to get a smooth background. Figure 3 is a crop of the same section of the image after blurring.

Figure 3

The noise has been reduced, but the stars have lost some of their sharpness leading to a soft image; here is where the wonders of masks come into play. Place a mask made from the inverted luminance channel of the blurred layer on top to let the brighter portions of the original image show through. Using *Paint Shop Pro* (or your imaging software), right-click on the top layer and select "New Mask Layer," select "From Image" in the popup menu, and finally select "Source Luminance" and "Invert mask data" from the dialogue that appears, and press OK. Other image editors will have similar ways to get the mask, so check the help file or manual. The last step is to use a curve to adjust the mask. The idea is to darken the dark areas of the mask to hide the blurred layer in these areas. The layer stack is shown below to give you an indication of the arrangement.

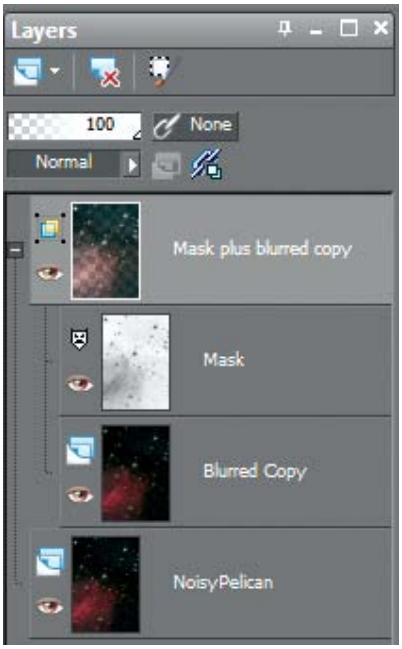


Figure 4

Now flatten the layer stack and you will have a noise-reduced image with most of the detail of the original. The flattened final image looks much better than the original as you can see below.

Again, the same crop as before shown in Figure 5.

Figure 5

There is still some low-frequency noise in the form of the larger blobs in the background, but that's a topic for a future column.

Figure 6

Remember, this column will be based on your questions so keep them coming. You can send them to the list at hfxrasc@lists.rasc.ca or you can send them directly to me at b.macdonald@ns.sympatico.ca. Please put "IC" as the first two letters in the topic so my email filters will sort the questions. ✶

Blair MacDonald is an electrical technologist running a research group at an Atlantic Canadian company specializing in digital signal processing and electrical design. He's been a RASC member for 20 years, and has been interested in astrophotography and image processing for about 15 years.

Second Light

A Type Ia Supernova in M101 Fueled by a Main-Sequence Star

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

A supernova was observed in the nearby galaxy M101 on 2011 August 24 by the Palomar Transient Factory. At a distance of just 6.4 Mpc, it is the nearest supernova to us since supernova 1987A. It was quickly identified as a type Ia (the kind used for cosmology), and telescopes around the world were trained on it. Some of the early observations were reported by Peter Nugent of the Lawrence Berkeley Laboratory and his colleagues. Wiedong Li of the University of California at Berkeley and his colleagues searched the archives of the *Hubble Space Telescope* to look for the companion of the white-dwarf star that exploded. Both groups exclude as a companion a red giant and most kinds of helium stars (see the 2011 December 15 issue of *Nature*).

Figure 1 — Supernova 2011fe in Messier 101.

It seems embarrassing for astronomers to admit, given how much of modern cosmology depends on them, but we are rather uncertain about how type Ia supernovae happen. There has been general agreement for over 20 years that they arise from the thermonuclear explosion of white-dwarf stars whose mass has approached the "Chandrasekhar mass" of about 1.4 solar masses ($M_\odot$). This is the most massive a white dwarf can be. Right before this mass, because of a coincidence in nuclear physics, the temperatures and densities are high enough to ignite carbon in a runaway explosion. It is the more-or-less uniformity of the mass at which this happens that allows type Ias to be calibrated as standard candles (following the pioneering work of Mark Phillips of the Las Campanas Observatory and Mario Hamuy of the University of Chile). The big question is the pathway by which the white dwarf hits the critical mass and explodes.

There has in the past been a fairly strong theoretical preference for what in astronomer's jargon is called the "single degenerate path" – the white dwarf (which is degenerate matter) has a close companion star from which matter falls onto the white dwarf, so that its mass gradually increases until it approaches 1.4 $M_\odot$. The constancy of the mass at explosion sets the energy scale for the supernova. In the alternative "double degenerate" path, two white dwarfs orbit each other, their separation gradually decreasing as they radiate gravitational waves. The smaller of the two white dwarfs is disrupted into an accretion disk, which feeds matter onto the larger one until it explodes as it nears 1.4 $M_\odot$.

There is a controversial claim to have found a main-sequence (type G0-G2, very like the Sun) ex-companion to the exploding white dwarf that was Tycho's supernova (see Ruiz-Lapuente *et al.* 2004 *Nature* 431, 1069). Other arguments have been made (also controversial) that the single-degenerate path cannot dominate the numbers. So the situation is not settled.

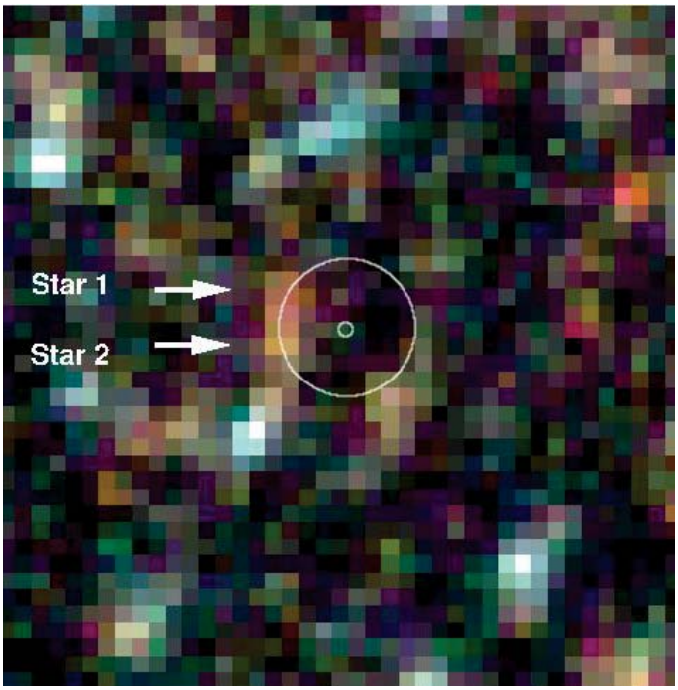


Figure 2 — The site of SN 2011fe as observed by the Hubble Space Telescope *on 2002 November 13. The inner circle (barely visible) has a radius of 0.021 arcsec, the outer one a radius of 0.168 arcsec. Photo courtesy of Weidong Li,* Nature, *and NASA.*

The Palomar Transient Factory is a project running on the old 48-inch telescope on Palomar Mountain (the telescope that made the first sky survey back in the 1950s). The brain child of Shri Kulkarni at Caltech, the project searches the night sky on a regular basis, looking for optical transients. There's an app called "Transients" for an iPhone that contains the time and brightness of the transient and its type (usually "unknown" for newly discovered ones). Clicking through takes one to the images available, and there is even a finder chart! Most of the transients are 19th-20th magnitude, and so not accessible to most amateur astronomers. Supernova 2011fe was 17th magnitude at discovery, increasing to just brighter than 10th mag at its peak around September 12.

From studying the spectra obtained from the supernova over a period of weeks, Nugent and his colleagues conclude that the exploding star was most likely a carbon-oxygen white dwarf. The lack of evidence in the light curve for an early shock leads them to conclude the former companion was likely a main-sequence star.

M101 is a beautiful, almost face-on, galaxy that has been observed many times by the *Hubble Space Telescope* (see for example http://heritage.stsci.edu/2009/07/supplemental.html). Weidong Li and his colleagues went through the many images, looking for signs of the binary system before the explosion. They first had to determine the position of the supernova with great precision—a non-trivial task given the brightness of the supernova. Using the adaptive optics system on the Keck II telescope, they were able to get a precision of 0.021 arcsec, or about a half of a pixel on the *HST*'s camera (the Advanced Camera for Surveys, for *HST*-ophiles). Nothing is evident inside a circle with a radius of 0.021 arcsec, nor is there any star visible within a larger circle with a radius of 0.168 arcsec, which is their estimate of the maximum (statistical – 8σ) uncertainty in the position of the supernova. There are two red stars just outside that circle. Formally, they are excluded as companions to the progenitor white dwarf. There is no visible companion, which excludes all red giants and most O and B stars, known collectively as "helium stars" because of the strong helium lines in their spectra, which imply vigorous winds.

Taken together, all of the data so far are best explained by a white dwarf being fed by a main-sequence star. Of course, this applies only to this particular supernova, and other possible progenitors are conceivable for other supernovae, so the more general problem certainly is not settled. Watch this space for future updates. ✶

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.*

Through My Eyepiece

Observing Mars

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

Mars is one of the most fascinating astronomical objects to the public, and something that most beginners in astronomy look forward to seeing through a telescope. Unfortunately, it often turns out to be a major disappointment because of its small size and the difficulty of making out any detail.

Because of the closeness in orbital speed of Mars and Earth, the two planets only get next to each other every 26 months. The next time of close approach will be in the first week in March. Mars will be in opposition on March 3 and will be closest to Earth two days later on March 5.

You'd think these two events would happen on the same day. They don't because Mars' orbit is highly elliptical, and it is still approaching the Sun (and the Earth) on the date of opposition and so doesn't reach minimum distance until two days later.

You'll often hear astronomers talk about "favourable" and "unfavourable" oppositions of Mars. Again, Mars' elliptical orbit is to blame. There's a nice diagram on page 222 of the RASC *Observer's Handbook* that explains this. At a favourable opposition, such as the ones in 2018 and 2020, Mars is at its closest to the Sun when in opposition to Earth. At an unfavourable opposition, such as the ones in 2012 and 2014, Mars is farthest from the Sun when at opposition. The opposition of 2012 is about as bad as it gets, with Mars a distance of 0.67 au away from Earth. Compare this to a distance of 0.38 au in 2018.

Even this pales in comparison with the extremely favourable opposition of 2003, which many of us fondly remember. At its closest, Mars was only 0.37 au away. Even at that most favourable of oppositions, many of the public were extremely disappointed with the views they got of the planet. The basic problem with Mars is that it's a very small planet. It is only 6792 km in diameter, slightly more than half the Earth's

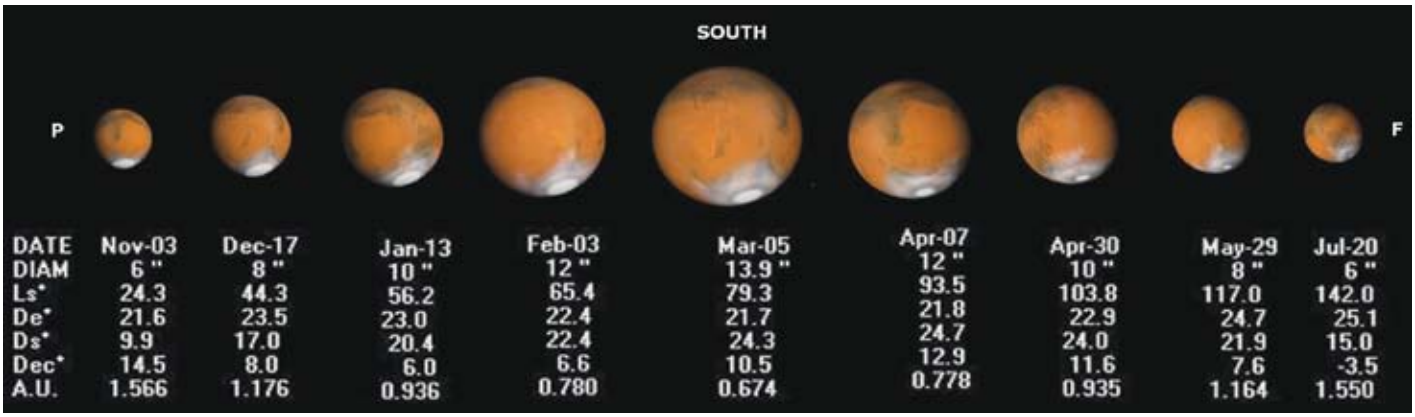


Figure 1 — As Mars approaches Earth, it will swell from a small apparent disk of 6" on 2011 November 03 to a maximum diameter on 2012 March 05 and then shrink as it moves away. Schematic prepared by Jeff Beish of ALPO and used with permission.

diameter of 12,756 km. At its largest in 2003, it appeared only 25 arcseconds wide, compared with Jupiter at 48 arcseconds and Venus at up to 57 arcseconds. This year it will barely reach 13.9 arcseconds.

Jeff Beish of the Association of Lunar and Planetary Observers has prepared a useful diagram of Mars' appearance during the 2012 apparition in Figure 1.

Jeff has written the standard reference article on observing Mars (www.alpo-astronomy.org/jbeish/Observing_Mars.html), which includes articles giving details of the upcoming and future apparitions of Mars (www.alpo-astronomy.org/jbeish/2012_MARS.htm).

As you can see in the above diagram, the diameter of Mars changes significantly over the course of an apparition. It used to be a rule of thumb that there was no point in observing Mars when its apparent diameter was smaller than 10 arcseconds. That was before the days of Webcams and stacking. The first images of the current apparition were made last July when Mars was only 4.3 arcseconds in diameter.

What can be seen visually with typical amateur telescopes? The most obvious feature is the polar cap, which I have seen in apertures as small as 75 mm. With an aperture of 150 mm, you can see the dusky albedo markings, such as Syrtis Major, which is well placed in the April 7 image above.

Mars takes slightly longer than the Earth to make a rotation on its axis. If you observe over a few hours, you can actually see the dusky markings move as the planet rotates. If you observe Mars at the same time every night, for a week, the markings will appear to move in the opposite direction due to Mars' slightly slower rotation period; this amounts to 39 minutes worth of rotation every night.

My favourite thing to look for on Mars is the atmospheric haze, which appears along the morning terminator and close to the poles. This can be brought out through the use of special filters. All this is well and good, except that most people, when they look at Mars through a telescope, can't see much more than a tiny featureless peach-coloured disk. How can you see the detail?

The answer is "Practice!" And, the best way to train your eye is to make sketches of Mars at every opportunity. At first, you will see nothing at all, but as your eye and mind relax and the bubbling of the Earth's atmosphere comes and goes, you will begin to see a bit of shading here and there. Get it down on paper and wait for the next hint. This may seem like an exercise in "averted imagination," but there really is detail there just at the limits of what the eye can detect, and, with practice, you will begin to see it more definitely and reliably.

A few years ago, Jim Low conducted an experiment in which he made sketches of Mars with his 250-mm reflector every clear night and took great care never to consult any maps of Mars. He would send his sketches along to me, and I would check them against maps of Mars and, sure enough, he was drawing features that were really there.

This year's Handbook has a beautiful colour sketch of Mars by Michael Gatto on the front cover. This was made with the commonest of today's amateur telescopes, a 200-mm Dobsonian. Mars this year will be much smaller in size than it was in 2003 when this sketch was made, but Mars is much higher in the sky, so the seeing will be steadier. Let this be an inspiration for you to attempt some sketches of Mars yourself. Remember, artistry is not important: think of what you are doing as *copying* what you see through your eyepiece. ✶

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

Society Award Winners at the 2011 General Assembly

At every General Assembly, the Society takes the opportunity to confer awards on deserving members and other practitioners of the astronomical arts, a practice that extends into the distant past, to the beginnings of the RASC itself. Two awards were made at the Winnipeg General Assembly, and we take the opportunity to publish the nomination citations that were presented to National Council. Congratulations to Jay and Rob.

Citation—RASC Service Award

Robert Dick

Rob is Chair of the National Light-Pollution Abatement (LPA) Committee, a position he has held since 2000. In addition, he volunteered his time during most of the last dozen years as one of the Ottawa Centre's National Council Representatives. In the Ottawa area, Rob negotiated the LPA measures that are now part of City of Ottawa policy documents. He has also advised and consulted on lighting policies of numerous municipalities and townships. Rob authored the Parks Canada Guidelines for Outdoor Lighting and he developed an Outdoor Lighting Protocol for the RASC. Following natural evolution, he authored, led the development of, and implemented the new RASC Dark-Sky Preserve (DSP) and Urban Star Park Programmes, which has resulted in six new DSPs since 2008, following the program's approval by the National Council.

The goal of the DSP Program is to promote the reduction in light pollution, demonstrate nighttime lighting practices, improve the nocturnal environment of wildlife, protect and expand dark observing sites for astronomy, and provide accessible locations for the public to experience the naturally dark night sky. In addition, a common by-product has been increased public astronomy activity sponsored by the parks with support from local RASC Centres. Light pollution affects more than just astronomy, and as such, some of his recent efforts have focussed on scotobiology, the science of effects of darkness on biology.

Rob has made many presentations and written many articles on LPA topics, including:

- Urban Lighting with Less Environmental Impact, Building Sustainable Communities Conference, Kelowna, B.C. (November 2010) (www.freshoutlookfoundation.org/conferences/bsc10/bsc10.asp)
- Scotobiology and Shoreline Lighting, The Land Between Research Forum, Haliburton, Ontario (October 2010), (www.thelandbetween.ca)
- The Dark–sky Preserve Program in Canada, 3rd UNESCO International Symposium on Dark-sky Sites, Lastovo, Croatia (September 2010), (www.darkskyparks.org)
- Scotobiology and Canadian Dark-Sky Preserves, 2nd UNESCO International Symposium on Dark-sky Sites, Lastovo, Croatia (September 2009), (www.darkskyparks.org)
- Scotobiology and Dark-Sky Preserves, Spruce Woods Provincial Park, Manitoba (2009) (www.gov.mb.ca/conservation/parks/popular_parks/spruce_woods/info.html)
- Impact of Night Lighting on Nature, Cube Gallery, Ottawa, Ontario (2009) (http://cubegallery.ca/)
- Scotobiology, The Land Between Conference, Buckhorn, Ontario (2009) (www.thelandbetween.ca)
- Artificial Light and Ecological Integrity, National Capital Commission, Gatineau Park (February 2009)
- Limiting Light Pollution with Municipal Lighting Policies, RASC Annual Meeting (2008) (www.rasc.ca)
- Scotobiology Applied to Shoreline Stewardship, Lake Links Conference, Ontario (2008) (http://users.xplornet.com/~nfrontenac/LakeLink08.pdf)
- Dark-Sky Preserves, Mont-Mégantic Observatory Conference, Québec (2007) (http://astrocanada.ca/_en/a2109.html)
- Scotobiology and Artificial Lighting, Rideau Valley Conservation Authority, Ontario (2007) (www.rvca.ca)
- Royal Astronomical Society of Canada (RASC) Light-Pollution Abatement Program, Ecology of the Night Conference, Muskoka District, Ontario (2003) (www.ecologyofthenight.org)

In addition to his LPA activities, Rob joined the RASC in 1968 and has been a very active member of the Ottawa Centre, participating in many activities and giving many presentations to the Centre over the years. Rob built and operates an observatory with a custom-made 24-inch telescope near Rideau Ferry, where he regularly hosts open houses for astronomy enthusiasts. Rob also works as an astronomy instructor, having taught Introduction to Astronomy at Carleton University for 22 years, and Introduction to Astrophysics at University of Ottawa for three years, and has assisted with the Spacecraft Engineering course at Carleton University since 2004. He has also provided astronomy instruction to Canadian astronauts.

In light of his tireless commitment over many years to the cause of light-pollution abatement, the Ottawa Centre is proud to nominate Robert Dick for the RASC Service Award.

Citation—Simon Newcomb Award

Jay Anderson

We (Alan Whitman and Scott Young) nominate that Jay Anderson be honoured with the Simon Newcomb Award for his many years of service to the Canadian and worldwide total solar eclipse-chasing community. Mr. Anderson and Fred Espenak, are best known as co-authors of the NASA eclipse bulletins, their most recent the book-length bulletin entitled *Annular and Total Solar Eclipses of 2010*. The two also co-author the solar eclipse section in the RASC *Observer's Handbook*, plus short articles in *Sky & Telescope* a few months before major eclipses.

For decades Mr. Anderson's authoritative summary of the climatological cloud cover along the length of each solar eclipse path has been one of the main considerations that eclipse expeditions from around the world use to choose their intended observing site. Mr. Anderson's discussion of the usual weather patterns and topographic influences at various potential observing sites along the eclipse path is the starting point for the self-education that every eclipse meteorologist must undertake in the two years prior to any eclipse tour abroad for which he will be providing weather consultation.

Mr. Anderson's reputation is now such that he is the recognized expert on eclipse meteorology, and the hundreds of worldwide members of the Solar Eclipse Mailing List routinely direct their questions on climatology and causative weather factors to Mr. Anderson. An important part of Mr. Anderson's advice is the strategies that he suggests for mobility on eclipse day if clouds threaten.

This Council recognizes the great service that Mr. Anderson's writing on these topics has provided to his worldwide readership for decades, leading to an increased success rate for solar eclipse expeditions that are mobile on eclipse day in comparison to the one-time practice of just setting up at a pre-determined point and hoping for the best.

See also the Web page devoted to Award winners www.rasc.ca/awards ✶

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

New Honorary Members of the Society

Dra. Julieta Fierro (Mexico)

Dra. Julieta Fierro, "the Carl Sagan of Mexico," is a professor at the Institute of Astronomy, Universidad Nacional Autonoma de Mexico (UNAM) and one of the world's foremost communicators of astronomy. Her graduate degree was in astronomy, and she teaches regularly at UNAM, where she carries out research on interstellar matter. Her contributions to Spanish-language science education and outreach are prodigious—over 40 books, directorship of a major science centre, Universum, in Mexico City (and consultant to other science centres), numerous radio and TV series, programs and appearances, and countless public lectures, including one to 100,000 schoolchildren in a stadium! She works extensively with schoolteachers and students, giving workshops, developing resources, and writing books and articles for young people. She is constantly innovating; most recently, she has collaborated with a dance company to present astronomy through that medium. Her public presentations are legendary—highly kinetic and engaging. But unlike some public figures, she radiates a warm and generous personality. She has served nationally as President of the Mexican Academy of Professors of Natural Science, and the Mexican Society of Science Museums, and internationally as President of the International Astronomical Union's Commission on Astronomy Education and Development. Her many national and international awards include honorary doctorates, the Klumpke-Roberts Prize of the Astronomical Society of the Pacific, the prestigious UNESCO Kalinga Prize for promoting public understanding of science, and membership in Mexico's Academia de la Lengua—an honour usually reserved for scholars in the humanities.

Dra. Julieta Fierro

Prof. Andrew Fraknoi (USA)

Educated at Harvard and the University of California, Berkeley, Fraknoi has taught astronomy and physics at San Francisco State University, the City College of San Francisco, Canada College, and several campuses of the University of California Extension Division, and is a prolific writer of astronomy books. Among his work are two collections of scientific articles and science fiction, a teaching guide (*The Universe at Your Fingertips*), and a children's book on astronomy (*Disney's Wonderful World of Space*). Franknoi is the organizer and acts as moderator for the ASP's Cosmos in the Classroom conference that brings astronomy to a quarter-million students.

Prof. Andrew Fraknoi

Society President Mary Lou Whitehorne has had occasion to meet Prof. Fraknoi and notes:

> *His work represents the global gold standard in astronomy education and outreach. He has inspired many to follow in his footsteps. I have had the pleasure of meeting him a few times, and of hearing him speak. He is nothing short of phenomenal—passionate, inspiring, dedicated and caring. I have used and marvelled at his work for over two decades. He has been my personal role model for over 20 years and is unquestionably deserving of honorary membership status.*

Andrew Fraknoi is a science educator who is known for his skill in interpreting astronomical discoveries and ideas in everyday language. His accomplishments include:

- Chair of the Astronomy Program at Foothill College near San Francisco
- Professor of the Year in 2007 for the state of California
- Over 400 public lectures
- Executive Director of the Astronomical Society of the Pacific for 14 years.
- Founded and directed Project ASTRO, brings astronomers into 4th – 9th grade classrooms.
- He is a prolific author, speaker on news and talk programs.
- Board member of the SETI institute.
- Fellow of the Committee for Skeptical Inquiry, specializing in debunking astrology and other pseudo-sciences.
- Fellow of the California Academy of Science. In 2009, he served as national secretary for the program committee for the International Year of Astronomy, celebrating the 400th anniversary of Galileo's turning the telescope to the heavens.

Asteroid 4859 was named Asteroid Fraknoi by the International Astronomical Union to recognize his contributions to the public understanding of astronomy.

Dr. Oscar Álvarez-Pomares

Dr. Oscar Álvarez-Pomares (Cuba)

Dr. Oscar A. Álvarez-Pomares, now with the Cuban National Academy of Sciences, is a respected radio astronomer and was the Cuban National Node for IYA2009, during which he led the project to create the new Havana Planetarium, which opened in January 2010 (www.astronomy2009.org/organisation/nodes/national/view/CU).

Dr. Oscar Álvarez has been a constant supporter of amateur astronomy in Cuba. Under his leadership as Director of astronomy at IGA, he organized the IAU's XVI International School of Young Astronomers in 1989, recognized as one of the most important milestones related to astronomy outreach in the country. Dr. Álvarez is a natural communicator, with the rare ability to explain difficult concepts in simple words. So, in the media, his person is recognized as the visible face of astronomy in Cuba. In that discipline, he is regarded as an effective science communicator, and his participation is requested in almost every science/pseudoscience debate, which explains his extraordinary popularity beyond scientific environments leading him to become one of the most acknowledged scientists in the country.

See also, the RASC Web page devoted to our Honorary Members www.rasc.ca/content/honorary-members ✶

Edmonton welcomes you!

53rd General Assembly of the Royal Astronomical Society of Canada
2012, June 28 – July 1

Enjoy Canada's festival city this summer while attending the 2012 General Assembly (GA) of the RASC. It's an excellent opportunity to mix and mingle with fellow astronomers. We've put together an amazing program of exciting speakers for you together with some outstanding social events. We have lined up some great tours for you and your family, including an opportunity to meet a dinosaur face-to-face and a chance to hunt for a meteorite.

The GA will take place at the **University of Alberta** main campus, located in the heart of Edmonton next to the North Saskatchewan River valley—the largest urban greenbelt in North America.

The principal venue will be the **Centennial Centre for Interdisciplinary Science** (CCIS)—the newest building on campus and a vibrant environment for learning and discovery.

Lodging

Lodging will be available at the Lister Centre, which has easy access to campus and offers three styles of accommodation—hotel style, residence style with private washroom, and dormitory style with shared washrooms. We have block booked 80 rooms—some of each style.

The University of Alberta does **not** offer on-line bookings for these facilities, but a form is available on the web site that can be faxed or emailed.

A **hospitality suite** has been reserved for the duration of the GA.

Featured Events

National Council BBQ

We are continuing the fine tradition started in Fredericton by hosting a BBQ for National Council delegates and their guests. The menu will consist of a choice of steak, chicken, or fish entrée* barbecued to your liking. Pre-registration is required. [Thu June 28]

Wine & Cheese Reception

This will be a great opportunity to relax and mingle in the astronomy-themed West Atrium of the CCIS. Admire the stellar terrazzo floor and the Solar System mobile, tour the observatories on the roof, participate in Murphy Night. This reception will be kicked off with an invited talk by **Dr. Martin Connors**. [Fri June 29]

Helen Sawyer Hogg Public Lecture

This public lecture will be presented by **Dame Jocelyn Bell Burnell**, best known as the discoverer of pulsars. A reception will follow. [Sat June 30]

Closing Banquet

The closing banquet in the Maple Leaf Room at Lister Centre will feature a choice of beef tenderloin, stuffed chicken, or glazed salmon for the entrée*. The featured speaker at the banquet will be **Dr. Chris Herd**. [Sun July 1]

Catered Meals

- National Council BBQ [Thu June 28]
- Wine & Cheese [Fri June 29]
- Catered Lunch [Sat June 30]
- BBQ before Hogg Lecture [Sat June 30]
- Closing Banquet [Sun July 1]

** Vegetarian options available upon request for all catered meals.*

Other Invited Speakers

Dr. Martin Connors
Athabasca University

Invited Talk

"Earth's Trojan Asteroid: A Space Odyssey to a Space Oddity"

Dr. Christopher Herd
University of Alberta

Banquet Speaker

"When the Sky Falls: Meteorites as Probes of Other Planetary Bodies"

Tours

Our tours are designed to offer fun for the whole family. Choose among three full-day tours and four half-day tours. See the Web site http://edmontonrasc.com/2012ga/ga_registration.html for details.

Whitecourt Meteorite Crater

About 1,100 years ago, a space rock the size of a big tree stump slammed into western Canada. This is your chance to go on a guided tour of the impact crater. Hunt for your very own meteorite specimen!

Elk Island National Park & Beaver Hills Dark-Sky Preserve

Explore this beautiful oasis, home to herds of free-roaming plains bison, wood bison, moose, deer, and elk. Be it for wildlife viewing, hiking, golfing, picnicking, or camping, there is something for everyone at Elk Island National Park.

Fort Edmonton Park

At Canada's largest living history museum, explore Edmonton's progress from a fur-trade post in the vast Northwest to a booming metropolitan centre after the First World War.

Enjoy Centre

More than a garden centre, the Enjoy Centre is built on the central conviction that consumers want more than products and services. They want an experience. Always inspiring. Always evolving. Always inviting.

Jurassic Forest

A new interactive dinosaur park, featuring Tyrannosaurus rex, one of 40 life-sized, pre-historic robotic beasts. Take a guided tour or walk by yourself.

Muttart Conservatory

A year-round escape into the beauty of the world's plant life. Vibrant, colourful, tranquil and inspirational, the pyramids' display gardens are a welcome oasis for all.

TELUS World of Science—Edmonton

There's nothing quite like the TELUS World of Science. Kids love it. Adults think it's great. Experience science like never before. Explore an exhibit or two, catch the latest IMAX film, immerse yourself in cool Full-Dome shows in the Margaret Zeidler Star Theatre, or be dazzled by an array of Science Demonstrations.

Display Competition

We will have three display competitions, open as follows:

- Project displays (adult RASC members)
- Project displays (students—open)
- Photography and Visual Displays (open)

See the Web site http://edmontonrasc.com/2012ga/ga_registration.html for details.

Call for Papers

We will have two sessions of papers where delegates can share their astronomical experiences, data, and insights. Submissions are due by 2012 April 1. See the Web site http://edmontonrasc.com/2012ga/ga_papers.html for details.

Registration

Registration is now open! Registration fees are:

$110/person by March 31,
$135/person by May 31,
$150/person June 1, onwards

Online registration http://edmontonrasc.com/2012ga/ga_registration.html closes June 18.

Transportation

We are offering complimentary transportation between the Edmonton International Airport, VIA Rail Terminal, or bus terminals and Lister Centre *(or wherever you may be staying, if possible)*.

See the Web site http://edmontonrasc.com/2012ga/ga_registration.html for details. Parking is available at Lister Centre for those who wish it.

Contact Us

GA Chair
Howard Gibbins, 2012ga@edmontonrasc.com

Papers & Posters
Doug Hube, papers2012ga@edmontonrasc.com

Registrations & Accommodations
Ross Sinclair, register2012ga@edmontonrasc.com

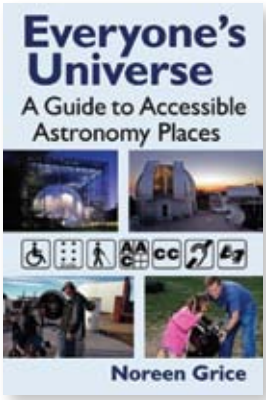
Transportation
Geoff Robertson, transport2012ga@edmontonrasc.com

Web site

edmontonrasc.com/2012ga

Follow us on Twitter: @RASC2012GA

Everyone's Universe, A Guide to Accessible Astronomy Places, by Noreen Grice, pages 176; 15 cm × 23 cm, You Can Do Astronomy LLC 2011. Price $18.95 paperback (ISBN 978-0-9833567-0-7).



One of the rewards of presenting astronomy outreach activities is the occasional flare of excitement ignited when it elicits an "aha!" moment in a newcomer. It may be a sudden revelation about the place occupied by our planet in the vastness of the Universe. Sometimes the catalyst is a view of the first-quarter Moon, or Saturn's rings, or the Great Orion Nebula. When it happens, the participant's worldview has likely been enriched, bringing a more personal sense of their relationship to the Universe (and science). A sensation of discovery then develops; the planets, nebulae, and galaxies become objects of direct experience, not just fantastic visuals from the unknown provided by the *Hubble Space Telescope*. Such breakthroughs are bright flashes of human awareness that should be open to everyone, including people whose visual acuity may be different from yours or mine, and people who face perceptual, mobility, or communication challenges, who number in the millions in Canada alone. It is to be hoped that, once they realize their participation is welcomed, they will swell the ranks of attendance at astronomy activities.

Making astronomy events more inclusive makes them better for everyone. Bringing true inclusiveness and accessibility means reaching past apparent barriers with small gestures that shift perceptions on the largest scale. The rewards include great satisfaction for the presenters, greater community support for the activities, and more support for astronomy. Extending the "reach" of outreach to people with disabilities does not require great expense or expertise. It requires awareness, and a desire to communicate and share the enjoyment of astronomy. In *Everyone's Universe*, astronomer Noreen Grice reviews the many strategies and shortcuts she and others have developed over the past 27 years, and demonstrates that even blindness need not stand in the way of doing astronomy!

The book is printed in a large (16/22 Gill Sans) font, quite friendly to people who, like the reviewer, may constantly mislay their reading glasses. In part I, "How to Make the Universe Accessible," the author lays out her methods in an extremely lucid, direct, and easy-to-follow style. Part One (55 pages) can be read in an evening, but deserves frequent re-visitation. It challenges our notions of what is possible, and inspires plans of action. The methods described, including "tactile images" and touchable star charts, are practical and ingenious.

In Chapter 2, "Visual-Friendly Observing," we are introduced to the concept of the "Tactile Telescope Tour," which may include a decommissioned telescope modified for the purpose, or a creative hands-on guided tour by voice and touch. Such a tour benefits full-sighted onlookers as well, since touchable images and tactile star charts for use by a low-vision person at the eyepiece can also enhance the experience of an observer with normal vision. Video astronomy is explored both as a way of making the view through the eyepiece remotely accessible, and as a way of making the image bigger and brighter. The live view provided by a low-light video camera and large conveniently placed monitors (even one in the lobby) does more to increase accessibility than anything else. It is especially true if the setting allows viewers to get as close as they need to the screen.

Part II is a "Guide to Accessible Astronomy Places"—a list of destinations for people who may not yet have found their own portal to the Universe. Its 77 pages describe 35 astronomy places that make use of "multiple paths of inclusion." Unfortunately, in the first edition, some geographical areas had to be left out and significant travel may be necessary in some cases. One of the areas is Canada. The author's intention is to fill in the gaps in the 2nd edition. If your club or institution has developed ways of making the Universe accessible, please

communicate with the author by visiting her Web site at www.youcandoastronomy.com.

Some clubs, individuals, and institutions are involved in a variety of remarkable undertakings reported in the volume: At Yerkes Observatory, Vivianne Hoette has conducted weeklong workshops for blind students, starting off with materials prepared by the author. In California, the Pomona Valley Amateur Astronomers regularly conduct star parties and classes for people with visual disabilities. At such events, enjoyed by the fully sighted and the totally blind alike, legally blind people have been thrilled by views of lunar mountains, and even (on a live video monitor) the dust lanes in the Sombrero Galaxy.

Chapter 3 (Part I) deals with "Augmentative and Alternative" Communication. Chapter 4 tells us how to get our message to people who are deaf or hard of hearing, and Chapter 5 reminds us that not all disabilities are readily obvious. Anyone who has watched another's eyes filling with wonder at their first sighting of the Pleiades or lunar craters though a telescope remembers the excitement of that shared event. How much more wonderful is the experience if the eyes belong to a person who had previously felt excluded?

The rewards of including people who have so far been left out are well worth the effort. This excellent guide by Noreen Grice will show you and your fellow astronomy resource people the way to open the Universe to everyone. ✶

Steve Dodson

Steve Dodson is a member of the Ottawa Centre who lives in Sudbury. A life-long amateur astronomer, he is known for Star-gazer Steve Telescopes and for Asteroid 13822 (stevedodson). In the 1980s he toured Ontario with his 16-foot-tall, 22-inch, trailer-mounted scope, and set up astronomy exhibits and activities at Science North.

Society News

by James Edgar
(jamesedgar@sasktel.net)

The previous *JRASC* issue was so jam-packed that we didn't have room for some photos from the recent GA in Winnipeg. To make up for that shortfall, we offer these, courtesy of Dave Clark and others (read "me").

I call my offering "The Three Amigos"—Drs. Jayanne English, Christine Wilson, and Samar Safi-Harb, of Winnipeg, McMaster, and Winnipeg, respectively, enjoying a relaxing time in the hospitality room. One might also title the picture "Visual, Radio, and Infrared," with a nod to their astronomical work. ✶

Figure 1 — L to R: Drs. Jayanne English, Christine Wilson, and Samar Safi-Harb

Figure 2 — L to R: The RASC Executive Committee: Deborah Thompson, Mary Lou Whitehorne, Glenn Hawley, James Edgar, Mayer Tchelebon, and Colin Haig

Figure 3 — The hospitality-room scene where Rick Huziak does a "show-and-tell" session with Dr. Christine Wilson, explaining about his Buzzard Coulee meteorite collection. L to R around the table: Rob Dick (hand on head), Betty Hesser, Patrice Scattolin, Rick Huziak, James Edgar, Dr. Christine Wilson, Alan Dyer, Ryan May, and Brian Hunter.

Call for Nominations

Colin Haig
Vice-President, RASC

The RASC is seeking candidates to fill the following four positions on the national Executive Committee: President, 1st Vice-President, 2nd Vice-President, and Treasurer. These positions will become vacant at the conclusion of the 2012 Annual meeting, on 2012 July 1. If you or your Centre know of a person interested in, and qualified to, assume the responsibilities associated with any of these positions, please get in touch no later than 2012 April 15, by emailing the chair of the Nominating Committee (2VP Colin Haig) at: www.astronomer@cogeco.ca

The Nominating Committee has confirmed the willingness of the current Vice-Presidents to ascend to the next level on the Executive committee. Any other member who wishes to run for these elected positions may do so by following the procedures outlined in the Society's By-Laws. The Committee must present the name(s) of all interested candidates for these openings to the National Secretary at least 60 days prior to the Annual Meeting.

For more information about the duties and responsibilities of these nationally elected positions in the Society, please refer, via the link provided below, to these sections of the RASC By-Law Number 1:

Sections 6.05 (1) and (2): **Nomination Of Elected Officers**

Sections 6.06 (1) and (2): **Election Of Officers**

Sections 6.09 (1 through 2): **Duties Of The President**

Section 6.10 (1 through 4): **Duties Of The Vice-Presidents**

Section 6.12 (1 through 3): **Duties Of The Treasurer**

Section 7.09 (1 through 5): **Executive Committee**

By-Law Number 1 is available on the members' only section of the Web site www.rasc.ca/governance/bylaws

Here are the relevant sections of By-Law Number 1, for reference;

6.05 Nomination of Elected Officers

(1) The Nominating Committee shall prepare a list of one or more candidates for each elected office for which an election must be held. This list shall be presented to the Secretary of the Society at least sixty days before the annual meeting.

(2) Any other eligible member of the Society may be nominated for any elected office for which an election must be held. Such nomination (in writing, signed by at least five voting members of the Society, and confirmed by a written statement of acceptance from the candidate) must be delivered to the Secretary of the Society at least sixty days before the annual meeting.

6.06 Election of Officers

(1) Where there is more than one nomination for such office, the Secretary shall prepare a ballot listing in alphabetical order all candidates who have been nominated for each elected office for which an election must be held at an annual meeting. The ballot shall not differentiate between those candidates nominated under Article 6.05 (1) and those candidates nominated under Article 6.05 (2). Where there is only one nomination for any such office, the Secretary shall prepare a notice of acclamation of such office. Any such ballot and any such notice of acclamation shall be sent with the notice of the annual meeting to all voting members of the Society, together with written instructions to return the marked ballot to the Secretary prior to the annual meeting, as prescribed in Article 8.01 (2).

(2) All marked ballots received by the Secretary prior to the commencement of the annual meeting shall be counted by two scrutineers appointed by the Council. The candidate for each office who receives the greatest number of votes shall be declared elected to that office at the annual meeting.

6.09 Duties of the President

(1) The President shall:

(a) preside at all meetings of the Society and the Council as provided by Articles 5.02 (4) and 8.04;

(b) prepare and submit to the Secretary by 31 January an annual report of the activities of the Society for the preceding calendar year; (amended, July 1999)

(c) supervise the operations of the national office, the Executive Secretary, and any other employees of the Society, with the assistance of the Vice-Presidents; (amended, July 1999)

(d) represent and speak for the Society when appropriate;

(e) chair meetings of the Executive Committee referred to in Article 7.08(4);

(f) act as liaison between the Centre, Centres or group of members acting as host of the forthcoming General Assembly, ensure that the proposed schedule of dates and meetings is suitable for the purposes of the Society, and report to the Council respecting plans for the General Assembly; and

(g) have such other duties as may be prescribed by the Council.

(2) The President is a member of all committees of the Council, as prescribed in Article 7.03.

6.10 Duties of the Vice-Presidents

(1) The Vice-Presidents shall assist the President in the discharge of his or her duties, shall preside at meetings of the Council and of the Society in the circumstances prescribed in Articles 5.02 (4) and 8.04, and shall have such other duties as may be prescribed by the Council.

(2) The Vice-Presidents shall be members of the Executive Committee as prescribed in Article 7.08.

(3) The First Vice-President shall be a member of the Constitution Committee as prescribed by Article 7.07(1), and shall be chairperson of the Publications Committee as prescribed in Article 7.14(1).

(4) The Second Vice-President shall be a member of the Finance Committee, as prescribed in Article 7.09 (1), and shall supervise the Society's management of membership and collection of fees. (amended, July 1999)

6.12 Duties of the Treasurer

(1) The Treasurer shall:

(a) prepare and keep complete financial records of the business of the Society, including books of receipts, disbursements, assets, and liabilities;

(b) receive and supervise the deposit of receipts;

(c) supervise the disbursement of Society funds;

(d) supervise the safekeeping of the Society's securities and other monetary assets;

(e) discharge the duties specified in Article 9.03 (2);

(f) make the payments prescribed in Article 3.05 (9)

(g) in general conduct the financial business of the Society in accordance with the direction of the Council; and

(h) have such other duties as may be prescribed by the Council.

(2) The Treasurer shall be a member of the Executive Committee as prescribed in Article 7.08, a member of the Property Committee as prescribed in Article 7.13, and chairperson of the Finance Committee as prescribed in Article 7.09.

(3) The Treasurer shall prepare and shall present to each meeting of the Council (except the meeting, referred to in Article 5.02 (1), that is held within two days after the annual meeting) a statement of the Society's revenues and expenses for the period ended as close as possible to the date of the meeting. (amended, July 1999)

7.09 Executive Committee

(1) The Executive Committee shall consist of the elected officers of the Society referred to in Article 6.01.

(2) The Executive Committee shall transact the routine business of the Society when the Council is not meeting and shall transact such business as requires immediate action.

(3) The Executive Committee shall appoint or dismiss, and shall fix the remuneration and benefits to be paid to, the employees of the Society.

(4) Meetings of the Executive Committee shall be called by the President at the request of any member of the Committee or when the business of the Society requires such meeting. The President shall make every reasonable effort to ensure that every member of the Executive Committee is informed of the time, location and purpose of each meeting of the Executive Committee, as far in advance of its occurrence as possible.

(5) All actions taken and decisions made by the Executive Committee shall be reported by the President at the next meeting of the Council. ✶

Astrocryptic

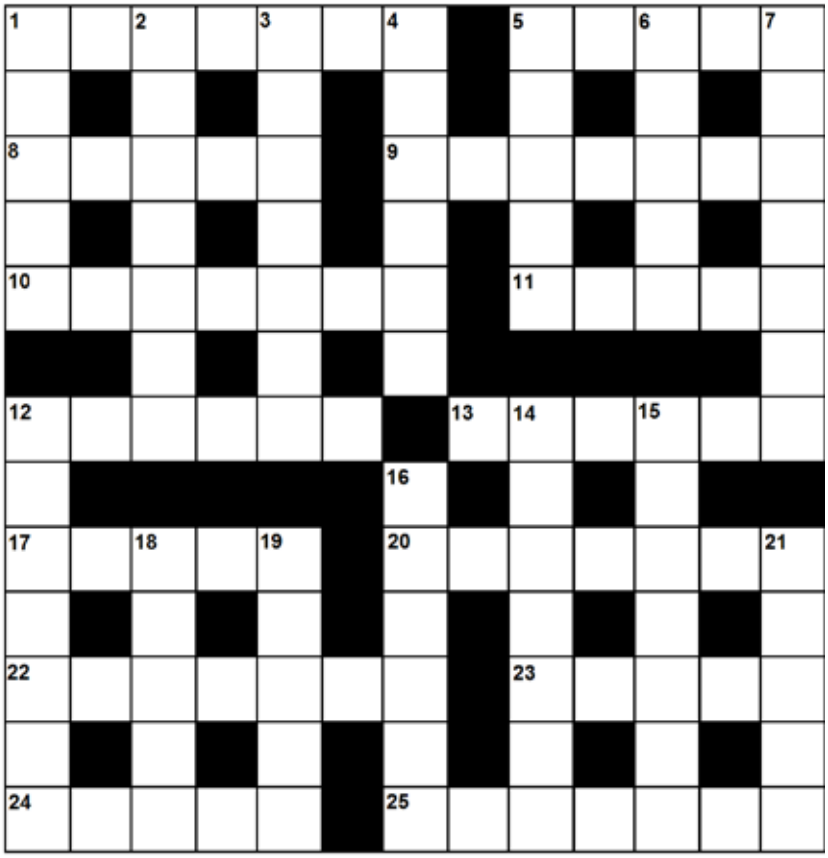
by Curt Nason

ACROSS

1. Christmas wish about copper found on the planet (7)
5. Radar makes first RH detection of β Centauri (5)
8. The Andes reformed beyond Neptune (5)
9. The little king returns Heisenberg's pistol to us (7)
10. Meteorite mineral for hungry collectors, we hear (7)
11. French woman formally recreates Houston work (5)
12. Monday turns a supernova generator (6)
13. Russian spacemen lost nothing audibly in the universe (6)
17. Dietary group of galaxies (5)
20. Northern night crawler in Aquila, certainly (7)
22. Extravagant promotion of emission colour with sensitized film (7)
23. Observe launch without a snack (5)
24. An eye for observing when a Denk gets out of collimation (5)
25. The Eagle has nail broken in its head (7)

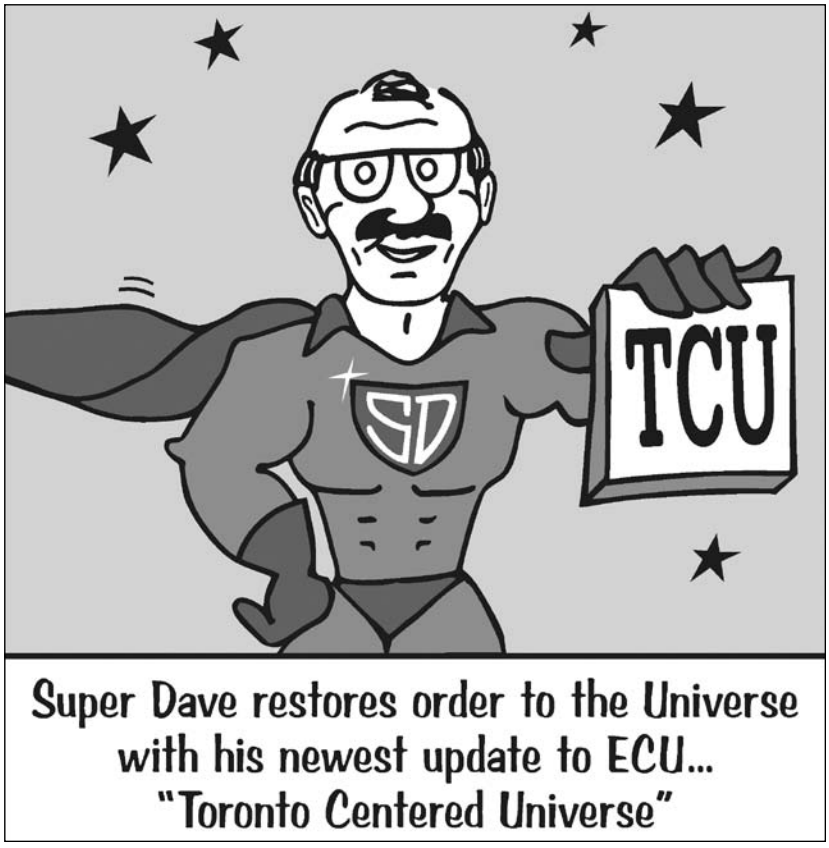
DOWN

1. Fly in the sky across Starmus, Canary Islands (5)
2. Cinematic start of WWIII may be a warning to sailors (3,4)
3. Soundly see you exchange cranium for a power source (7)
4. Edmund eyepiece in affirmative observatory (6)
5. George Gamow starts in his elusive particle (5)
6. A new eyepiece sold back around the start of Easter season (5)
7. Rings around Saturn I see in eastern appearances of stars (7)
12. Mammal in Job's Coffin (7)
14. Obsessive compulsive sects meet when the Moon does this (7)
15. Variable Mira and a moon with odd features (7)
16. Turn dual right ascension knobs to locate the big dog's tail (6)
18. Czech warned of robots in Cape Kennedy (5)
19. Drily spin a tale of April showers (5)
21. She enters an eerie light on Venus (5)



It's not all Sirius—Cartoon

by Ted Dunphy



THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

Executive committee and appointed officers for 2012/Comité exécutif et membres attitrés pour 2012

Honorary President	Jim Hesser, Ph.D., Victoria
President	Mary Lou Whitehorne, Halifax
1st Vice-President	Glenn Hawley, B.Sc., B.Ed., Calgary
2nd Vice-President	Colin Haig, B.Sc., M.Sc., Hamilton
Secretary/Recorder	James Edgar, Regina
Treasurer	Mayer Tchelebon, MBA, CMA, Toronto
Past Presidents	Dave Lane, Halifax and Scott Young, B.Sc., Winnipeg
Editor of Journal	Jay Anderson, B.Sc., MNRM, Winnipeg
Editor of Observer's Handbook	David M.F. Chapman, M.Sc., Halifax
Editor of The Beginner's Observing Guide	Mary Lou Whitehorne, Halifax
Editor of Observer's Calendar	Dave Lane, Halifax
Executive Director	Deborah Thompson, CAE, Toronto

Centre addresses/Adresses des centres

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

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

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

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

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

Halifax Centre
PO Box 31011, Halifax NS B3K 5T9

Hamilton Centre
c/o Mr. A. Blanchard, 2266 Lakeshore Rd W
Oakville ON L6L 1G8

Kingston Centre
PO Box 1793, Kingston ON K7L 5J6

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

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

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

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

Montréal Centre
18455 Meloche St
Pierrefonds QC H9K 1N6

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

Niagara Centre
c/o Dr. Brian Pihack
4245 Portage Rd
Niagara Falls ON L2E 6A2

Okanagan Centre
PO Box 20119 TCM
Kelowna BC V1Y 9H2

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

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

Québec Centre
2000 Boul Montmorency
Québec QC G1J 5E7

Regina Centre
PO Box 20014
Regina SK S4P 4J7

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

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

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

Sunshine Coast Centre
5711 Nickerson Rd
Sechelt BC V0N3A7

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

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

Vancouver Centre
1100 Chestnut St
Vancouver BC V6J 3J9

Victoria Centre
3046 Jackson St
Victoria BC V8T 3Z8

Windsor Centre
c/o Greg Mockler
1508 Greenwood Rd
Kingsville ON N9V 2V7

Winnipeg Centre
PO Box 2694
Winnipeg MB R3C 4B3

Great Images

The Vancouver Centre's James Black likes wide-angle vistas, and this image of the Cocoon Nebula superimposed on the dark nebula Barnard 168 shows off his considerable skills. James mounted a Starlight Express SXVF-M25C camera on an f/5 Takahashi FSQ 106ED to take 56 15-minute frames, a total of 12.5 hours exposure from Pitt Meadows, B.C. The Cocoon is an emission-reflection-absorption nebula surrounding the young open cluster IC 5146. The brightest central star is believed to have opened a cavity in the background dark nebula to give the Cocoon its shape.