The Journal of The Royal Astronomical Society of Canada

Journal

Le Journal de la Société royale d'astronomie du Canada

PROMOTING ASTRONOMY IN CANADA

October/octobre 2012
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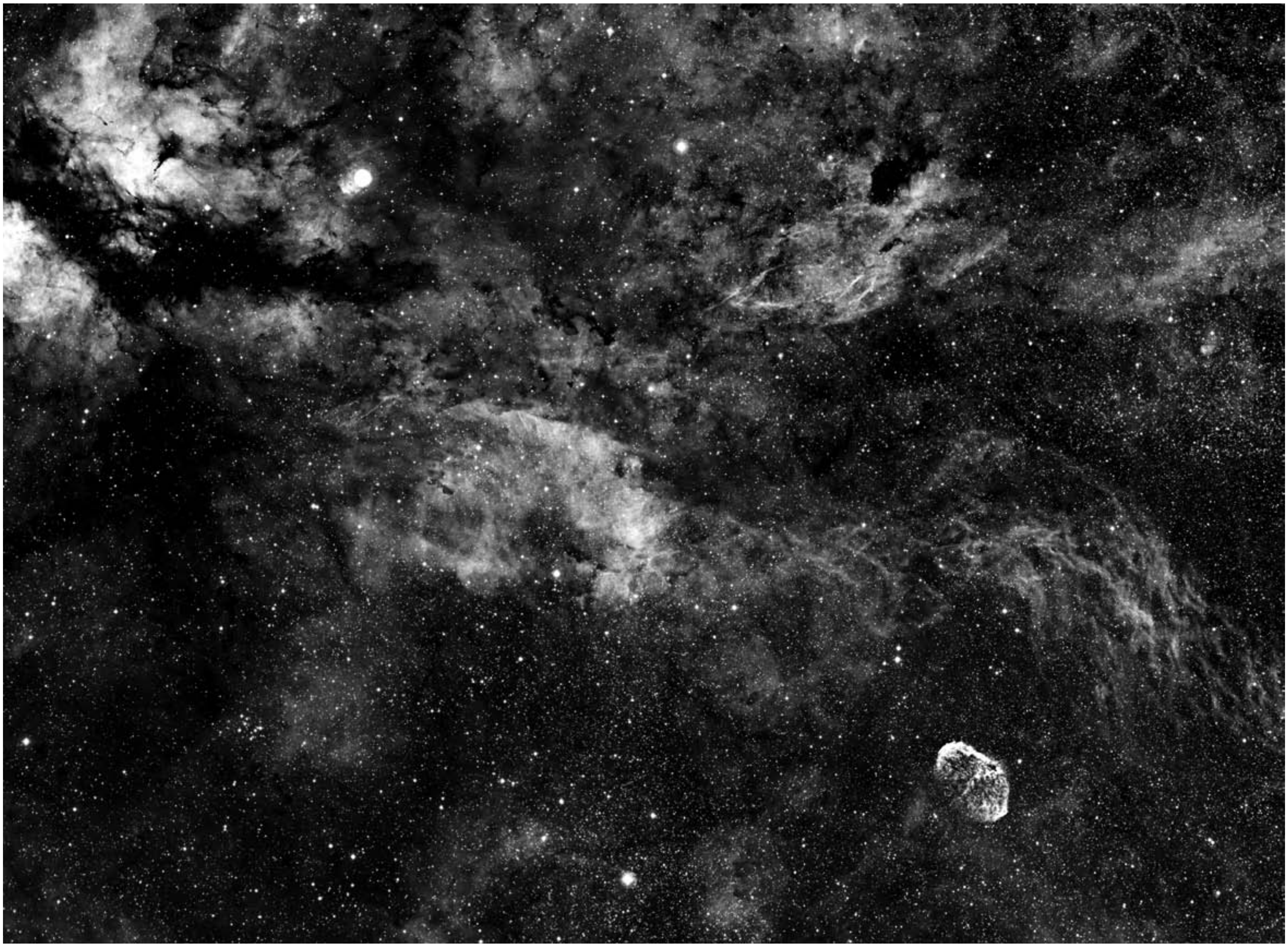
Number/numéro 5 [756]

Inside this issue:

Very Large Array caught not looking

Astrophotographers take note!

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



Tony Peterson does narrow-band observing from his home in Ottawa and the surrounding area, capturing this image of the area between Sadr and the Crescent Nebula in Cygnus over two weeks in late June and early July. The image is a four-panel mosaic in Hα taken with a Tele Vue TV85 telescope at f/5.6 and an Orion Parsec 8300M camera; exposure was a total of 60×1000s.

Journal

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Royal Astronomical Society of Canada — Société Royale d'Astronomie du Canada

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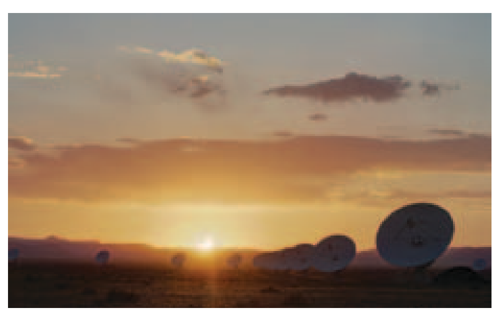

Front cover *— Jennifer West from the Winnipeg Centre experimented with HDR photography to assemble this image of the partially eclipsed Sun setting over the Very Large Array near Socorro, New Mexico, on May 20.*

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

President's Corner

Glenn Hawley
President, RASC

Our second major governance upheaval in less than five years is now more or less under control. While the Society will not vote on final approval for the new By-Law until the 2013 General Assembly in Thunder Bay, and it won't be fully in play until the Victoria General Assembly in 2014, the new By-Law itself is almost entirely written now, with only trivial fine tuning likely to occur.

On paper, it appears to contain major changes to the way the Society functions, but in practice, the changes will not be noticeable at any level but that of the Executive. Members will remain Members, Centres will remain Centres, and we'll still have our National Council with representatives from the Centres. Most Members will notice no difference.

We are working on implementing an online voting process that will remove the need for proxies, and thus all members, whether they manage to come to the GA or not, will be able to vote directly on major issues and for the people running for positions on the new Board of Directors. Also being contemplated is some way for our Unattached Members to have representation on the National Council. Those are aspects of the new Policy Manual, though, rather than needing to be sclerotized in the By-Law.

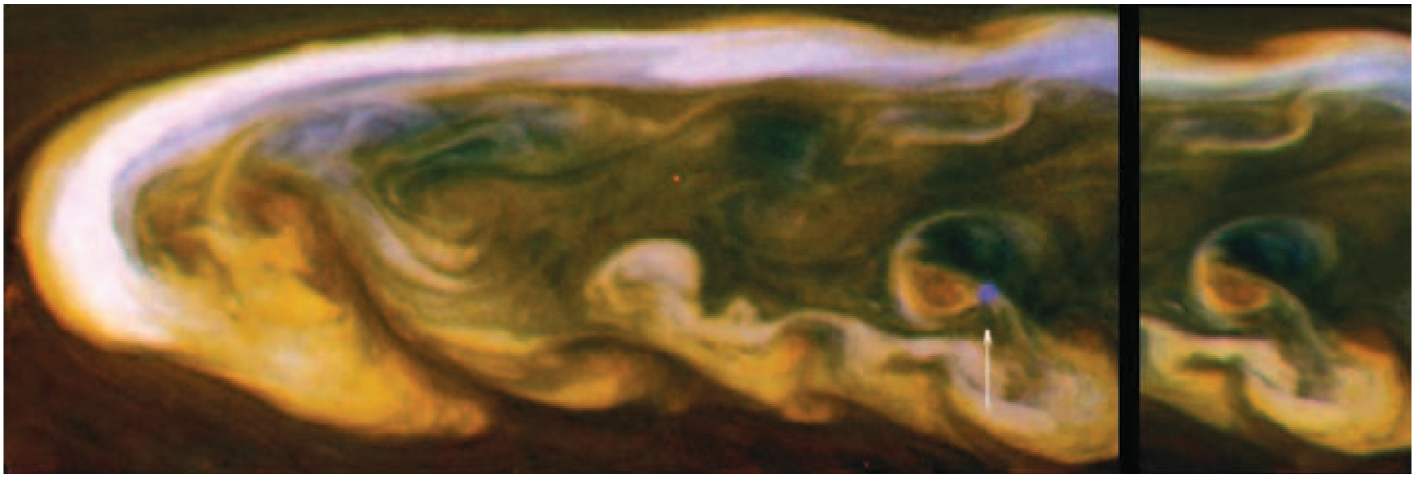

Figure 1 — False-color mosaics from NASA's Cassini *spacecraft capture lightning striking within the huge storm that encircled Saturn's northern hemisphere for much of 2011. The larger mosaic on the left shows the daytime lightning flash as a blue dot (at site of arrow). The smaller mosaic on the right is composed of images taken 30 minutes later with no lightning. NASA/JPL-Caltech/Space Science Institute*

News Notes / En manchettes

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

Bluish flashes indicate daytime Saturn lightning

NASA's *Cassini* spacecraft has captured images of flashes of daytime lightning within Saturn's deep, storm-laden clouds. Bluish spots, seen in the middle of swirling storm clouds on 2011 March 6, indicate flashes of lightning. They mark the first time that scientists have detected lightning in visible wavelengths on the side of Saturn illuminated by the Sun.

The *Cassini* imaging team did not expect to see lighting on Saturn's day side, but now that they have, it is an indication that the lightning was very intense; the visible-light energy was estimated at about 3 billion watts, lasting for one second. The optical energy is comparable to the strongest of the lightning flashes on Earth. The flashes appeared brightest in the blue filter of *Cassini*'s imaging camera. It is not yet known why the blue filter caught the lightning, but scientists speculate that the reason might be that Saturn's lightning really is blue, or it might be that the short exposure of the camera in the blue filter makes the short-lived lightning easier to see.

The flash was calculated at approximately 200 kilometres in diameter when it exited the tops of the clouds. (The width of the flashes is used to gauge the depth of the lightning below the cloud tops.) Scientists have worked out that the lightning bolts originated in the clouds deep down in Saturn's atmosphere where water droplets freeze, which is analogous to where lightning is created in Earth's atmosphere. In composite images that displayed last year's large storm, wrapping all the way around Saturn, scientists saw multiple flashes, with one composite image recording five flashes, and another, three.

Saturn's atmosphere has been changing over the eight years *Cassini* has been at Saturn. Since the spacecraft's arrival in 2004, it has been difficult to see lightning because the planet is itself very bright and reflective. Sunlight shining off Saturn's enormous rings also makes even the night side of Saturn brighter than a full-Moon night on Earth. However, the equinox—the period around August 2009 when the Sun shone directly over the planet's equator—brought the needed darkness when the Sun lit the rings edge-on only and left the bulk of the rings in shadow. It was during this dark period that it became possible to detect the planet's lightning.

Curiosity lands on Mars for two-year mission

NASA's car-sized rover *Curiosity* is now on Mars preparing for its two-year mission of exploration after successfully landing on that distant planet at Gale Crater in the early hours of 2012 August 6. The rover landed in a depression on the right-hand side of the 154-km-wide crater, just south of the Martian equator, close to the steep slopes of the crater's central mound, which rises 5.5 km above the crater floor.

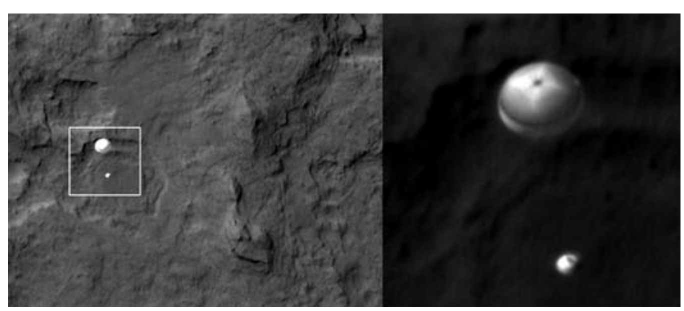

Figure 2 — NASA's Curiosity *rover and its parachute were spotted by NASA's* Mars Reconnaissance Orbiter *as* Curiosity *descended to the surface. The HiRISE camera captured this image of* Curiosity *while the orbiter was listening to transmissions from the rover. Image: NASA/JPL-Caltech/Univ. of Arizona NASA/JPL-Caltech/Space Science Institute*

Past orbiting spacecraft have identified minerals and clays in the central mound that suggest water may have once filled the area. Each layer of minerals provides a different chapter in the story of water on Mars that *Curiosity* will help to read by analyzing samples of these materials with its onboard laboratory and possibly determine whether life may ever have existed on Mars.

As *Curiosity* parachuted through the thin Martian atmosphere for a planet-floor touchdown, an image from the High Resolution Imaging Science Experiment (HiRISE) camera aboard NASA's *Mars Reconnaissance Orbiter* (*MRO*) captured the rover still connected to its almost 16-metre-wide parachute as it descended to the landing site at Gale Crater. The image was taken while *MRO* was 340 kilometres away from the parachuting rover. *Curiosity* and its rocket-propelled backpack, contained within the conical-shaped back shell, had not deployed yet. At the time, *Curiosity* was about three kilometres above the Martian surface.

Young Belgian astronomer honoured as "inspirational outreach role model"

The *2012 Europlanet Prize* for excellence in public engagement with planetary science has gone to Dr. Yaël Nazé, a Belgian scientist, writer, and advocate of astronomy careers for young women. During the past 15 years, Nazé has carried out a diverse outreach program carefully tailored to audiences across the spectrum of society, including children, artists, and the elderly, and has been particularly active in highlighting the contribution of women to planetary science, showing opportunities for girls looking at careers in astronomy.

Although Nazé's main research interest at the University of Liège focusses on massive stars, the astrophysicist, who obtained her Ph.D. in 2004, has also focussed her attention on the Solar System, to inspire young and old and to share her love of science.

In 2006, Nazé published a book—one of seven already to her credit—entitled *L'astronomie au feminine*. The popular text won the 2006 Jean Rostand "Plume d'Or" Book Prize for the best work of popular science in the French language, the 2007 "Prix Verdickt-Rijdams" from the Royal Academy of French Language and Literature (Belgium), and the 2007 "Prix Marie Popelin/Femme de l'Année" from the Belgian Council of French-Speaking Women.

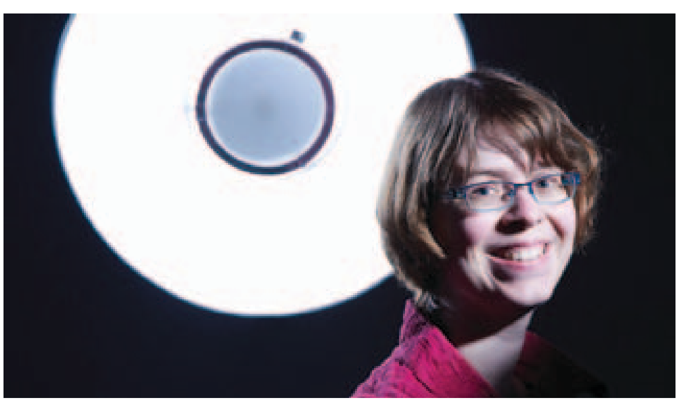

Figure 3 — Dr. Yaël Nazé, recipient of the 2012 Europlanet Prize *for excellence in public engagement with planetary science. Image: Europlanet RI / Harry Fayt*

A prolific writer of other astronomy-related subjects, Nazé has even written a cookbook inspired by the planets, which includes a recipe for Io pizza. She also pioneered (with a colleague) a service for journalists, giving daily summaries of space news translated into French.

The *2012 Europlanet* award, valued at €4000 (Euros), was to be presented to Nazé at the European Planetary Science Congress (EPSC) 2012 in Madrid, Spain, September 23-28.

According to Dr. Thierry Fouchet, Outreach Coordinator for Europlanet, Nazé, who was born in 1976, "sets the standard for researchers active in public engagement. With this [*2012 Europlanet*] prize, we hope to encourage planetary scientists across Europe to follow her example and be inspired about the amount that one person can achieve."

In the media release announcing her as the recipient of the 2012 award, Nazé said, "Planets are a real "stargate"—there is no better tool than showing images and movies obtained by (European) scientists to move imaginations beyond the limits, and inspire people, from 7 to 77 years old!"

Two more instruments delivered for *James Webb Space Telescope*

Canada has delivered two instruments for integration into the *James Webb Space Telescope* (*JWST*, or *Webb* for short) that will replace the *Hubble Space Telescope* in 2018. This delivery represents another milestone in the international project, following an earlier instrument delivery in May 2012.

The twin instruments called the Fine Guiding Sensor (FGS) and the Near InfraRed Imager and Slitless Spectrograph (NIRISS) are the result of efforts undertaken by scientific teams led by Dr. René Doyon of l'Université de Montréal (UdeM) and Dr. John Hutchings of the National Research Council Canada (NRC). The instruments were mostly constructed by COM DEV International, a private company based in Ottawa and Cambridge, Ontario, a world leader in the design and construction of space technology. The international FGS/NIRISS science team, led by Doyon, included astronomers from the UdeM, the University of Toronto, Saint Mary's University (Halifax, Canada), the NRC (Victoria, Canada), the United States, and Switzerland.

The two "eyes" of the FGS are key parts of the *Webb* and will be the telescopes "steering wheel," enabling it to remain pointed at objects with immense precision in order to ensure

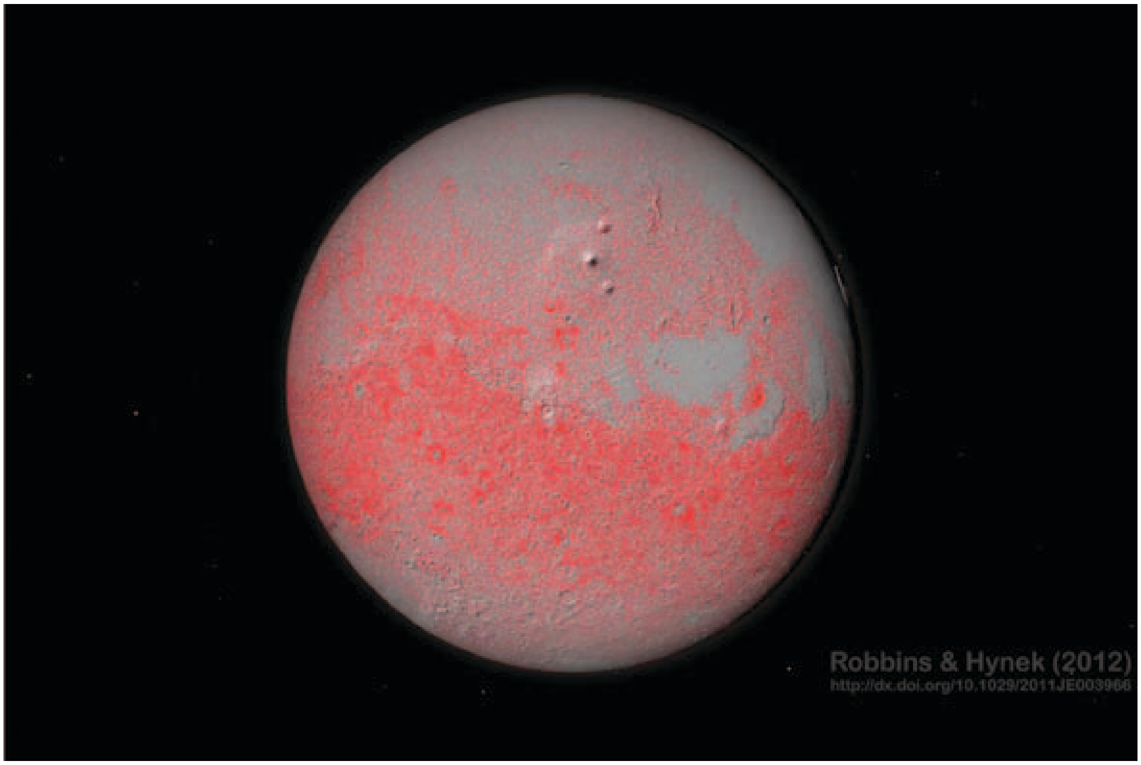

Figure 4 — Every dot on this image of Mars represents a single crater more than 1 km in diameter. Image: CU, Boulder

that the *Webb*'s images remain sharp. FGS will enable the *Webb* to point in the direction of an object with a precision reaching one-millionth of a degree—for example, the width of a hair seen from 5 km distance.

Housed within the same platform as the FGS, the NIRISS will be one of *Webb*'s four scientific instruments. It will search for the faintest and most distant galaxies formed early in the Universe. Its spectroscopic sensitivity in the infrared will also be a crucial capability for the research of exoplanets. Already a leader in the exoplanets field, having participated in capturing the first image of an exoplanet system, Doyon and his team specifically designed and optimized NIRISS so that it could detect the fine atmosphere of Earth-sized exoplanets.

NIRISS could also determine whether these atmospheres contain water vapour, carbon dioxide, and potentially, some biomarkers such as methane or oxygen that could suggest the presence of life. The August 2012 issue of the *Journal* reported the delivery of the first instrument to be completed for the *JWST*, the Mid InfraRed Instrument (MIRI), from the ESA, marking an important completion milestone for the *JWST* project.

New crater atlas for Mars scholars

A University of Colorado Boulder research team has finished counting, outlining, and cataloguing an astounding 635,000 impact craters on Mars that are roughly a kilometre or more in diameter. The new crater atlas represents the largest single database of impacts on a planet or moon in our Solar System. The database will help in dating the ages of particular regions of Mars, enabling researchers to better comprehend the history of water volcanism on Mars through time, evaluating the planet's potential for past habitability by primitive life, and helping understand erosion on the planet.

Most of the smaller-diameter craters on Mars are younger than the largest craters and form the bulk of the planet's crater population. In age-dating crater areas, a portion of a planet's surface that has more craters is deemed to have been around longer. Much of Mars has been "resurfaced" by volcanic and erosional activity, erasing older geological features, including craters.

The new crater database contains both rim heights and crater depths, helping scientists to differentiate between craters that have been filled in, versus those that have eroded by different processes over time, giving a better idea about long-term changes on the planet's surface.

The most complete databases of the Moon's craters include only those roughly 10 to 15 kilometres in diameter or larger, while databases on Mercury's craters contain only those over roughly 20 kilometres in diameter. This makes the latter difficult to compare with the Martian crater database. Meanwhile, there are only about 150 to 200 known impact craters left on Earth. In contrast to the Earth, both the Moon and Mercury remain peppered with craters because of the lack of an atmosphere and the absence of plate-tectonic activity.

The crater study was funded by NASA's Mars Data Analysis Program. A paper on the subject of the new global database appeared in a June 2012 issue of the *Journal of Geophysical Research-Planets* (*JGR-Planets*). ✶

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

The Grand Schism in Canadian Astronomy II: Exploring the Origins of the Conflict

by Victor Gaizauskas
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Introduction

The dispute that erupted in 1967 over placing a national astronomical observatory on a mountain in British Columbia (B.C.) was conducted between men who had entirely different visions of how the science of astronomy should evolve in Canada. To put it in a nutshell, those who staffed the two government-operated observatories, one in Ottawa (Dominion Observatory, DO), and the other in Victoria (Dominion Astrophysical Observatory, DAO) believed growth should be organic, building on strengths already developed since the founding of both institutions early in the 20th century.

On the other side were academics, principally at the University of Toronto (UofT), including some who had begun their astronomical careers elsewhere and then had returned or immigrated to Canada after WWII. As professors wishing to attract the best graduate students to astronomy, their position was that access to the most modern equipment was essential to engage in internationally defined frontier research. Those facilities would be situated wherever the clearest skies with the best image stability obtained, and not be confined necessarily to Canada.

R. M. (Bert) Petrie, the Director of DAO, put out feelers in 1961 to top departmental mandarins about building a new large reflecting telescope in Canada. He was encouraged to develop a plan, but under a time constraint. DAO staff rushed through an initial proposal that was intended strictly for internal departmental consumption. When Petrie presented that proposal to a meeting of Canadian astronomers in 1962 March, he was disappointed by its cool reception. As the project passed through different stages of approval and implementation, each side was wary about accepting the other side's priorities. Suspicion festered and rivalries developed. The rivalries ultimately led to a breakdown in personal relationships, to the humiliating cancellation of a highly publicized major telescope named in honour of the Queen, and to a major reorganization for the operation of federally supported astronomical observatories. These aspects of the Grand Schism have been dealt with in Part I of this three-part series (Gaizauskas 2011).

Parts II and III deal with underlying causes. One can try to uncover scapegoats to blame for the debacle, but there are none. There are instead flawed human beings who sincerely believed in the superiority of their utopian visions of a national observatory for Canada. It is more instructive to examine the background out of which their motives developed.

I begin with my own entry into an unusual institution, the DO, when it was struggling to modernize and to assert its scientific relevance after WWII. The DO was unusual because it engaged in astronomical and geophysical activities under a single directorship. I look back to the founding of that institution by a pair of squabbling rivals, and to its fading into obscurity during economic depression and war. I then present DO's fate as intersecting with that of DAO's as the parting move in Carlyle Beals' strategy—before he retired as Dominion Astronomer—to create an institute of astronomy attached to a major university in Western Canada. The threat that his strategy posed for the ambitions of Toronto's Astronomy Department goes a long way towards explaining the bitterness of the ensuing dispute. Recommendations put forward by the advisory group that was appointed to resolve the dispute surprised everyone's expectations. Archival documents reveal that the unexpected twists grew out of Beals' strong sense of Canadian nationalism.

Ottawa at Mid-Twentieth Century

On Monday, 1955 January 24, I slipped out of my recent life as a doctoral candidate in infrared molecular spectroscopy in the Physics Department at UofT and began a new life as a novice solar physicist at the Dominion Observatory in Ottawa. On entering its distinctively trimmed red sandstone building beside the northern edge of the Central Experimental Farm (CEF), I encountered a confused scene. The corridors and the library were piled high with cartons containing books, reprints from foreign observatories, and star catalogues. New office furniture, still in protective wrappings, and strange unrecognizable objects were crammed into every other available space. The high-ceilinged walls were festooned with loosely hung cables that distributed a beeping time signal to every nook and cranny from a new generation of quartz-crystal clocks hidden somewhere in a temperature-controlled cavern. Every office, except the Director's and Chief Administrator's, was crammed with extra bodies and desks. I recognized a number of recent fellow graduates from the McLennan Laboratory at the UofT—young geophysicists and astronomers. The air of expectation of an impending transformation was palpable. What was going on?

Transformation was indeed occurring, and on two levels: institutional and national. The DO had suffered badly from spending cuts (by a third) and staff losses during the Great Depression, and then again from secondments of its staff to other government departments during WWII. By the end of the Second War, senior staff hired just before the First War were retiring. With the end of WWII in sight, some branch directors in the Department of Mines and Resources (DMR) were openly questioning the viability of an astronomical branch in a department dedicated to the exploitation of Canada's mineral resources. When the third Chief Astronomer, R. Meldrum Stewart (also the first to bear later the title of Dominion Astronomer), retired in August 1946, there was no heir-apparent among the DO staff.

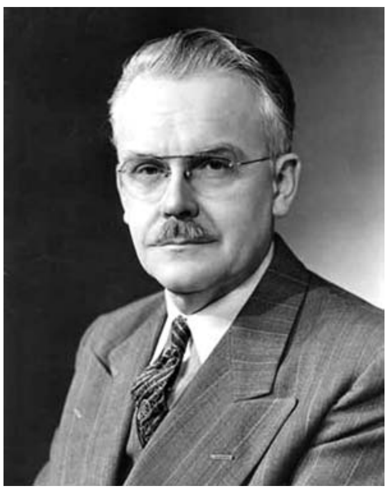

Figure 1 — Carlyle Smith Beals (1899-1979), Director, Dominion Observatory, 1947-1964.

Stewart's successor arrived in Ottawa during the autumn of 1946. He was soon exposed to rough realities arising from the low regard for his branch. Carlyle Smith Beals had been persuaded to leave a highly successful career spanning two decades in astrophysical spectroscopy at the DAO in order to lead the Dominion Observatory out of an abyss created by the Depression and the War. He was called almost immediately to a meeting of all Branch Directors in DMR. The meeting's sole aim was to recommend that the DO be closed, that its geophysical divisions be absorbed into the Geological Survey of Canada, and that whatever astronomical units were deemed necessary be transferred to the National Research Council (NRC). After his retirement, Beals confided his predicament to Ian Halliday. There was only one other person besides himself at the meeting who disagreed with that advice. Fortunately for him, that person was the Deputy Minister. Having been put on notice, Beals reacted with a vigour that made him a legend in his time as Dominion Astronomer.

The crowding I witnessed that late January day in 1955 was the outcome of eight years of selective recruitment and acquisition of new equipment across all divisions, astronomical and geophysical. Scientific programs were being reoriented and modernized. A new building, named the Geophysical Laboratory, was nearing completion about 100 m to the NE of the 1905 Observatory. When the contractor handed over the completed building to departmental authorities two months later, the bulging offices in the old Observatory burst forth. We spilled down the terraced slope to spacious new quarters, our brand-new possessions in tow.

The new building's Library-Assembly room at once became the hub of DO's communal scientific and social life. Beals saw to it that a steady stream of internationally renowned astrophysicists and geophysicists lectured to his staff in that room. Visiting senior staff from DAO kept us abreast of their research. All professional staff members were required to prepare seminars as reviews of new research topics in order to inform themselves and their Director of the latest advances. Following our seminars on radio astronomy in 1956, Beals announced his intention to establish a new station of the Dominion Observatories dedicated to radio astronomy. J.L. (Jack) Locke (1921-2010), the scientist charged with creating the Dominion Radio Astrophysical Observatory (DRAO), later recalled with nostalgia how quickly and easily Beals obtained spending authorization from Treasury Board (Locke 1998). Two decades later, when Locke himself was Director of an even larger institution, NRC's Herzberg Institute of Astrophysics (HIA), such rapid approval for a major capital project was unthinkable. That leads us to consider how Canada was governed in the immediate post-war years across the nation, and especially inside Ottawa.

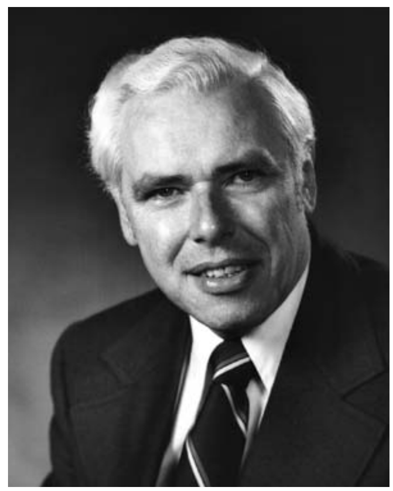

Figure 2 — Jack Locke (1921-2010).

Canada participated in WWII as a unitary state. All taxing and spending powers were concentrated in the hands of the federal government. It mobilized, regulated, and administered every aspect of life for the conduct of the war. When the war ended, the federal government hung onto many taxing and spending powers to rebuild and modernize a country exhausted by war and economic depression. It was in the spirit of planning for a prosperous economic future that major nation-building projects like the St. Lawrence Seaway were undertaken. An expansive, nationalistic mood pervaded the Ottawa that I knew during the 1950s. It was against a backdrop of spending by a strong-willed federal government that Beals carried out his revitalization of the Dominion Observatories with great success.

Beals was awarded the Gold Medal of the Professional Institute of the Public Service of Canada in 1958: "for his contributions in raising the Dominion Observatory to the standing of one of the world's leading institutions in the fields of astronomy and geophysics." Up to that time, as I recall, improvements in astronomical equipment and performance were just beginning, while the developments in geophysics were well advanced or completed, *e.g.* a three-component airborne magnetometer developed by the Division of Geomagnetism and a network of seismic stations across Canada in anticipation of a role in monitoring underground testing of nuclear devices. Perhaps the most fruitful advance at the DO under Beals' leadership was the investigation, begun around 1951, into suspected "fossil" craters detected in the Canadian Shield from aerial photographs. An important motivating factor was the controversy as to whether large lunar and terrestrial craters were formed by volcanism or by impact with asteroidal bodies (Beals & Halliday 1967).

Beals was especially committed to the study of fossil craters; indeed, it became his abiding scientific passion for the rest of his life. He saw it as opening an entirely new field that required the combined resources of astronomers and geophysicists to address some of the most intriguing questions posed about the physical history of our planet, including life itself (*e.g.* extinction of the dinosaurs). As Hodgson (1994) points out in his history of the Dominion Observatories, this project "...established the Branch's position, independent of the Geological Survey, as an authority on the forces shaping the Earth." It also brought considerable international recognition to Beals, including consultations sought by NASA's scientists associated with the lunar landing program.

But how did this mix of astronomers, astrophysicists, and geophysicists come to be in one scientific institution in the first place? Was it planned that way from the beginning, or did it just happen? My curiosity was triggered on my first day at an astronomical observatory housed in a department whose primary mandate was to assist the Canadian mining industry. A link to geophysics was clear; not so for astronomy and astrophysics. The answer lies in the political beginnings of the Canadian federation.

The Dominion Land Survey

Support for astronomy in Canada by the federal government arose out of political necessity at the time of Confederation. Sir John A. MacDonald, Canada's first Prime Minister, urged the pursuit of three goals with utmost haste in order to forestall annexation of any part of the thinly populated Western lands by the USA: demarcation of the international boundary with the USA; the building of a transcontinental railway so that B.C. could be brought into the Confederation; and the creation of land surveys to prepare for the colonization and development of the territories extending westward from the head of the Great Lakes to the Pacific Ocean. Surveys conducted over such vast distances relied on astronomical methods. To that end, a Dominion Lands Office was set up in Ottawa within the Department of the Interior to develop and implement plans for a Dominion Land Survey.

The establishment of the western Canada-USA border had to await negotiations in London for territorial rights to the lands claimed by the Hudson's Bay Company (HBC) since the late 17th century. Controlling interests in London eventually sold to Canada in 1870 what they called Rupert's Land and the North-West Territories. In exchange, they received 300,000 pounds sterling and 1/20th of all the arable land. By contrast, the aboriginal and Métis people, who actually inhabited the land for centuries and who had supplied the furs out of which HBC made its profits, got short shrift. Their land claims and their demands for political recognition were openly scorned by agents sent from Ottawa in 1869 to take over the governance of what became Manitoba. When surveyors appeared that same year in the Red River Settlement at Fort Garry (the future Winnipeg), the stage was set for conflict. What are known as the North-West Rebellions of 1869-70 and 1885 enter this story only to the extent that they reveal the fragility of the new Dominion's authority over the remote Western territories.

Thus, in addition to the hazards presented by the terrain and harsh climate, surveyors had to contend with disruptions forced by the resentment of the indigenous Prairie peoples. They saw in the surveyor's instruments the end of their free-ranging lifestyle. Enough land was surveyed nevertheless to meet Macdonald's aspirations in a surprisingly short time. When the famous last spike was driven in at Craigellachie in the mountains of B.C. to mark the completion of the Canadian Pacific Railway in November 1885, some 68,000,000 acres of arable land had been divided up into townships, sections, and quarter sections. When the Dominion Land Office was eventually closed in 1930 and its remaining assets transferred to the Prairie Provinces, the Dominion Land Survey had covered 200 million acres in those three provinces and along the Railway Belt in southern B.C. It is the world's largest survey grid laid down in a single integrated system, and it is astronomically based (Thomson 1969).

Founding the Dominion Observatory

The steps leading from the notable success of the Western surveys to the establishment of the DO were neither direct nor hurried; they too followed practical needs. The first Surveyor General, Col. John Stoughton Dennis, did not see fit to set up a permanent facility in the capital for storage, repair, and calibration of instruments. When Col. Dennis died in 1885, Édouard-Gaston Deville was promoted to succeed him as Surveyor General. An experienced hydrographic surveyor with the French navy, Deville had been hired in the same capacity

Figure 3 — The Dominion Observatory viewed from the NE in April 1967. The white structure houses the mirrors that comprise the horizontal solar telescope.

by Québec after he retired from the French service. He later joined what was called the "Special Survey" in Western Canada in 1880. The Special Survey was designed to recognize and correct discrepancies in completed surveys and to raise the accuracy of ongoing surveys. It used specially designed astronomical instruments and time signals transmitted along telegraphic lines. At the urgings of two of his senior subordinates, William Frederick King and Otto Julius Klotz, Deville sought approval in 1887 for erecting a permanent observatory in Ottawa. Its intended purpose was for storing and calibrating instruments as well as for training in the accurate determination of longitude. Deville's proposal aroused territorial instincts elsewhere in Ottawa's bureaucracy. The Director of the Canadian Meteorological Services had the proposal rebuffed at the Cabinet level on the grounds that his observatories already provided these services.

This setback did not deter Deville, King, or Klotz from persevering in their quest. In 1890, the Department of the Interior created an Astronomical Branch with W.F. King as Chief Astronomer. That same year saw a wooden cabin erected to house two transits on Cliff St., close to where the Supreme Court of Canada now stands. A nearby roll-back shed protected an equatorially mounted 21-cm reflector to observe star occultations; it served as well to educate visiting Members of Parliament. In 1892, Klotz was persuaded to move his family home from Preston, Ontario (which was his operating base) to Ottawa. From that time forward, the lobbying for more substantial quarters for astronomical work was unrelenting. It took a change of government in 1896—from Conservative to Liberal—and a new Minister of the Interior—Clifford Sifton—before the notion of a national observatory located in Ottawa took root inside a new federal cabinet.

United in their purpose until then, King and Klotz fell out once financial support was assured. Disagreements between them grew thick and fast: over the general concept of a national observatory; over scientific programs; over its location; and over details of its design. Points of disagreement covered in detail by Hodgson (1989) are too numerous to be repeated here. The primary source describing their conflicts is one-sided—a set of diaries kept by Klotz and now preserved in Library and Archives Canada (LAC). No personal recollections were left by King; the underlying causes for so much friction remain open to speculation.

Klotz had spent far longer in the field as a surveyor than either his younger (by two years) superior King, or the Surveyor General Deville. It may be that he resented King's more rapid rise through the ranks to a position of eminence. King had, however, "grown up" with the Dominion Land Survey. While still an 18-year-old 3rd-year student of mathematics at the UofT, King was attached as a junior member to a British Commission involved with an initial survey of the international boundary in 1872. He did not return immediately to UofT; not until 1875 did he complete his studies and graduate with the Gold Medal in Mathematics. He immediately joined the Special Survey of Western Canada as an "astronomic assistant."

Klotz's training had included astronomy, but that was not to be his métier. Like King, he was a skilled mathematician, albeit of a more practical bent. On graduation as a civil engineer in 1872 (from U. Michigan because he found teaching in the sciences at UofT to be substandard!), he set up a private practice as a surveyor in his hometown of Preston. In 1879, he began a career as a Contract Surveyor to the Canadian government with baseline work on the Special Survey; he remained a contractor until his move to Ottawa in 1892. He was not appointed to the permanent civil service until 1896 with the official title of Astronomer. This is astonishing in view of the invaluable service Klotz rendered on many occasions, including setting down a net of accurately determined astronomic stations along the railway line through B.C. that formed the basis for a future geodetic survey.

The picture that emerges from Hodgson's (1989) account of the decade prior to the completion of the DO is that King, a mild-mannered, reticent man, was a visionary taking the long view, while Klotz, a proud, vain man who did not shy from boldly stating his opinions, was a pragmatist concerned with immediate benefits. Their differing outlooks begat the different scientific interests that gave the DO its split personality. For King it was positional astronomy and curiosity about astrophysics; for Klotz it was the gravitational, geomagnetic, and seismic forces that shape the Earth's crust and affect the accuracy of geodetic measurements. Klotz's interests were not given equal weight in either the scant documentary evidence supporting the creation of a national astronomical observatory or the equipping and staffing of the completed Dominion Observatory. Astronomy was clearly given the upper hand.

A lengthy memorandum dated 1898 November 7 addressed to Clifford Sifton, signed by King as Chief Astronomer, but with contributions from Klotz, is interesting for its exploration of the merits of astronomy and astrophysics as both pure and applied science in the service of a modern state (Hodgson 1989, p. 10-12). Justifications in the form of stimulus to other sciences, national industrial development, and satisfying public fascination in astronomy all have a familiar modern ring. The document ends with an estimated cost for the proposed observatory: $16,075 for a building of brick supporting a dome for a 10-in equatorially mounted refractor, less purchase of land. This modest expenditure for such lofty goals appealed to Minister Sifton. He had no difficulty appropriating the amount. Indeed, he was even encouraged by interested opposition M.P.s to increase it so that a larger refractor could be accommodated.

In almost no time, the project for a national astronomical observatory began to exhibit "mission creep." It began over the choice of a site. Klotz was aghast to learn that King proposed to place the new observatory on a knoll about 30 m in diameter on the west side of Parliament Hill. Architectural drawings were soon prepared of a building in stone that reflected the grandeur of its proposed location. In a frenzy of anger over this absurd choice with its concomitant expense, Klotz went over King's head directly to the Minister and pleaded for a more sensible location where future expansion would be possible. Sifton took Klotz's objections seriously; it was he who directed King and Klotz to the CEF, already government-owned land. King and Klotz quickly settled for a plot on the brow of a ridge where it crosses the northern boundary of the CEF. The domed DO building stands there today, still wearing an architectural overcoat fashioned for more splendid surroundings.

The next step in "mission creep" was the purchase of a 15-in equatorially mounted refractor with a complement of auxiliary optics: a spectrograph and auxiliary lenses for photographing the Sun and Moon. Next came a meridian circle transit for fundamental positional astronomy, which necessitated the addition of a transit house attached to the Observatory's west wing, plus the later addition of south and north azimuth-mark huts with crenellated roof lines, made of stone to match the main building. A solar coelostat was purchased to feed several spectrographs transported to North West River, Labrador, to record spectra of the chromosphere and corona during a total solar eclipse in 1905. The coelostat was later used with the addition of two movable mirrors to create a horizontal solar telescope, placed on the north side of the DO; it beamed a large solar image into an underground spectroscopic laboratory (Figure 4). Later still, a small observatory for stellar photometry, of matching stonework, was erected to the SE of the main entrance. The main building grew far beyond the initial requirement for space to store and repair sensitive field survey equipment (see Hodgson's (1989) description of the original three-storey floor plan). Because vibrations from machines installed in the basement workshop interfered with the operation of nearby sensitive seismographs, the workshop was rehoused in a purpose-built structure about 150 m to the NE. Finally, a handsome three-storey residence for the Director was erected about 75m due E of the main building (Figure 3, right). Klotz (1919) toted up the cost of the observatory and

Figure 4 — Two plane mirrors of the three-mirror horizontal solar telescope, autumn 1963. The lower 24-inch mirror is mounted on an adjustable polar axis; it is the original coelostat purchased to observe the total solar eclipse of August 1905 in Labrador. The image-forming mirror is out of sight under the roll-back roof to the left. It reflects the beam, inclined slightly downward, to the right through a large opening in the casting that supports the upper plane mirror and toward a spectrometer housed in a basement laboratory. The Director's House is in the background to the right.

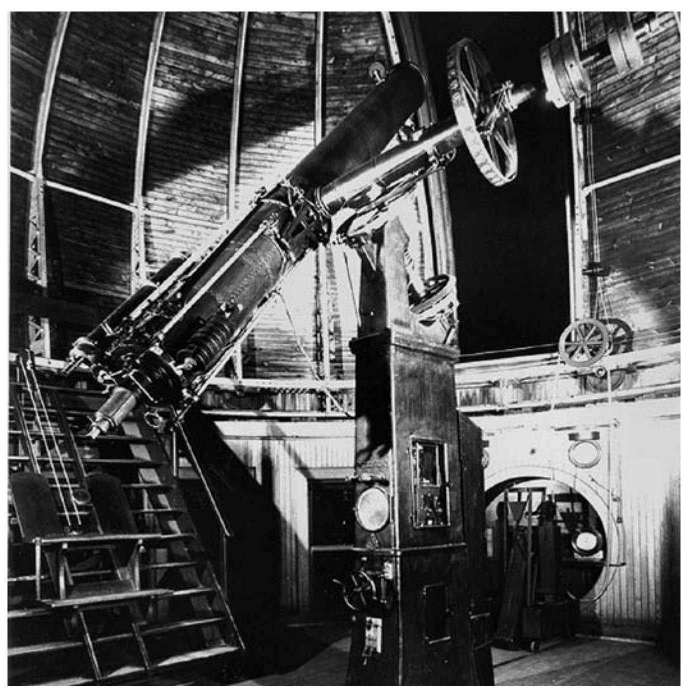

Figure 5 — The 15-inch refractor as it appeared in 1930.

auxiliary buildings, instrumental equipment, and the library to be $310,000, 19 times the modest estimate provided to Minister Sifton in 1898.

What of the surveyors whose instrumental needs and training led to the establishment of the DO? Their function had changed drastically since the rush to settle the West. An ever-growing need for accurate maps could not be satisfied from data acquired for astronomically determined locations. Accurate in themselves on the order of a metre, astronomically based data are insufficient as a control for large-scale topographical maps. These difficulties were recognized early on: in 1885 when Klotz was President of the Association of Dominion Land Surveyors, he called for a "triangulation" survey to cover all Canada. But it was not until early 1905 that the federal government finally authorized that type of survey and appointed Chief Astronomer King to supervise it. The Geodetic Survey of Canada (GSC) was next established as a separate unit in the Astronomical Branch in 1909 with King as its first Superintendent. Too numerous to be housed in the DO, the surveyors occupied rented office quarters in downtown Ottawa until 1914, when a conventional three-storey red-brick office building was erected for them adjacent to the DO. By 1923, the GSC had become a Branch in the Department of the Interior with its own Director and ceased to be part of the DO's further evolution.

Klotz was appalled by what he saw as wasted expenditure on fancy instruments whose operation or purpose had little or no relation to his or King's prior experience as surveyors. When the new observatory opened in 1905, its permanent staff was tiny: 11 professional and technical support staff combined. None were specifically classified as geophysicists. Even Klotz, who saw to it that apparatus was purchased for fieldwork for gravity, geomagnetic, and seismic observations, was classified as an astronomer. Later hires up to 1914 altered the balance only slightly: six astrophysicists, five positional astronomers, but only two geophysicists were added. Nevertheless, Klotz provided reports of field observations of gravity, geomagnetism, and seismicity for inclusion in the annual Report of the Chief Astronomer as early as 1907. Thus the DO was created through an odd mixture of altruistic and pragmatic planning that stemmed from the conflicting personalities of its two founders. Except for a brilliant first decade, the institution would suffer for a long time from the absence of a firm controlling vision of its purpose.

Ottawa's astronomical monument to modernity might have faded quickly into obscurity had not King been blessed with enormous luck. While the Observatory was under construction, he recruited John Stanley Plaskett as his "mechanician." Plaskett's original job description required him to maintain and repair the DO's large and growing number of instruments. They included numerous chronometers for field surveys and the latest and most complex pendulum clocks for providing a national time standard. But, in almost no time, it was Plaskett who turned King's vague interests in astrophysics into concrete observing programs. Their success caught the attention of the astronomical world.

Early Success at the DO Paves the Way to Galactic Fame at the DAO

Plaskett's career is pivotal to the development of astrophysics in Canada. The following paragraphs summarize how this unusually gifted man brought an early success to the Federal government's Astronomical Branch.

Plaskett left the family farm at the age of 16 to supplement the family income by working as a machinist for an engineering firm in the nearby town of Woodstock, Ontario. Within a few years, he was employed in both the USA and Canada by the Edison Company in the manufacture of electrically powered machinery. At age 25, he was hired by the UofT's Department of Physics to be its shop foreman and lecturer's assistant. In the latter capacity, he was so fascinated by the demonstration of physical principles that, at age 30, he enrolled in the four-year Maths and Physics course, gaining 1st Class Honours in each year. Upon graduation in 1899, he retained his connection with the university, where he experimented with three-colour photography in order to record solar eclipses by this novel technique.

Figure 6 — John Stanley Plaskett (1865-1941), first Director of the Dominion Astrophysical Observatory in Victoria.

That opportunity arose with his arrival at the DO in Ottawa in 1903 to take up his appointment as "chief mechanician" made the previous year by W.F. King. Plaskett set about immediately to design and build the experimental apparatus—spectrographs and cameras—for observing the total solar eclipse on 1905 August 30 at the North West River, Labrador (near Goose Bay). This turned into a momentous event that attracted the wealthy nabobs of New England in their sailing yachts, as well as dignitaries from around the world. Plaskett's preparations were thorough and much admired for their novelty. But the skies did not co-operate: clouds obscured the Sun. The report Plaskett (1906) wrote for inclusion in the Chief Astronomer's Report for 1905 is so incisive in exploring a new scientific problem that it serves to mark the beginning of his career as an astrophysicist, at age 40!

Undeterred by the lack of success at Labrador, Plaskett turned his attention to the spectrograph supplied with the DO's new 15-in refractor. Mounted at the end of the refractor, this instrument flexed so badly that, during a long photographic exposure, the spectral lines of stars were gradually displaced and thus smeared. This finding launched Plaskett's Odyssey to design and fabricate rigidly mounted spectrographs for telescopic use. Within a few years, he established the DO as a centre of excellence in the study of spectroscopic binaries, *i.e.* telescopically unresolved pairs of orbiting stars. When the superposed spectral lines of the stars in a pair are separable, their orbital properties can be determined from the precise measurement of the radial (line-of-sight) velocities of each star. He also initiated a program to measure the variation with latitude of the Sun's radial velocity at its limbs, its so-called differential rotation, with the equipment originally purchased or built for the 1905 eclipse.

Plaskett quickly exhausted the short catalogue of spectroscopic binaries that were within the reach of a 15-in telescope. With W.F. King's blessings, Plaskett began to lobby Members of Parliament and the politically influential elite across Canada to procure for Canada's astronomers the world's largest telescope—a 72-in reflector. Such was his self-assurance in claiming a great and lasting success for his project that he won over the necessary support. An Act of Parliament, authorizing the purchase of the large reflector and the construction of a new observatory in Canada, was passed in 1913. That same year saw W.E. Harper, one of DO's astrophysicists, tour Western Canada in search of a suitable site for the large reflector. He settled on Victoria, which had poorer sky transparency than sites in B.C.'s Okanagan Valley or at Medicine Hat, Alberta, but which enjoyed a much smaller diurnal change in temperature (Harper 1915). The mild Pacific climate at Victoria ensured stable images and very little focal drift during night-long exposures in an era when low-expansion glass did not exist for large telescopic mirrors.

Despite the hazards and turmoil of WWI, work on the new telescope and observatory proceeded unhindered. The new telescope, then the world's largest, began operation in May 1918. In a whirlwind of activity, Plaskett and the two colleagues he brought from Ottawa, R.K. Young (later first Director of the David Dunlap Observatory (DDO)) and W.E. Harper, acquired thousands of spectrograms. So many were of spectroscopic binaries that they made the DAO for years to come a Mecca for the study of these objects. International recognition followed swiftly. Twenty years after he had been hired to keep the clocks at the DO running on time, John Stanley Plaskett was elected a Fellow of the Royal Society (London). His election recognized his major contributions to the study of spectroscopic binaries, to the spectroscopic determination of the rotation of the Sun, and to the design of spectrographs for stellar observations.

Before he retired in 1935 at the age of 70, Plaskett had published (with J.A. Pearce) his *magnum opus*: the first extensive observational test of the rotation of our Milky Way Galaxy. Their observations of the motions of both stars and interstellar matter proved beyond doubt that the galaxy is rotating as a whole.

Figure 7 — The Plaskett Telescope at the Dominion Astrophysical Observatory in Victoria.

Their data on proper motions of stars formed a large sample that allowed them to calculate the period of revolution and the distance of our Sun from the galactic centre. This landmark study was the foundation on which many future investigations were based. The work on galactic rotation brought wide international acclaim to Plaskett.

By the time he died in 1941, Plaskett had received medals and honours from every significant scientific society in Canada, the USA, and the UK, and honorary doctorates from five universities. He died secure in the knowledge that his legacy, his giant telescope (by then no longer the world's largest), was in the hands of younger men of great talent. Carlyle Beals, Andy McKellar, and Bert Petrie would advance the DAO's reputation for spectroscopic studies of binary stars, shell stars, and galactic structure, including interstellar matter, to still greater heights.

The DO Fades into Obscurity during the Inter-War Years

Plaskett's great success at the DAO in Victoria completely overshadowed the DO's astrophysical programs. Hopelessly outclassed in instrumental power and without the driving ambition of a real leader, the stellar, photometric, and spectrographic programs, along with the measurements of solar rotation, languished. Plaskett had foreseen this outcome. During the administrative turmoil occasioned by W.F. King's death in April 1916, Plaskett was discovered to be packing some plate-measuring machines for shipment to Victoria.

Figure 8 — Dr. Otto Julius Klotz (1852-1923) with granddaughter.

Since these machines were often used by other astrophysicists at the DO, an unseemly struggle ensued over their possession. Plaskett offended his colleagues with haughty remarks to the effect that completion of the giant telescope at Victoria would put an end to astrophysics at DO. His forecast was accurate, if somewhat premature.

The turmoil referred to above was entirely of King's own making. During his distinguished career, he had acquired many titles with their concomitant responsibilities: Chief Astronomer, Superintendent of the Geodetic Survey, and Boundary Commissioner. But, unlike Klotz, he was a poor organizer. It was fortunate for him that he had able subordinates at the Geodetic Survey who took over with his blessing the organization of the field surveys. In running the affairs of the Astronomical Branch, King relied heavily on his Chief Clerk, W. (Bert) Simpson, employed in that capacity since 1893 while King was still involved with the Western surveys. Unable to discuss with Klotz substantive issues regarding the DO without risking a quarrel, the conflict-averse King literally kept him at a distance by assigning Klotz to a remote office. Simpson came to play the wily courtier who, in the palace of an indolent prince, relieves his master's anxieties by such eager servility that he ends up in total control. During his prolonged final illness, King did nothing to ensure that Klotz would succeed him. With King gone, Simpson had himself designated Acting Chief Astronomer and began plotting to become the permanent Director (Hodgson 1989, pages 81-85). By controlling the flow of information between the DO and departmental HQ, Simpson was able to persuade Deputy Minister Cory (appointed by patronage and hopelessly beyond his depth in the turbulent waters of his Astronomical Branch) that the Observatory's scientists were incapable of managing their own affairs.

Klotz had more to face than Simpson's attempted usurpation of the Directorship. Anti-German feeling ran high in Ottawa during the Great War. The appointment of a new Chief Astronomer had to be made by the Prime Minister in whose office every appointment was scrupulously scrutinized for political nuance. Klotz was a Canadian-born loyal citizen who had made conspicuous contributions as a surveyor to the settlement of Western Canada. He was a popular figure in Ottawa's social circles with many influential friends. There was a great public outcry when it became known that Klotz's appointment as Chief Astronomer had become a political hot potato. It was all to no avail. Seventeen months were to elapse after King's death before Klotz was finally appointed Chief Astronomer in September 1917. Klotz then had his hands full: to repair the damage created by Simpson, to refill staff positions lost to the GSD and to the DAO in Victoria, and to redefine the Chief Astronomer's responsibilities.

Klotz did not use his new authority to hold back on the replacement of astronomers while increasing the number of geophysicists: he was fairly even-handed. In the long run, his choices for a gravity expert (A.H. Miller), an assistant geomagnetician (R.G. Madill), and an astronomer (C.C. Smith), led to their long and successful careers at the DO. Despite mocking King for purchasing a large refractor for the DO's principal instrument, Klotz appointed two scientists in 1920 to continue astrophysical research with the 15-inch equatorial. F. Henroteau, an experienced astrophysicist, was put in charge while J.P. Henderson, a recent graduate in astronomy from the UofT, was to be his assistant. They soon fell out. Henderson transferred to the Time Service where he pioneered radio transmission of the DO's time signals. Henroteau's impact on the DO was less salubrious. He became highly unpopular with the rest of the staff. None regretted his forced retirement in 1932 after bringing discredit to DO's scientific reputation over elementary errors in his measurements of radial velocities.

The Klotz-Plaskett relationship had soured while King was still alive. Klotz incurred Plaskett's wrath by criticizing the giant telescope project as well as the manner of choosing the site at Victoria. During the turmoil, while Simpson was Acting Chief Astronomer, Plaskett managed to get DAO recognized as a separate branch of the Department of the Interior, mainly on the grounds that he could not tolerate Klotz's "interference." By 1920, the department was so swollen with branches that their number had to be cut in half. A neutral panel recommended that the two observatories be combined in a single branch. Plaskett protested loudly but had to comply. Klotz must have savoured the irony when he and Plaskett sat down together in May 1921 to draught a memo to define the relationship between the two observatories. In essence, the administrative functions at DAO, apart from those affecting scientific activities, were to be handled by the Director of DO; the scientific programs at DAO were to be entirely in the hands of the Director of DAO, with the proviso that he keep the Director of DO informed of the work so that the latter could respond instantly to queries from Departmental HQ. The relationship so defined, with only a minor change, was to endure until the Observatories Branch was dissolved in 1970.

Klotz occupied the Director's chair for only six years. Physically active, he enjoyed robust health until the last years of his life. In the spring of 1922, Klotz experienced serious heart difficulties. Over the next 18 months, he alternated between recovery and confinement to bed. He maintained his interest in the scientific work of the observatory until weeks before his death at the end of December 1923, aged 71. His irascibility and vanity had repelled some of the staff at DO so much that they transferred to the GSC. Others respected his abilities and remained loyal to him. Of special interest to the RASC is Klotz's role behind the scenes in draughting a constitution in 1906 that proposed considerable autonomy for Centres of the Society outside Toronto. Klotz's version of a constitution for an Ottawa Centre of the RASC was unacceptable to the Toronto group. It took a visit by King and Plaskett in early 1908 to persuade the Torontonians to adopt Klotz's principles.

Klotz's successor, R. Meldrum Stewart, was appointed Chief Astronomer in May 1924. Stewart had arrived on staff in 1902, before the move to DO's permanent location on the CEF. He was assigned to develop a time service based on measurements of the transits of selected stars. As the need for an expanded catalogue of stars for this purpose grew, the DO undertook a prolonged observational program to improve stellar positions as its contribution to international collaboration. Stewart accordingly planned and developed a Division of Positional Astronomy. Although the necessary observations were diligently performed each clear night over many years, the computational effort leading to a published catalogue of stellar positions stayed hopelessly in arrears. A similar situation existed with regard to the data collected in the field and at magnetic stations operated by the Division of Geomagnetism.

As a scientific leader, Stewart was uninspiring and lax. In his defence, the times during most of his 22-year tenure were such as to induce a sense of hopelessness. As an administrator, he fought vigourously and courageously against drastic and arbitrary cuts to his staff during the Dirty Thirties. He did his best to save the jobs of recently hired young professionals and to rid himself of older under-performers; he did not always succeed. On the whole, his efforts mitigated the pain suffered by the professional staff in Ottawa. The staff at DAO, already small, was not threatened. In the late 1920s, Plaskett succeeded in establishing two new positions, one of them filled by C.S. Beals. With Plaskett's retirement in 1935 and the resignation that same year of another employee, the new Director at DAO, W.E. Harper, was able to appoint Petrie and McKellar to the permanent staff.

In 1936, the over-sized Department of the Interior was dissolved. The Dominion Observatories became part of the Surveys and Engineering Branch of the Department of Mines and Resources, even though the DO had years ago severed its ties with its surveying origins. This change had short- and long-term consequences. The Observatories took over the operation of magnetic and seismic stations from the Meteorological Service of the Department of Marine and Fisheries. This involved a transfer of staff in which the DO gained four geophysical positions. The change also raised questions about the viability of an institution like the Dominion Observatories, with many of its operations devoted to curiosity-driven basic research, in a department that was meant to be mission-oriented. The debate about a "home" for astronomy in a federally funded institution would continue for decades.

At the end of WWII, many of the staff at the DO were nearing retirement. Others were demoralized by the lack of funds and stimulating leadership. An infusion of new blood was sorely needed. In the last months of his tenure, Stewart appointed three scientists who were to improve greatly the DO's scientific stature: P.M. (Peter) Millman in meteor physics, a new addition to the Observatories research agenda; M.J.S. (Morris) Innis in gravimetrics; and P.H. (Paul) Serson in geomagnetism. The most noteworthy aspect of Stewart's tenure from the perspective of this article was the steadily widening gap in scientific achievement between DO and DAO. It would take a fresh, energetic leader to orchestrate the changes under which the talents of new staff at DO could flourish. ✶

[*This article will continue in the December issue.*]

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Oregon Columbus Hastings (1846-1912)—Pioneer Astronomer of British Columbia

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Abstract

O.C. Hastings completed what is probably the first astronomical observatory in British Columbia in the early 1890s and equipped it with a 10.8-cm equatorially mounted refractor of his own manufacture. Some of Hastings' achievements, particularly in photography, science, and astronomy, are discussed along with a few biographical details to put his work in context.

Introduction

This year marks the sesquicentennial of the founding of the city of Victoria and the hundredth anniversary of the death of one of its early residents who was also an amateur astronomer. On 1912 August 5, the city papers announced the death of Oregon Columbus Hastings in headlines that read "Pioneer Scientist Has Passed Away," and "City Loses First Amateur Astronomer."[1] About 1890, Hastings built what was alleged to be the first observatory in British Columbia. The claim may well be true if we discount the temporary observatories erected on Nootka Island by Cook in 1778 and by Galiano in 1791, who, as explorers, looked at the stars to shed light on their terrestrial location rather than on celestial understanding. Though 1890 is late in comparison with the States, where the first truly astronomical observatory in California (and perhaps in the western U.S.) was erected in 1860 (Abrahams), the widely held view has been that a similar establishment did not arise in British Columbia until after 1912. The only book on the history of Canadian astronomy to even hint otherwise is by Malcolm Thomson (1978), and all he said was that in 1912, F. Napier Denison, the federal government's meteorologist and seismologist in Victoria, "acquired a telescope that had been made by a local amateur astronomer, O.C. Hastings." On the other hand, residents of Victoria with an interest in local history know somewhat more about Hastings the astronomer, thanks mainly to an article by journalist Danda Humphreys (2000).

Personal Life[2]

Oregon Columbus Hastings was born in the tiny Illinois village of Pontoosuc, on the banks of the Mississippi, on 1846 April 26. His given names hint at the wanderlust that came to characterize his life. When he was just a year old, his father,

Figure 1 — Oregon C. Hastings. Photo by S.A. Spencer, courtesy Jefferson County Historical Society.

Loren Hastings, moved his family by covered wagon across half the continent on the Oregon Trail, bound for Portland, barely even a settlement at that time. Loren's chance discovery of some gold nuggets in California in 1851 gave the family the financial stability to settle down. Port Townsend, Washington, became their home, where Loren, an original settler there, held a number of political posts, eventually becoming a state legislator. Oregon attended school in Port Townsend until he was 16, and then worked for his father. He married in 1867 and, in 1870, bought the Joseph Kuhn photographic studio.[3] Four years later, he and his wife moved across the Strait of Juan de Fuca to Victoria, where he became manager of the well-established Fort Street photographic business of Stephen Allen Spencer (1829-1911). In 1882, after a year's hiatus in Port Townsend due to his wife's illness and death, Hastings came back to Victoria to form a partnership with Spencer. Three years later, he bought out his partner's share after Spencer left to follow another commercial opportunity.[4]

In 1884, Hastings remarried. Silvestria Theodora Smith, a widow, was a remarkable woman. Born in Sydney, Australia, in 1846, she emigrated with her family, the Layzells, to California at the age of four. In 1858, the Layzells moved to Victoria, where the father, Robert, served as a city councillor in 1866-67. Silvestria's first marriage to Philip Smith in 1862 produced four children but lasted only eight years due to her husband's early death. As the head of her household, she felt legally entitled to vote, but there was no precedent. In 1875, she persuaded two of her friends in similar circumstances to join her in defying convention by voting in the municipal election. They reputedly were the first women in Canada to vote.

The Hastings lived on Elizabeth Street (near present-day intersection of Rebecca and Mason Streets) where their daughter, Juanita, was born in 1889, but over the next several years, their address changed a number of times, and Oregon seems to have been in and out of the photography business, both in Victoria and Port Townsend.[5] In the summer months, he went north to the remote port of St. Michael, Alaska, as U.S. Collector of Customs. In the winter, he pursued his scientific studies in Victoria.

Hastings died on 1912 August 5, after a two-day illness. He was buried in Ross Bay Cemetery, where Silvestria was also laid to rest in 1926. A street in the municipality of Saanich (part of Greater Victoria) is named for him, as is an island (52°38′N, 128°46′W) that the Geographic Board of Canada designated in 1927.[6]

Photography

Hastings is primarily remembered today as an important west-coast photographer. The British Columbia Archives holds 77 photographs by Hastings, many now available on-line. Most of the images are portraits of individuals and families taken in the studio, an aspect of his trade that was his main source of income.[7] Judging by his advertised sale in 1890 of properties he had accumulated, it was a profitable occupation.[8] Hastings also recorded memorable events like the inaugural train trip on Vancouver Island[9] and captured scenes such as sunrise on Mount Baker.[10]

Like a few of his able contemporaries, Hastings was sometimes employed outside his workplace as official photographer on expeditions to First Nations settlements along the Pacific coast. He was first engaged in that capacity in 1879 by Israel W. Powell, on a tour of inspection for the B.C. Indian Affairs Department. Hastings's seven surviving images in the B.C. Archives show the village and Tsimshiam people at Haida Gwaii (then called the Queen Charlotte Islands). A second and more famous assignment was an expedition led by the German-American anthropologist, Franz Boas, for the American Museum of Natural History and the Smithsonian Institution in 1894 (Jacknis 1984). Within an eight-day period, Hastings secured 180 photographs and made several plaster casts of the heads of individuals in the Kwakwaka'wakw settlement at Fort Rupert on northern Vancouver Island. Most of his photographs are described and some are viewable in the Smithsonian Institution Research Information System.[11] A third trip in which he participated was the Jesup North Pacific Expedition in 1898 (Krupnik and Kendall 2003). Images of native life captured by Hastings and other photographers in the second half of the 19th century have been incorporated into several recent studies that try to give a balanced understanding of the encounter between cultures (Williams 2003).

Another government job that Hastings landed was to take a series of photographs showing native fishing practices. These images were an important component of a display being sent by the U.S. Fish Commission to an international exhibition in London in 1883.[12] A collection of his photos also appeared at the Colonial and Indian Exhibition in London in 1886. Later in life, he entertained social groups and school children by showing stereopticon views of Victoria scenes and pioneers.[13]

One characteristic that set Hastings apart from most of his contemporary photographers was mentioned in a newspaper article: "Oregon Hastings … has just constructed a magnificent camera, just as good as one that you would pay seventy-five dollars for to the manufacturer. It is a really fine specimen of workmanship."[14] As we shall see, he would later employ similar talents in building a refracting telescope.

Natural History and Science

Hastings was a founding member of the B.C. Natural History Society in 1890, and before long held various offices and spoke at meetings of the organization.[15] On 1896 December 14, he lectured on microscopic features of local geology, showing fossilized foraminifera, marine and fresh-water diatoms.[16] He evidently made a specialty of this, advertising microscope slides of diatoms of the Pacific coast, "both recent and fossil" for $4 per dozen in *The American Monthly Microscopical Journal* of 1897. In 1911, he chaired a newly formed microscopy section of the society, reporting on the plans of its six members, including his own intentions to "continue his work with his old love, the diatoms."[17]

Among his papers were some on ethnography, a popular field of study during the period of colonization, and an interest that was likely stimulated by his work with Boas. Hastings and a young assistant of Boas, Harlan I. Smith, were reported to be working their way northward from Vancouver in the spring and summer of 1898, "collecting old Indian legends and gathering relics."[18] (Smith later became head of Archaeology in the Geological Survey of Canada.) Their work was part of the Jesup expedition, named for its wealthy American financier, which tried to establish the origins of the First Nations people of the north Pacific coast. Hastings used his experience to give "one of the most interesting presentations of the season" to the Natural History Society, displaying and interpreting specimens taken from shell mounds near the mouth of the Fraser River.[19] In 1902, he gave an illustrated lecture to the society on "Six Months at Cape Nome" and "Native Ideas of Alaskan Races as to Future Condition."[20] A newspaper account of the former talk shows that Hastings was very well informed in geology. Botany was another area where Hastings made a significant contribution to natural history. For instance, his plant collecting at St. Michael, Alaska, in 1901 earned him a place in the Harvard University Index of Botanists.[21]

Astronomy

Though astronomy was clearly only one of many of Hastings's interests, it must have been especially important to him, for he invested a great deal of time and effort in making an equatorially mounted refractor, constructing all the parts himself—even grinding and polishing the lenses. According to an article in *The Engineering Journal*, Hastings "constructed all the parts of the telescope with his own hands in 1894 and the lens is rated as a perfect piece of workmanship."[22] He installed the telescope in a domed observatory, built on the rocks behind his large house at 915 St. Charles Street, a well-situated property that he named "Observatory Hill." It was located a couple of blocks due east of Craigdarroch Castle, built about the same time for Robert Dunsmuir, one of the richest men in western Canada.

There is no evidence that Hastings put his telescope to any scientific use, but he did belong to at least three astronomical associations. Our Society was not his first choice—in the 1890s it was mainly based in Toronto. However, some transplanted Torontonians, most notably Baynes Reed and

Figure 2 — Observatory built by O.C. Hastings at the rear of his house on St. Charles Street, Victoria. Hastings' wife and daughter are together at the left. This photo and others of Hastings, his observatory, and house can be found on the British Columbia Archives Web site.

Napier Denison, did try to establish an RASC Centre in Victoria in 1907. Hastings was among those, numbering about 20, who joined, nominally as Toronto Centre members since there were no unattached members in those days. Unfortunately, sufficient interest to form a Centre could not be maintained among the Victoria group until 1912.[23] Earlier, however, Hastings had joined other astronomical groups. Within months of the founding of the Astronomical Society of the Pacific in San Francisco in 1889, he was elected to membership. Though his name continued to appear in the published membership lists until 1895, there is no other indication of his activity in the Society.[24] He joined the British Astronomical Association in 1893, and maintained his membership there until his death.[25] In November 1902, Hastings sent three lantern slides to the BAA showing his observatory and the telescope with its attached spectroscope.[26] In his accompanying letter (surprisingly written from 29 Elizabeth Street, his address back in 1884), he explained that the telescope had an objective lens 10.8-cm in diameter and 1.8-m focal length, and the grating in the spectroscope was ruled with 5600 lines per cm. The slides were shown at a meeting of the association on 1903 January 28.[27]

A spectroscope, especially one with a grating for the dispersing element, may seem to be surprising equipment for an amateur astronomer. However, many did take an interest in stellar spectroscopy in the late Victorian era. That point was made by Alan F. Miller, an early member of the Toronto Astronomical Society, in a letter he wrote to *The English Mechanic and World of Science* (1885 February 13, 518). He used his two-prism spectroscope to look at spectra of stars and nebulae. (By chance, Miller's telescope, but not the one made by Hastings, became the property of the RASC Victoria Centre and is now on display at the Herzberg Institute's "Centre of the Universe" (Mozel 1984).) Beyond an interest in the variety of lines and colours revealed by the spectroscope, most amateurs were not equipped to do any quantitative work and it seems highly unlikely that Hastings was an exception. His only presentation on astronomy seems to be a talk he gave about the Moon to the Natural History Society on 1904 December 5.[28] The minutes of the meeting state that the lecture, entitled "Our Satellite and the Configuration of its Surfaces," was:

> *finely illustrated by clear and beautiful lantern views, and plainly showed the present condition of the moon's surface, with all its rugged mountain scenery and desolate appearance. The lecture and views were ably explained by Mr. Hastings and proved to be highly interesting. At the conclusion of the lecture, it was moved by Mr. Sutton and seconded by Mr. S.P. Mills that a cordial vote of thanks be tendered to the lecturer, and also to his daughter [Juanita] …, who had so ably assisted in the manipulation of the lantern.*[29]

It is tempting to think that Hastings, such an able photographer, would have taken some lunar photographs, but that is unfortunately only speculation.

Probably the reason Hastings has left no record of observations with his telescope is, as he explained in his letter to the BAA, that he got little time to do so. A later problem may have been an immense concrete water tower that the city erected right beside his observatory in 1909. Nonetheless, a newspaper account shortly after his death does say that he "enjoyed years of intense pleasure and instruction in observing the wonders in the heavens [and] allowed numbers of his fellow-citizens the same great pleasure."[30] There can be little doubt that Hastings' homemade telescope performed well. After his death, government meteorologist, F. Napier Denison, acquired it and thought highly enough of it to revise the plans for the new Gonzales Heights observatory so it could be accommodated in a 4-metre dome. No records have been found of any astronomical observations by Denison, but he continued Hastings' tradition of making the telescope available for public viewing. An example is a brief notice in the *Victoria Times* inviting members of the RASC and others to observe the partial phases of the solar eclipse of 1923 September 10 at the observatory.[31]

Hastings' observatory at St. Charles Street was demolished years ago and the present whereabouts of his telescope is unknown. Perhaps it was retained by Denison's nephews and nieces after his death on 1946 June 24, since it was his personal property. The Gonzales site is a now a small park (1.8 ha) in the Capital Regional District (purchased in 1992), and the observatory, designed by Denison and built a century ago, is a heritage building used by the School of Earth and Ocean Sciences (SEOS) Biogeochemistry Facility at the University of Victoria.

Conclusion

Like many an RASC member today, Hastings earned his living and a measure of recognition from his daytime work. At night, he got pleasure from the celestial sights through his telescope and enjoyed sharing those delights with others. Through his membership in astronomical societies, he would have learned what others were capable of doing; perhaps, if he had had sufficient leisure time, he would have brought his demonstrated scientific and photographic abilities to bear on his nighttime hobby and earned even greater recognition. Nonetheless, he is remarkable as a pioneer, and probably the first, amateur astronomer and telescope-maker in British Columbia.

Acknowledgements

Fellow member of the RASC History Committee, Chris Gainor, kindly facilitated contacts, and former Victoria Centre president, Bill Almond, generously shared information that will appear in a forthcoming book marking the Centre's centenary. Chris had also posted on the Web a description of an astronomically oriented tour he had enjoyed at Ross Bay Cemetery where Hastings is buried. Stasia Ferbey and Jim Hesser at the DAO were very generous with their time in trying to track down the whereabouts of the Hastings telescope. In this connection, there are many others who lent their expertise. The list is too long to include here, but I must mention Lindsay Hall, Librarian at Environment Canada [EC], for sending documents relating to the history of the Gonzales Heights Observatory and Morley Thomas's notes from the 1980s, Garry Rogers (Geological Survey of Canada, Pacific Geoscience Centre, Sidney, B.C.) who told me of their display and collection of seismic instruments from the Gonzales Observatory, Sarah Rathjen, archivist for the City of Victoria, who gave considerable help, and Sheila Norton who searched the B.C. Natural History Society records. ✶

Notes and References

Copies of many of the newspaper articles cited here were supplied by the City of Victoria Archives. In addition, scanned and searchable articles in the *Colonist* up to 1910 are at www.britishcolonist.ca and the Puget Sound Argus at www.sos.wa.gov/history/newspapers_detail.aspx?t=44.

Citations to unsigned articles, mainly in newspapers, are found in the endnotes. References with identified authors are listed below in the usual way.

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Endnotes

In the following notes, VDC means the *Victoria Daily Colonist*. No author is given for these newspaper articles.

1 *Victoria Times*, 1912 August 5, 11; 8 August 8, 12; and VDC, 1912 August 6, 3.

2 Details of Hastings' life come mainly from his obituaries just cited. For information on his father see www.Historylink.org. Information about Silvestria Hastings comes from her obituary [*Victoria Times*, 1926 March 11, 6] and other papers in the City of Victoria Archives including *VDC*, 1950 September 24.

3 Jefferson County Historical Society, "Oregon Hastings" at www.jchswa.org.

4 *VDC*, 1885 March 10, 2.

5 *VDC*, 1950 September 24; copied from City of Victoria Archives, 98411-30, Native Sons of BC Post #1 collection, George Gardiner scrapbooks, vol. 13, p. 123.

6 *VDC*, 1927 February 27, 13.

7 Many details and references relevant to Hastings' commercial career can be found at http://cameraworkers.davidmattison.com.

8 *VDC*, 1890 April 26, 1.

9 *VDC*, 1886 April 1; the photo is in B.C. Archives, A-01596.

10 The photograph, taken in 1901, is identified as no. 12228 in John R.T. Ettlinger and Patrick B. O'Neill (1984). *A Checklist of Canadian Copyright Deposits in the British Museum*, vol. 5.

11 http://siris-archives.si.edu/ipac20/.

12 *Puget Sound Argus* (Port Townsend), 1882 October 27, 1.

13 *VDC*, 1904 October 27, 5; 1905 December 25, 5.

14 *Puget Sound Argus*, 1882 December 1, 5.

15 *VDC*, 1892 March 22, 1; 1901 March 26, 5.

16 *VDC*, 1896 December 15, 5.

17 "Report of Chairman of Section upon Microscopy," 1911 March 20, Natural History Society, B.C. Archives, Microfilm A534.

18 *VDC*, 1896 May 11, 8.

19 *VDC*, 1899 April 25, 3; April 26, 6.

20 The Natural History Society of B.C., like many others, including the RASC, made sporadic annual reports to the Royal Society of Canada that were published in its *Proceedings and Transactions*. A full published account "Six Months in the Far North," is among the papers of the Natural History Society, B.C. Archives, Add Mss. 284, Microfilm reel A533, Minutes 1895, p. 53.

21 http://kiki.huh.harvard.edu/databases.

22 *Engineering Journal* 6 (June 1923), 294.

23 See membership list in *JRASC* 3 (1909), viiii.

24 See membership lists, *PASP* 2 (1890), 86; 3 (1891), 4; 4 (1892), 5; 5 (1893), 6; 6 (1894), 6; 7 (1895), 6.

25 *JBAA* 3(1893), 242 and 286, and 22 (1912), 449.

26 *JBAA* 13 (1903), 170.

27 *JBAA* 13 (1903), 157.

28 *VDC*, 1905 April 12, 5.

29 B.C. Archives, Natural History Society, mf A533, 203.

30 *VDC*, 1913 October 19.

31 *Victoria Daily Times*, 1923 September 8, 1.

Peter Broughton is a former president of the Society. He notes that this is the 16th time he has inflicted an article on Journal *readers in 36 years, always with the hope that others will build on these few bricks to erect a sturdier understanding of our astronomical history.*

Pen & Pixel

Figure 1 — The Dumbbell Nebula (M27) is a familiar object to even the most casual observers and astrophotographers, so it takes a considerable effort to show it in an unfamiliar light. Lynn Hilborn has managed to reveal its diaphanous outer envelope with his 10-hour exposure into which the light of hydrogen and oxygen has been blended. Lynn used a TEC140 telescope at f/5.6 and an ML8300 camera; exposure was 3 hours each of Hα and OIII added to 4 hours of L (12×10 m) and RGB (each 9×5 m).

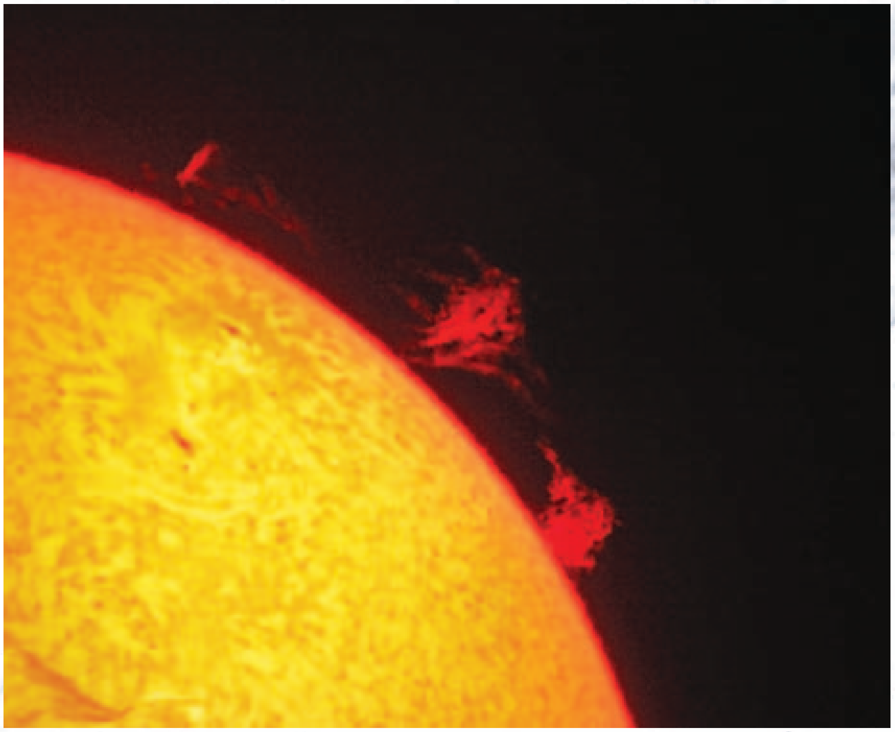


Figure 2 — Steve Irvine nailed these prominences on July 28 using a 60-mm Coronado Solar Max II telescope in an eyepiece projection mode. A dark filament occupies the lower left of the image while a small sunspot lies centre left, surrounded by a vague circular halo. Prominences are flame-like structures seen in projection on the limb of the Sun and composed of hydrogen plasma levitated by solar magnetic fields. Filaments are prominences seen from above, outlined against the solar disk. Exposure was 1/13 s at ISO 800.

Figure 3 — Stuart Heggie likes the unusual and this image of the faint reflection nebula Sh2-73 high above the galaxy plane. The nebula is illuminated by the integrated flux from the Milky Way and is known as an "integral flux nebula." Stuart captured this faint object with a 400-minute exposure (16×10m L, 8×10m each in RGB) using an AP155 EDF telescope at f/7.

Figure 4 — Edmonton's Murray Paulson travelled to Yellowknife to view the transit of Venus and sends us this image of the early moments of the event as the planet completes entering the Sun's disk. In Murray's words, "It was a great trip and despite the late afternoon cloud, we got to see most of it. We missed the last 1 to 2 minutes as Venus slid off the disc."

Vesperus, Helios, Phosphorus, Lucky-Us!

by Sherrilyn Jahrig, Edmonton Centre
(sj_starskip@hotmail.com)

Transit of Venus Day! I swing my feet to the floor and lift the black garbage bag hung as a temporary window shade, the norm for northern residents managing the persistent daylight at 62°N. Early June affords just over four hours of sundown for this lively cluster of 19,000 northerners settled on a picturesque peninsula on Great Slave Lake. Squinting hard against the sudden sunlight, I rejoice in a clear-sky start to this special day. Not only have the northern weather-gods arisen on the right side of bed, 21 astronomy aficionados, 10 to 80 years old, are greeting Tuesday, 2012 June 5 in Yellowknife, Northwest Territories, with a careful optimism.

We hurry to our "site call meeting" at the Explorer Hotel to catch the 10 a.m. weather update. Most of western Canada is still blanketed by thick cloud, echoing the perpetual cloud shroud of our sister planet, Venus. After several clear days, this system is due to close in on us mid-transit. Photographers and astronomers from Washington D.C., Los Angeles, Seattle, Okanagan, Calgary, Edmonton, Ottawa, and Yellowknife have been drawn together by Jay Anderson's weather prospects for Yellowknife: "…offering the most promising statistics of any northern site in Europe or North America, with sunshine hours averaging 64% of the maximum—and you can drive there." The big draw is the opportunity to observe the entire transit from 4:05 p.m. to 10:49 p.m. with sunset at 11:24 p.m. local time.

Astronomy North is hosting Yellowknife's public-viewing event at Sombe K'e Park, enabling our astronomy group to make a guilt-free departure mid-morning to one of 10 possible observing sites spread over more than 380 km of highway. Our generous and diligent hosts, Stephen and Lynn Bedingfield, have meticulously surveyed each site, checking for any obstructions on the horizon, obtaining permissions, considering atmospheric effects of lakes and natural features, and tracking several nearby forest fires. Our primary destination, informally named "Black's Lookout" for the occasion, is an 83.5-km drive west to a spot near the Dene community of Behchoko. It has a panoramic view that will reveal approaching weather or smoke. Nervously aware that we will be beyond Internet and cell reception, precluding weather updates, we all opt to observe at the same place.

After an exciting vehicle climb on smooth, undulating granite, we clamber about and stake our claims, minding the natural paradise of lichen and winter-dwarfed trees, avoiding obstructions on the horizon for the +2.0° altitude at external egress. The afternoon is warm with the lemon-wedge tang of spring lake ice invigorating the crystal air. The land and lichen seem to emit their own light, giving the scene an effervescent but exquisitely even luminescence. Small flowers are abundant; mosquitoes are waiting for the coolness of external egress.

Shortly before Venus meets the Sun, we all meet the Dene friends and family of Alex and Bertha Black, who have graciously given our group access to this observing site, now arriving to share the Transit of Venus with our convivial crew. The transparency improves dramatically just minutes before Venus taps the shoulder of the Sun and delighted exclamations of "Got it!" erupt around the lookout. The backlit atmosphere of Venus and the Black Drop effect are observed. There is plenty of time and equipment available to share the experience with excited Dene children, parents and elders. Around 30 guests come and go throughout the event, some dressed in beautifully braided and beaded finery. Ten-year-old Margaret Scheible excitedly shares her Dad's telescope, and later I help her make a Sun-viewer with black foam-core, duct tape, and Seymour solar film, complete with neon alien decoration, a usable keepsake.

About an hour after internal egress, I have my unforgettable Transit of Venus moment. I return from a tour of binocular, Starfire, Lunt, FirstScope, and homebuilt-Dobsonian views to the Baader-filtered Williams 66-mm refractor I am using. Venus has sprung from the face of the Sun and is no longer a flat black dot, a bullet hole, or the Black Pearl sailing stormy plasma seas of the Sun. Instead, a welcome trick of the brain pops the planet into a truer proximity. Venus sits as it should, simply a suspended sphere reposing within the primary Astronomical Unit, a distance humans have relatively recently realized. Thanking my right-brained, left-eyed imagination for this perspective, I try to make it last, as I do when the Moon's craters suddenly transform into convex blisters through the eyepiece. The perception of a flat black circle crossing the Sun is the "real illusion," and my feet tingle with the thrill of adding a dimensional layer to the experience, non-repeatable in my lifetime.

Watching Venus on the daytime sky is not a new pastime for me. As a summer-staff observatory astronomer at TELUS World of Science, Edmonton, Venus is usually the second object I set up in the 7″ Astrophysics Starfire refractor after bringing the day's menu of sunspots, prominences, and flares into focus in white-light and H-alpha. The silver chalice edge of crescent Venus or razor-thin annulus of its reflective clouds is a beautiful daylight observation. However, the curtain is then drawn and one can never witness the final courtship phase between Venus and the Sun. As in a truly outstanding classical music performance, in the hours before stepping into the limelight, the soloist can become reclusive, shunning communication.

In the late evening, I watch the black bauble roll across the Sun, teased in and out of sight by waves of magnified Earth clouds destined to totally obscure internal egress, our only disappointment. To our delight, concentration and good optics, magnification, and filters allow many clear observations and photographs of the tricky-to-spot, cloud-infested external egress. I lean back in my camp chair, close tired eyes, and conjure the sturdy, compact coal-barque "Endeavour" slipping over Earth's watery curves in 1769. Stretching my imagination, I see Lieutenant James Cook, less than a speck at the helm, sailing to Tahiti to watch a similar Venus transit. At its conclusion, he opens the Royal orders to go forth and map uncharted coastlines, sustained by a new menu of southern constellations, rumours of land, and few maps.

To navigate great distances using our stars and wits is a practical and fascinating human pastime. While I don't have the opportunity to map the coast of New Zealand and parts of Australia after my ToV, I will get in a big metal bird and speed home, high over the gleaming curve of ice-glazed Great Slave Lake. I will watch the disappearance of quaint red and blue houseboats dotting Yellowknife Bay, knowing its exact longitude. My airship, unknown in Cook's time, is merely another black dot transiting.

There are many "naturalists" interpreting local flora and fauna, contributing to the record of our observation site. Artist Khati Hendry (Kelowna) paints the scene (back cover), Karen Finstad (Ottawa) and Joanne Osborne-Paulson (St. Albert) photograph lichen, and Patrick Sheible (Seattle) notes the highly reflective plagioclase feldspar in the coarse granite.

One should not wait for the next observable ToV in 2125 to visit Yellowknife! Exploring the Diamond Capital of North America, where historically "the gold is paved with road," you can literally drive over the mines. The Prince of Wales Northern Heritage Centre now houses the locally mined "Legendary Sky Diamond," carved over 2.5 billion years ago in our planet's mantle and carried by Canadian astronaut Julie Payette on STS-127, now resting in the curves of a Dolphus Cadieux kimberlite sculpture. Cadieux notes in an interview:

> *A lot of my own work is non-preconceived. I work with whatever emerges. I don't try and force images onto it. I'll try and let the stone speak to me almost, and just keep going (www.nnsl.com/arts/stories/jul3_10cad-arts.html; Dolphus Cadieux, 2010)*

The newest treasure unearthed in Yellowknife is a rarely occurring black Venus, best seen in natural sunlight, perfectly strung across a golden star. It is a stone that has spoken most eloquently in the transient collective memory of Canadian amateur astronomers, adventurous international visitors, and beaming Dene people. Comfortingly predictable, the orbits of the planets ring with the old adage, "It's not the destination, it's the journey that matters." What an easy privilege it is in 2012 to travel to such events. Peering into the future, I hope our own atmosphere doesn't duplicate the greenhouse state of affairs on Venus in 2125, obliterating the spectacle.

Back in Alberta, astronomers have navigated through the grid of Range and Township Roads to find peepholes through the thick cloud engulfing much of western Canada. Amid colourful tales of wins and woes, my favourite email on our astro chat-list reads: "I don't know where the hell I am, but I can see it!"

In closing, I add this "footnote" to my 2012 June 5 Transit of Venus story. At home, looking down at my bare feet, I still see perfectly shaped, vivid Vs of suntan where I missed with the sunscreen and left some skin exposed. I may just keep these two ToV signatures as long as I can fit these new sandals. After all, from Earth, I have "walked" almost a million kilometres in Venus's shoes. ✶

For more images, visit "The Transit of Venus Observing Project in Canada's Northwest Territories at http://skyriver.ca/astro/ToV/2012.htm

Sherrilyn Jahrig is an amateur astronomer and educator with RASC Edmonton Centre; TELUS World of Science, Edmonton; and Edmonton Science Outreach Network. She is also a musician, writer, and event producer. Sherrilyn has steadily followed a path of significant eccentricity long enough to notice that, relatively speaking, life is grand and the little things count.

Powering a Focuser

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

Of all of the many accessories available to an astro-photographer, one of the most important in my mind is a powered focuser. While the critical focus required can be arrived at by focusing manually, using a powered focuser is much more convenient as, with no "jiggles" to contend with, it is easier to refine a star's image or a focusing mask. A motorized focuser also can be connected to a computer for remote operation. With these advantages in mind, motors are offered by all the major focuser manufacturers as an option, either at point-of-sale or after-market.

For tinkerers, a suitable motor can be added to just about any focuser, sometimes for very little money and with simple tools. The project described here adds a focus motor (Figure 1) to my AstroTech 8-inch Imaging Newtonian. For this build, I can't quite claim that only simple tools were used, as the work was done in Dave Rubenhagen's shop in London, where a band-saw, mill, and lathe were at hand. Dave did all the work, while I provided sage advice and the occasional stupid question.

Figure 1 — The completed motorized focuser.

To power a focuser, the first thing that was needed was a motor. After first modifying my HEQ5 mount's drive system by the addition of Conrad gears, I employed some good quality 37-mm DC motors that I had on hand along with two surplus 132:1 gearboxes. These gearboxes, mated together, turned the output shaft at about 20 rpm, which was a bit too fast for my liking but was sufficient to prove the function of the project. After everything was built and tested, I purchased a 10-rpm gearhead-motor on eBay, and swapped the gearbox from it onto the motor to provide 8 rpm. This rate allows for very fine control.

Once a motor has been chosen, it is time to consider how it should be mounted. Many do-it-yourself setups drive the focusing knob using a belt. I had originally tried this method, but I found that the O-rings that I was using as drive belts wore out or broke often enough to be less than optimal. Another method of driving the fine-focus knob would be to have a rubber wheel on the motor output shaft press against the fine-focus knob. The logistics of motor placement in my case also precluded this method. This left me with the last option: directly driving the focusing shaft of the GSO Crayford focuser on my AT8.

To attach the motor to the focuser required the fabrication of a shaft fitting that would connect the 6-mm output shaft of the motor's gearbox to the 4-mm focusing shaft. To do this, Dave turned a piece of scrap brass bar on the lathe and bored the two proper-sized holes in the ends. These were then drilled and tapped for a #6-32 setscrew to lock things together. With the coupler in place, the focuser and the motor were effectively one unit. Doing nothing else would have allowed the motor to rotate on the focus shaft when activated, so some form of support was needed to anchor the motor.

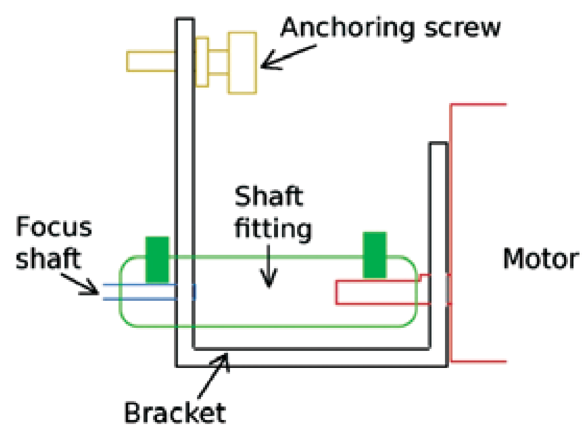


Figure 2 — Schematic of coupler that connects the 6-mm motor shaft to the 4-mm focuser shaft.

Dave had a chunk of what appeared to be 5-inch aluminum C-channel lying around and cut out a section of this on the band-saw. Three holes were drilled in one arm of the C to accept the motor-mounting screws and output shaft of the gearbox, and two were drilled in the opposite arm to allow the coupler to turn freely and to provide an anchor point. When this was done, he drilled and tapped a hole in the focuser body to accept a thumbscrew to keep the bracket, and therefore the motor, in place. After I filed and polished the bracket, it was given two coats of flat black spray-paint for aesthetics.

When fabrication was complete, I soldered about 15 cm of wire to the motor terminals and put a female RCA plug on the other end to allow a connection from either my hand controller or my TOGA LX Guider/Focuser. The motor part of the project was now finished, but a powered focuser is nothing without some way of controlling it.

The Controller

A simple single-speed controller can be fashioned from a pair of ON/MOMENTARY ON single-pole-double-throw switches as per the schematic in Figure 3. The two switches are wired so that when they are not pressed, they are connected to the negative side of the battery and to both terminals of the motor. When one switch is pressed, that side of the motor is connected to positive and the motor spins. Press the other switch, and the other terminal is connected to positive, and the motor spins the other way. Release the button and the motor's terminals are shorted together, dynamic braking occurs, and the motor stops. This works well with a low-RPM motor but offers no speed control. A resistor/variable resistor pair can be added on the positive side of the battery to adjust speed, but this method is not optimal.

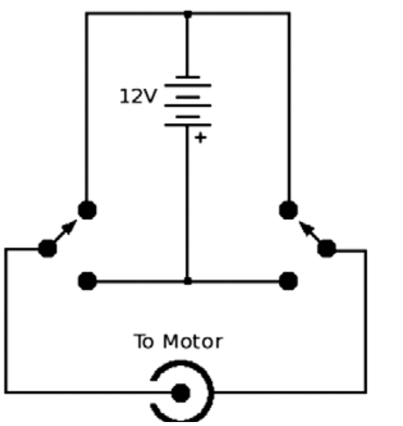


Figure 3 — Switching schematic.

The best way to achieve variable speed was to use a scheme called "pulse width modulation" (PWM). This simply means that power to the motor is pulsed on and off rapidly and that the pulse is adjustable. The "duty-cycle" of a pulse is the ratio of on time to off time. A high-duty cycle provides fast speeds and a low-duty cycle gives slow speeds. Figure 4 shows what the waveform looks like for slow and fast speeds. PWM is easy to obtain with a small and inexpensive IC chip known as a 555 timer and a few other small parts. These generate an adjustable duty-cycle square wave and the duty-cycle, and therefore the motor speed is set using a potentiometer.

I wanted the focus controller to be as simple to use as possible so that any complexity would be inside the box in order to simplify the controls outside of the box. The entire user interface consisted of a potentiometer to adjust the speed and two buttons to focus in or out. Each button also serves to connect the power to the timer circuit; no separate power switch was needed. To save battery power, nothing in the box was powered until a focusing button was pressed.

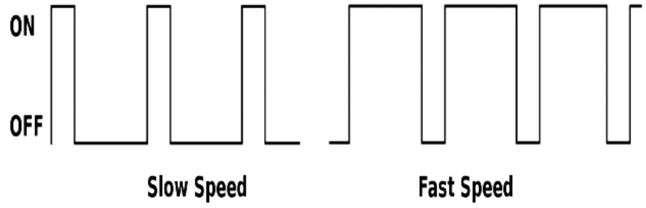


Figure 4 — Diagram of wave form for slow and fast focus-motor speeds.

The timer circuit was connected to a field-effect transistor that was turned on and off rapidly (in this case at about 2.3KHz) to complete the motor's connection to ground. When the transistor was on, the current flowed through the motor, and when it was off, the circuit was broken. The duty-cycle dictated how fast the motor would turn.

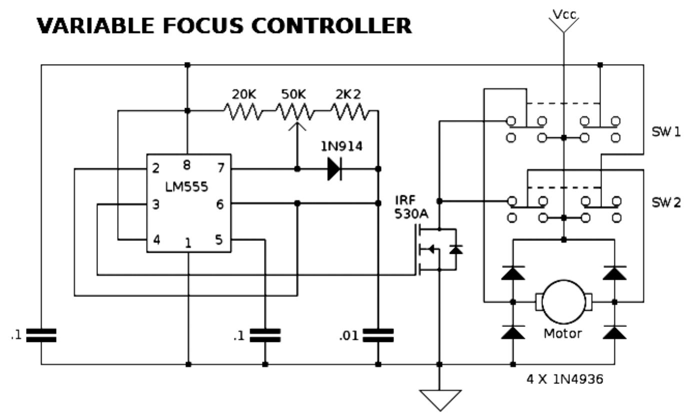


Figure 5 — Electrical diagram for the variable-speed focus controller.

The schematic diagram in Figure 5 shows how this all works. The timer circuit is to the left and the switches are on the right. Notice the four diodes that have been added around the motor. These are in place to protect the transistor, since when power to a DC motor is cut, the magnetic field in its coils collapses, and a large voltage can be generated. The diodes serve to steer this into the positive side of the power supply (battery) to keep it from damaging the transistor.

For versatility's sake, a 30K range-variable resistor (tuning pot) might have been better in place of the 20K part shown in the schematic. This would allow "tuning" the low speed to match the motor used. The motor that I used in this build wouldn't turn when the controller was set at minimum; I ended up needing a little more than 20K of resistance so that I would be able to set the pot to minimum. I fixed this with an inelegant solution: soldering together a 20K and a 2K2 resistor in series. A variable resistor would have allowed me to set the controller perfectly for my motor. Think about this before etching a circuit board.

To tie it all together, I etched a circuit board for all the components, but this project can be done as well on perf-board. The electronics were placed in a Hammond project box (Figure 6) with room for a 9V battery and the potentiometer.

A cable with RCA connectors was used to connect to the focus motor. You can use an audio cable, but it's best to make your own.

That was the whole project. It works very well and the total cost for the controller was under $50 including shipping. If a motor has to be purchased, check eBay with the search string "DC motor." There are lots there in the under-$15 range.

Controller parts list

Part	DigiKey #	Price
1 x 555 CMOS timer chip	LM555CNNS-ND	$1.21
1 x IRF530A n-channel PowerFET (or equivalent)	IRF530PBF-ND	$1.09
4 x 1N4936 1A fast-recovery diodes	1N4936DICT-ND	$2.52
1 x 1/4W 10K resistor (min quantity 5)	10KQBK-ND	$0.47 (pack)
1 x 1/4W 3K9 resistor (min quantity 5)	3.9KQBK-ND	$0.47 (pack)
1 x 1N914B fast recovery diode	1N914BCT-ND	$0.17
1 x 50K potentiometer with knob	Try Radio Shack	
2 x .1uF ceramic disk capacitors	BC1101CT-ND	$0.78
1 x .01uF ceramic disk capacitor	1103PHCT-ND	$0.35
2 x On-(mom on) DPDT push button switches	360-2152-ND	$16.66
1 x Hammond 1591LBK project box	HM113-ND	$6.31
A connector for the motor		
A connector for power (or 9v pigtail)		

Figure 6 — The Hammond project box containing the focus-motor control electronics.

The switches are by far the most expensive parts in this build. From digikey.ca they cost $8.33 each, but they are VERY good parts and well worth the expense. The rest of the parts came to about $15.00, not counting the potentiometer. These can be had for about $2.00 from somewhere like Sayal, and a knob will cost about another $1.00. Sayal has all the connectors and wire needed also.

The 4-rpm motor was obtained over eBay for about $10 (free shipping).

PRICES TEND TO CHANGE ✶

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

Great Images

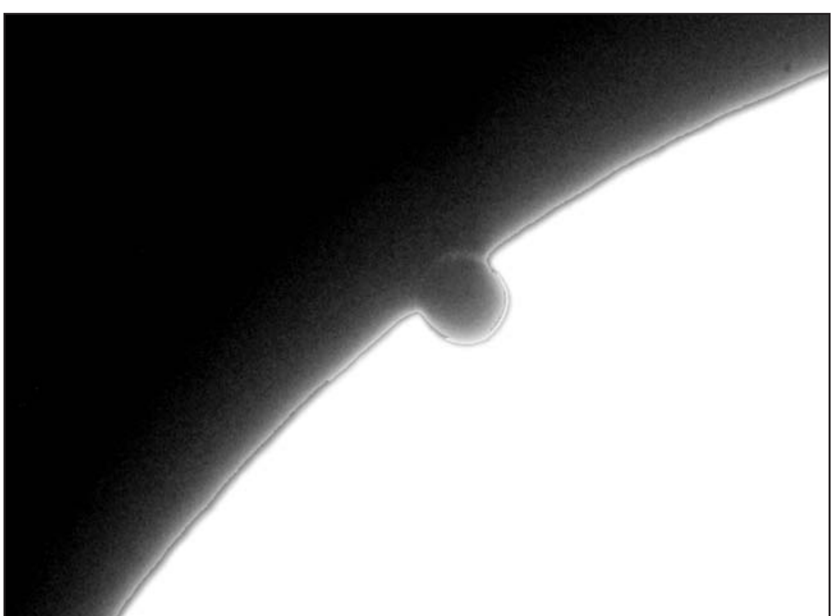


Figure 1 — This highly processed image shows the backlit Venusian atmosphere on the limb of the Sun at the start of the transit on June 6. The photo was taken by Winnipeg Centre's Steve Altstadt using a 1/250 s exposure at ISO 800 on a 14-inch Meade LX-200, a Canon 5D II, and a Kendrick 5-inch off-axis solar filter.

Inaugural RASC Astrosketchers' Contest

RASC Astroketch Group
(randall.rosenfeld@utoronto.ca)

This past spring (the time of meteor shower drought, M42 in glory, and the arcing zodiacal light), the RASC Astrosketching group conducted its first imaging contest. Entries were received from North America, Europe, and Oceania, and the quality of the planetary and deep-sky object subjects was impressive. The two winning entries chosen by ballot, one of the Moon by Alex Massey (Astronomical Society of New South Wales), and the other of Jupiter and its four Galilean moons by Gordon Webster (Ottawa Centre), are reproduced here, along with an outstanding Hydrogen-α image of the Sun by Deirdre Kelleghan (Irish Astronomical Society).

We wish to thank all who participated, and we look forward to holding the RASC's next astrosketching competition. If you have access to a telescope, binoculars, or the unaided eye (!), and are an experienced astronomical artist, or someone who isn't but is intrigued by the process, by all means consider submitting an entry. Details will be posted in due course on rasc.ca.

Aristarchus, Herodotus and Vallis Schröteri
By Alexander Massey, Sydney Australia

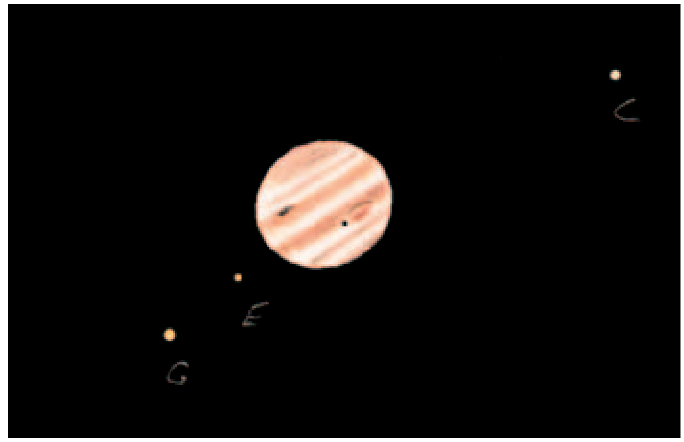
This sketch (2012 February 4) is of one of the brightest features on the Moon, the crater Aristarchus. The brilliantly illuminated internal western wall requires time to spy out the many fine details within; otherwise these features would be washed out. A myriad of riles radiate outward from this crater.

Wedged between Aristarchus and the terminator is the crater Herodotus. Its incompletely illuminated eastern wall seems to extend out to form one end of the serpentine Vallis Schröteri. This meandering valley sees the highlighted valley wall bounce around from side to side with the change in direction of the meander.

Again I chanced upon very stable conditions to be able to see such fine detail. This is one of my favourite sketches I've done.

Celestron C5 (5-inch SCT), 5mm Hyperion eyepiece (=250×), White pastel, black charcoal & white ink on A5 size black paper.

Jupiter with the Great Red Spot (GRS) and a Europa Shadow Transit
By Gordon Webster, Orleans ON



This sketch (2011 December 20) was done at the eyepiece, then cleaned up and inverted using Corel Paint Shop Pro. The colour was added using coloured pencils.

120-mm f/8.3 refractor, 8-mm eyepiece (=125×), black-lead pencil and coloured pencils on white paper.

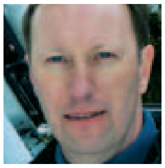
Sun in Hydrogen-α
By Deirdre Kelleghan, Bray, Co Wicklow, Éire

First solar observation of the year (2012 January 12, 10:50 UT - 11:20UT). Yes, the main active region that morning looked very detailed, but the hedge proms on the east limb were outstanding, and very busy indeed. A long, rope-like filament arched upwards above the chromosphere, whipping round the limb to become that very dramatic feature, the filaprom (=a flat surface filament that also extends over the solar limb to appear as an aerial prominence). The seeing that morning was good.

PST 40, 8-mm TVP eyepiece (=50×), pastel and Conte on black A4 paper. ✶

Imager's Corner

A Look at Canon's 60Da Camera



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

In this edition we will take a look at some new equipment in the DSLR market, in particular the Canon 60Da. The 60Da is Canon's latest foray into the specialty niche market of astrophotography and is the first camera aimed at astrophotographers since the 20Da was discontinued several years ago. Like its predecessor, the 60Da builds on the strengths of a current production model and modifies the spectral response of the IR cut-off filter to provide substantially more Hα sensitivity.

The camera, like all DSLRs, represents the quintessential compromise. It does many things well, but there are better choices for each individual use. Where the 60Da excels is that it can do them all in a reasonable manner. For DSLR astrophotography, there are less expensive solutions including simply modifying a stock 60D. The problem with that approach is that it means that using the camera for daytime work, from nature photography to snapshots of your kids, is more difficult, requiring additional filters and custom white balances. Then again there are more sensitive cameras—most of SBIG's lineup of cooled dedicated astro-only CCD cameras come to mind, but try taking a shot of a deer in your backyard with one of those if you want an exercise in frustration. And, of course, there are better video cameras that have continuous autofocus, but try to image a dim galaxy with one and the 60Da starts to look like a very good compromise indeed.

Now for some data and example images. The table below shows the camera read noise of both a Canon 60Da and an older Canon Rebel XT. This data was measured from five-minute dark frames taken at room temperature with an ISO setting of 1600. The upper left portion of the images was used to measure the mean and standard deviation so that the amp glow of the Rebel XT did not interfere with the comparison.

Camera	Mean	Standard Deviation
Rebel XT	253	53
60Da	2052	48

Table 1 — Noise comparison

As you can see the 60Da noise (standard deviation) is lower than the level of the older camera. The numbers only tell half the story though; the 60Da noise has a completely different spectral content dominated by high spatial frequencies. The older XT has far more low-frequency noise that is more difficult to remove in processing. The mean value is corrupted by some in-camera processing done on all raw images; more on that in a bit. The upper left of both dark frames are shown in Figure 1 at 100 percent, scaled to the same maximum level to make up for the different in-camera bias subtraction, and it is clear which is the quieter.

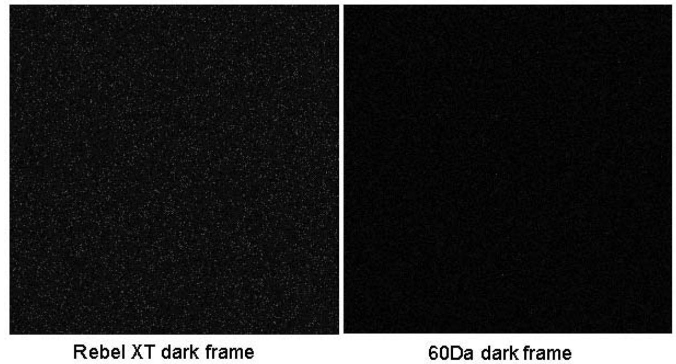


Figure 1 — A comparison of read noise between the Rebel XT and the 60Da.

Using the two-flat, two-bias-frame technique, the gains and read noises for both my Rebel XT and a 60Da were measured for ISO settings up to 1600 (the highest the Rebel could do) and the results are plotted in Figure 2. If anyone is curious, check out www.cloudynights.com/item.php?item_id=2001 for details on how to do this with your own camera. The gains were the same for both cameras.

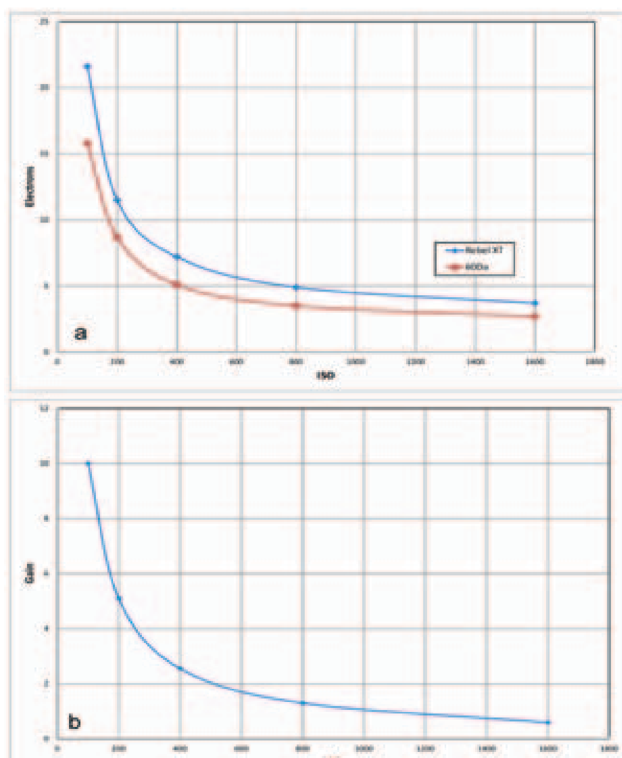


Figure 2 — Read noise (a) of the Rebel XT versus the 60Da above, gain (b) below. The gain is identical for both cameras.

DSLRs do some processing even on raw data. In particular, the raw data is scaled or, more correctly, shifted by some bias value to preserve dynamic range for typical daytime work. The scale factor is recorded in the image data and has to be applied to the data in order to compare darks of different times. If this is not done, you will find that, as exposure increases, the average value of the dark frame remains unchanged while the standard deviation (the noise) increases, which is not physically possible. After removing the effect of bias shifting from darks of doubling integration times, ranging from 30 seconds to 8 minutes, we get to see the linearity of the system to dark current (Figure 3).

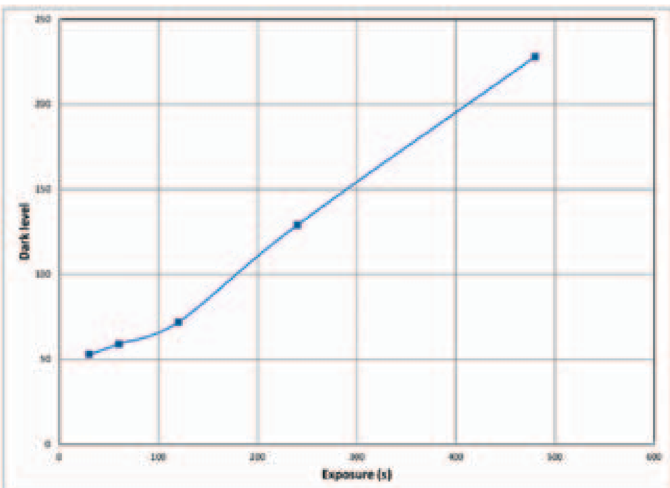


Figure 3 — 60Da average dark levels versus exposure time.

Due to the in-camera processing, I needed to enable white balance to get the correction for bias shift so the vertical axis is scaled in Figure 3. In order to get a more realistic estimate of the camera dark current, we can examine the standard deviation of the dark frames. Keep in mind that the dark current noise is, on average, equal to the square root of the

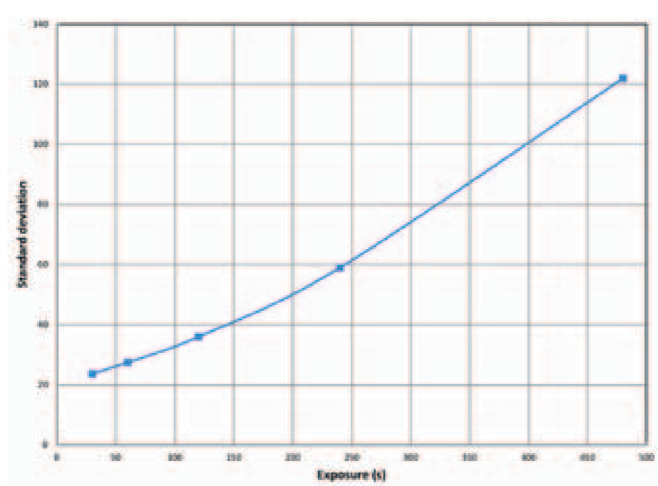


Figure 4 — Standard deviation versus exposure time for the 60Da.

number of dark current electrons collected by a pixel, so by examining the standard deviation, we can arrive at a more realistic version of the dark current. Plotting the standard deviation against exposure time (Figure 4) shows a normal result with the dark current noise increasing as a function of exposure.

Table 2 summarizes the exposure time, standard deviation, average dark frame level (calculated by squaring the standard deviation) and the dark current (calculated by taking the system gain into account) for the 60Da.

Exposure time	Standard deviation	Average dark frame value	Dark current
30	23.7	561	11.2
60	27.5	756	7.5
120	36	1296	6.4
240	59	3481	8.7
480	122	14884	18.6

Table 2 — 60Da dark-frame data

The standard deviations are affected by read noise at the low-exposure end and temperature increases at the long-exposure end, so the dark current shows a dip in around 120 seconds that is likely an artifact of the measurement technique. Using the average of all of the measured exposures, we arrive at a value of 11 electrons per second (rounded to the nearest electron).

Now let's take these values and the quantum efficiency of 35 percent (I looked that one up on the Web for a 7D, which uses the same sensor as the 60Da) and compare them to a one-shot colour CCD camera from QSI, the 540C. The room temperature data shown for the 540C comes from the data sheet of the sensor used in the camera, the Kodak KAI04022, found on the QSI Web site at www.qsimaging.com/docs/KAI-04022LongSpec.pdf.

Parameter	Canon 60Da	QSI 540C
Dark current at room temperature (electrons/s/pixel)	7 to 11	25
Quantum efficiency (%)	35	40
Sensor size	5200 X 3462	2048 X 2048
Pixel size (microns)	4.3	7.4
Full-well depth (electrons)	25000	40000

Table 3 — A comparison of the 60Da and the QSI 540C.

The next time someone tells me how bad is a CMOS sensor used in a DSLR, I'll have to pull out these data. These Canon sensors compare very favourably to a CCD camera costing twice as much. The real difference is the cooling system of the QSI camera and its totally unprocessed data. It allows the sensor to be cooled to 38 degrees below ambient, reducing the dark current by a factor of about 80. This makes the dark current noise vanishingly small, and the unprocessed data allows direct dark-frame subtraction without any scaling.

Now don't tell anyone that I'm saying that a DSLR is better for astrophotography, as that simply isn't the case. The QSI unit will most definitely outperform the Canon, it's just that the performance is not a function of the sensor—it's a function of the cooling.

Figure 5 — M51, 25 minutes.

Figure 6 — Pelican, 2 hours.

Figure 7 — M57, 22.5 minutes.

Figure 8 — HDR shot of the transit from Peggy's Cove.

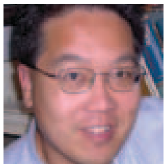
Summer vacation gave me a chance to give the 60Da a full workout under dark skies. The images in Figures 5 to 7 give an indication of both the sensitivity and low-noise performance of the camera. As for daytime performance, here is a shot of the transit of Venus as not seen from Nova Scotia. The image is an HDR combine taken with the 60Da of the Peggy's Cove lighthouse while the Sun and Venus set behind it on transit day.

For the best performance in astrophotography, there is no doubt that a dedicated CCD camera is still the way to go, but the performance of the 60Da and its ability to be used as a regular daytime camera makes it a very tempting choice indeed.

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 an RASC member for 20 years, and has been interested in astrophotography and image processing for about 15 years.

Cosmic Contemplations: A Simple, Portable Geodesic-dome Observatory



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

I suspect that the spherical design of observatory domes became prevalent due to the combination of the engineering virtues of light weight (it has to rotate), strength, and minimal surface area. For the amateur astronomer, building a dome structure is difficult and not for the weekend novice. The urban astronomer is often prevented from erecting a permanent structure at his residence and needs a solution that can be assembled and dismantled with ease. This solution should also be portable, so that it can be brought into the field for dark-site star parties and offer owners security for their equipment and protection from the elements. I will reveal how a simple and portable geodesic-dome observatory can be built over a weekend with PVC plumbing supplies, tarpaulin, cyanoacrylate (instant glue), duct tape, and a drill press.

Buckminster Fuller is widely credited with inventing the geodesic dome, for which he received a U.S. patent in June 1954, but he was probably unaware that, 20 years earlier, Walther Bauersfeld erected the first geodesic dome and received a German patent for it. He was the chief engineer at Carl Zeiss, and the structure became the company's planetarium at Jena in 1926.

The geodesic dome is composed of approximately equal triangles whose vertices lie on the surface of a sphere. Other more complex polygons can be used as the basic repeating shape, but, unless the joint at which the struts meet can be made absolutely rigid, the structure will flex, with disastrous consequences! Only the triangular shape can maintain the dome structure rigidly, even if the individual strut joints are not. The simplest geodesic dome is based on an icosahedron, which is a regular 20-sided solid, each side being an equilateral triangle.

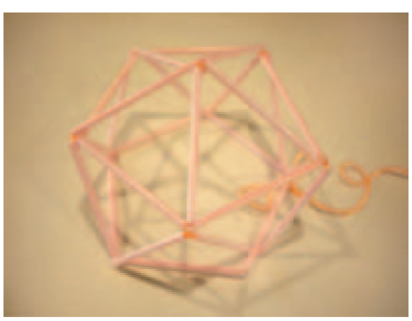


Figure 1 — Author's initial working model using 3-inch drinking straw pieces.

This design is known as a single-frequency dome. Further subdividing each equilateral triangle into smaller, similar triangles increases the frequency of the dome as well as better approximating the spherical shape. However this also greatly increases the build complexity, as the triangles are no longer congruent, so both the strut lengths and angle of strut intersection vary.

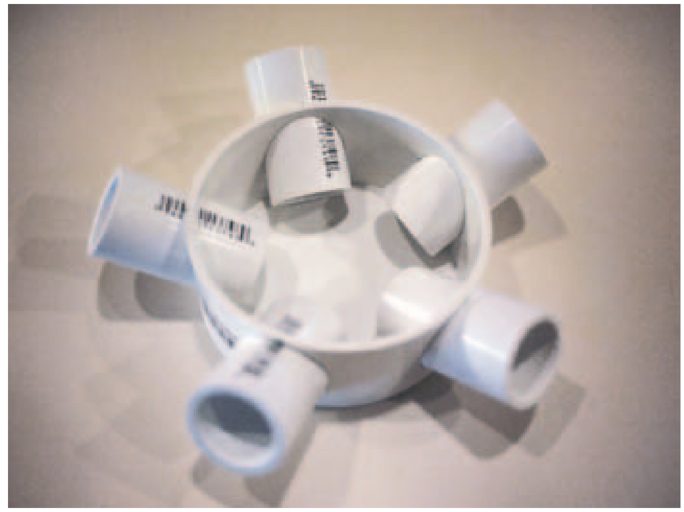


Figure 2 — The design of the hubs.

The struts in this project are 3 feet long and comprised of Schedule 40, ½-inch PVC pipe. These can be bought in 10-foot lengths and cut down, or found in precut 3-foot lengths used in building underground sprinkler systems. The hubs where the struts meet are made from 3-inch diameter PVC sewer pipe cap and ½-inch couplers. Eleven hubs are required and the couplers must meet the hubs at the critical angle of 32°. The five hubs that form the base of the dome have only four struts, while the remaining six hubs have five. The angle of the strut couplers can be maintained by making a custom drilling jig for a small drill press.

The couplers are glued to the hubs initially with cyanoacrylate to quickly bond in their position and then strengthened with polyurethane adhesive such as LePage's PL Premium Ultra. The struts are simply friction fit into the hubs so there are no screws to fumble around with in the dark, and the dome can be assembled single handedly by first erecting the base perimeter, then the individual triangular walls, followed by the top.

The skin of the dome is made from heavy-duty UV-resistant tarpaulin material, cut into equilateral

Figure 3 — The jig for drilling the hubs.

Figure 4 — The assembled framework.

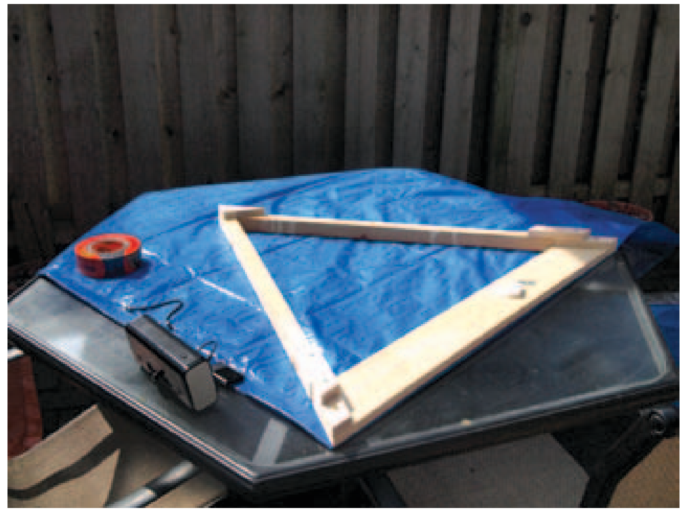


Figure 5 — The jig for cutting the tarpaulin

triangles using a wooden template, and taped together from the interior with Gorilla Tape™. A flap was cut and a strut removed to allow the dome to open for telescope operations. This flap was secured with a long self-adhesive zipper used by contractors to provide a zippered doorway in polysheeted construction sites.

Figure 6 — The assembled observatory, with telescope.

A Velco™-secured flap in the rear allows entry and provides enough space for one individual to sleep alongside or monitor his or her imaging equipment. The dome has a 6-foot diameter floor and is slightly less than 5 feet high at its apex.

A ground sheet can be placed first and then the dome secured to the ground with tent stakes in the event of windy conditions, although this will prevent rotation of the dome necessary to align it with the imaging target. The skin currently drapes over the structure passively but could be internally fastened to the struts. Non-astro applications are only limited by one's imagination, such as fabricating the skin from camouflage material to convert it into a hunting blind. Now go and build it! ✶

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. His dream is to spend a month imaging in New Mexico away from the demands of work and family.

Through My Eyepiece

Fun with Computerized Telescopes

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

Now that I've been using computerized telescopes for more than six years, I find that my approach to observing has changed. After many decades of doing things "the hard way," I've adopted new strategies and techniques, which I'd like to share with you.

Initially, I probably used the telescope's hand controller much the way a beginner might, entering objects from the built-in catalogues and then going to them. As time went by, I began to discover other features of the telescope's computer. Most of my observing has been with Celestron and related telescopes and mounts: a NexStar 6SE (150-mm Schmidt-Cassegrain) and CPC1100 (280-mm Schmidt-Cassegrain), both on altazimuth mounts; and a variety of telescopes on two German equatorial mounts: an Orion Sirius (similar to the SkyWatcher HEQ5) and a Celestron CGEM. The controllers are identical in all three Celestron mounts, and very similar for the Orion. If you're using another brand, you'll need to study the manual.

User-defined objects. While there is a huge database of objects built-in to draw on, these catalogues tend to be either too big and hard to use or too basic.

Good examples of too-basic catalogues are those of double stars and variable stars. These are fine for beginners, but rather skimpy for a serious observer. The "User Defined Objects" feature lets you enter up to 99 celestial objects, either by entering their co-ordinates or by saving their positions while observing them. Celestron's advertising claims 400 objects, but the reality is that there is only storage for 99 celestial objects and 99 terrestrial objects. Even 99 objects isn't enough for a serious variable-star observer, who may observe dozens of stars in a night, but having all these stars pre-programmed sure speeds up a night's run.

Identify. This command lets you search any database for the five objects closest to where the telescope is currently pointing. I guess this is supposed to be helpful for someone who accidentally stumbles across something interesting, what some people call "playing Herschel," however, I use the feature to find other interesting objects in a particular part of the sky. Say I'm looking at a particular Messier object. I select "Identify" from the menu, then specify the Messier catalogue, and get a list of the five nearest Messiers, including, of course, the one I started from. This gives me four new objects to look at. When I finish looking at those, I use the "Identify" command again to get a new list of objects. In this way I "daisy chain" across the sky, each night's trip being different. This is particularly handy on a partly cloudy night, when I'm observing through sucker holes. I can basically start anywhere in the sky, rather than being constrained by a preordained sky tour.

Hibernate. This command lets you move the telescope to a home position and park it there at the end of the night, then switch off the mount. The mount then remembers its alignment. The next time you turn it on, it checks the time and date with its GPS, and lets you start observing immediately.

While this is nice at night, it's even better during the day. I now regularly observe Venus during the day, when it is high above the horizon. I've also been able to observe Jupiter, Sirius, and Procyon in the blue daylight sky. There's something particularly neat about seeing a pinpoint of starlight against the bright blue of the sky. I probably would never have thought of doing this if Bruce McCurdy hadn't described observing stars in daylight in a *Journal* article a few years ago.

Polar alignment. My first "observatory," 55 years ago, was the back porch of my family's home. This gave me a wonderful view of the southern sky, but my view of Polaris was blocked by the house. My two first telescopes both had equatorial mounts, so I quickly learned how to plunk the mounts down pointing pretty close to north. Since I was strictly a visual observer, I wasn't bothered much by the slight drift in declination due to my "good enough" polar alignment.

Fast forward to 2004 when we moved to our present farm with its dark skies, and I tried to choose a good location for my observatory. The best location, in terms of convenience, was just south of my house. This gave me very low horizons from northeast through south around to west, but again my view of Polaris was blocked by the house.

I made do with approximate polar alignment; when I switched to the NexStar and CPC with their altazimuth mounts, this problem went away. When my CPC1100 got struck by lightning, I made do with poor polar alignment with my Sirius equatorial. I discovered that a GoTo equatorial mount really wasn't happy with poor polar alignment.

Then I upgraded to the Celestron CGEM mount, which had a new feature in its programming that allows accurate polar alignment on any star in the sky. You align it approximately, point it at any bright star, press a few buttons, and then use the altitude and azimuth slow motions on the polar axis to centre the alignment star, wherever it might be. The result is a perfect polar alignment. Very clever, and it works like a charm.

These are just a few of the ways in which intelligent computerized mounts have made my observing easier, more efficient, and, most important of all, more fun. ✶

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.*

Second Light

A Cooling Flow Found at Last

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

Back in the late 1960s and early 1970s, astronomers discovered lots of X-ray emission coming from clusters of galaxies. By the early 1980s, opinion had coalesced around the view that the gas forming the intra-cluster medium (with a temperature of ~10 million degrees) would cool and flow towards the centre of the cluster, from which came the name "cooling flow." Considerable energy (and telescope time) was devoted to looking for these cooling flows over about 20 years, with many people giving up early in the 21st century, when it became clear that gas falling onto supermassive black holes provided the energy to stop the flows. Now Michael McDonald—a fellow Canadian presently at MIT—and a group of more than 80 collaborators may have found an actual cooling flow in the cluster SPT-CLJ2344-4243 at a redshift of 0.6. They find that ~3800 solar masses of gas are cooled and channelled yearly towards the cluster centre. This flow is powering a massive starburst where ~740 solar masses of gas are converted into stars in a year.

The cosmic microwave background is the almost-uniform glow left over from about 300,000 years after the Big Bang. It represents the state of the Universe at the point where it had cooled sufficiently for electrons and protons (and helium nuclei) to combine and become electrically neutral. At that point, light streamed freely, and that, at a redshift of ~1100, is what we see today. The microwave background is important to this story, because of what is called the Sunyaev-Zeldovich effect.

All massive clusters of galaxies live in a pool of hot gas that has been ejected from the individual galaxies to form a relatively smooth ball of hot plasma that surrounds the cluster. As background microwave photons enter that hot plasma, they interact with the energetic electrons and protons of the hot gas, and gain energy (and the x-ray emitting electrons lose energy). Think of riding in bumper cars — if a slow car enters a region with a lot of fast moving cars, its speed is rapidly increased, which is a reasonable analogy for what happens in the cluster gas.

The S-Z effect can be measured as a "hole" in the X-rays from the cluster, or as a "bump" in the microwave. McDonald and his collaborators use data from numerous telescopes, including the South Pole Telescope, from which his cluster derives its name (the numbers are right ascension and declination, with the "J" indicated 2000 coordinates).

The X-ray data showed that this cluster is the most luminous known, leading to a cooling flow of ~3800 solar masses per year—the highest flow rate seen to date.

Data from the ultraviolet through the far infrared demonstrate that the central galaxy in the cluster is experiencing a burst of star formation, and that the supermassive black hole in the galaxy is being fed gas. Once McDonald removes the energy from the black hole, he calculates a star formation rate of ~740 solar masses per year. There is considerable debate amongst astronomers regarding the types of stars formed under such conditions, but by some estimates there is a preference for forming stars considerably more massive than the Sun.

A few other—very modest—cooling flows have been found, but the star-formation rate in the central galaxy of the cluster is ~ten times greater than seen before, and not much less than in Arp 220, which is one of the biggest starbursts known in the "local" Universe.

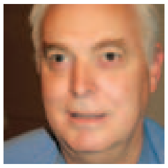
McDonald then considers why such big cooling flows and starbursts are not seen in the local Universe. There are three possible explanations. The SPT-CLJ2344-4243 system might be unique (but astronomers tend not to like such proposals), or the mechanism that quenches the cooling flow does not operate in the early Universe. The most likely, however, seems to be that there is a rather brief period during which the flow leads to lots of star formation before gas accumulating onto the black hole shuts down the flow. If such cooling flows operated for more than brief periods of time, the central galaxies would be much more massive than observed today.

Almost 40 years after cooling flows were proposed, and over 30 years since people started looking for them in earnest, we now likely have a sample of one to study. I hope the South Pole Telescope finds more clusters like this one—any models developed on the basis of a sample of one tend to be found wrong, when more examples are discovered. ✶

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.*

On Another Wavelength

Ray Craters on the Moon



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

It is an object in the sky that practically all observers, at one time or another, love to look at.

After the Sun, the Moon is the brightest object in the sky, even though its surface actually has a fairly low reflectance of around 12 percent. The dark lunar plains that can be clearly seen with the naked eye are called maria. Long ago they were believed to be filled with water; today they are known to be vast areas of solidified lava. The lighter-coloured regions of the Moon are called terrae, or more commonly, the highlands.

If we position ourselves above the north pole of our Sun, we would see that the Earth orbits the Sun in a counterclockwise motion. The Moon orbits the Earth in the same counter-clockwise motion. Our companion has synchronous rotation with the Earth, always showing us the same face, colloquially referred to as the "near-side."

Figure 1 — The first-quarter Moon, 2012 June 26, courtesy of Ron Brecher, K-W Centre. Celestron NexImage 5 with Gain = 4, exposure = 1/90th sec., 32-bit RGB, full frame, unbinned. Stellarvue 80-mm refractor operating @ f/4.8. EQ-6 mount

Figure 2 — The waning gibbous Moon, 2012 July 7, courtesy of Ron Brecher, K-W Centre. Celestron NexImage 5 with Gain = 4, exposure = 1/250th sec., 32-bit RGB, full frame, unbinned. Stellarvue 80-mm refractor operating @ f/4.8. EQ-6 mount

There is no erosion on the Moon since it has no atmosphere and no running water, and so the Moon keeps a very visible record of all impacts and craters that have occurred since its beginning 4.5 billion years ago. These scars provide valuable insights into the basic mechanics of planetary evolution that occurred early in our Solar System.

An excellent map of the Moon that identifies the maria and craters can be found at www.oarval.org/MoonMapen.htm. When we view the Moon, even through binoculars, we can see bright rays emanating radially outward from some of the larger

Figure 3 — The full Moon, 2012 July 3, courtesy of Ron Brecher, K-W Centre. Celestron NexImage 5 with Gain = 4, exposure = 1/500th sec., 32-bit RGB, full frame, unbinned. Stellarvue 80-mm refractor operating @ f/4.8. EQ-6 mount

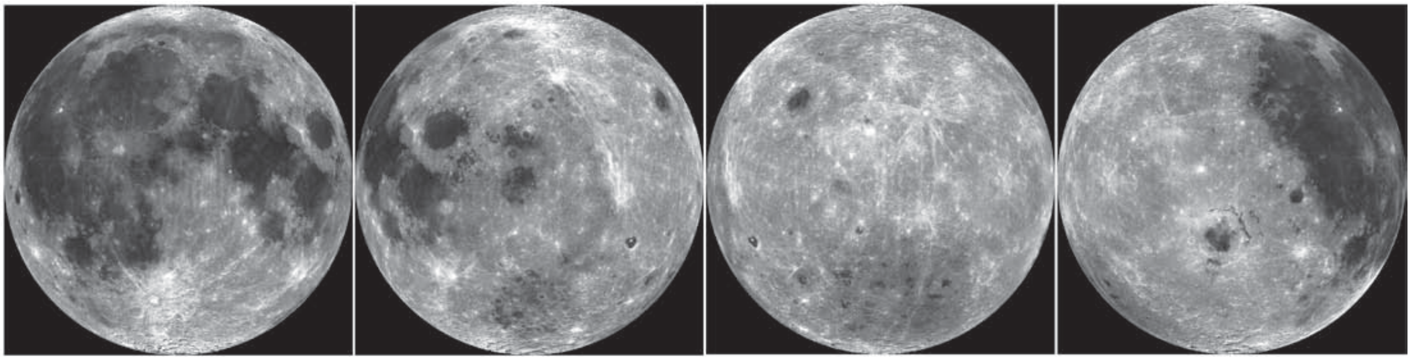


Figure 4 — Clementine images of four quadrants of the Moon showing albedo variations in a deep red colour (750 nm). About 50,000 images were required to process each view. Image: NASA/Arizona State University

craters such as Tycho, Copernicus, and Kepler; the rays from Tycho are plastered across the lunar landscape for as distance a far as 2000 kilometres. These rays were once believed to be salt deposits from evaporated water. Eugene Shoemaker, in the 1960s, recognized that the rays were fragmented material ejected from craters following impact events.

During first- and third-quarter lunar phases (Figures 1 and 2), the craters, particularly along the terminator, have very strong shadows and are easy to observe, but the rays are not as prominent. However, when the Moon is full and without shadows, rayed craters easily display their bright spokes, one of the most prominent features of the fully illuminated Moon. Figure 3 features the three most prominent craters, Tycho (lower centre), Copernicus (upper left of centre), and Kepler (left of Copernicus), each with extensive rays of debris blasted out by the crater-forming impacts. Since this debris overlays many other craters, it seems fairly obvious that ray craters are relatively young. Tycho, with its far-reaching spokes, is thought to be the youngest large crater on the nearside with an age of approximately 100 million years.

The *Clementine* satellite, launched in 1994, was designed to make observations of the Moon in visible, ultraviolet, and infrared wavelengths from a variety of perspectives. Some of the High-Resolution Camera (HIRES) images of that mission are shown from rather unique points of view in Figure 4. These include a view of the leading face at 270°, the trailing side at 90°, and a comparison of the near and far sides.

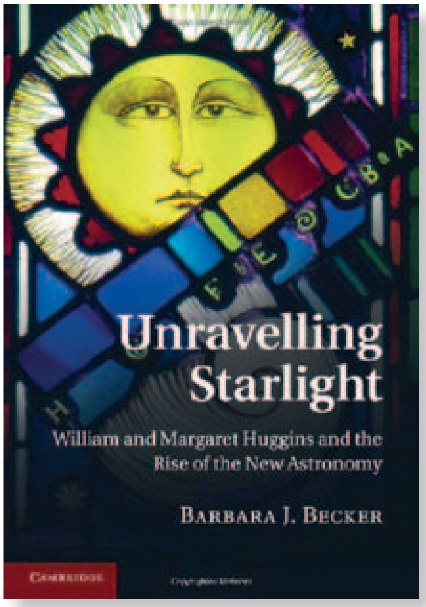
Analysis of the *Clementine* images has revealed a significant variation in the density of rayed craters on the Moon. Hundreds of craters with rays were identified during the study and the average density of rayed craters on the leading side of the Moon is found to be substantially higher than that on the trailing side. The reason behind this leading and trailing asymmetry is relatively simple: the Moon is in a counterclockwise synchronous orbit around the Earth, so that the Moon encounters projectiles such as meteorites and asteroids more often on its leading side than on its trailing side. Furthermore, the impact velocity of a projectile tends to be higher on the leading side than on the trailing side since the Moon is moving in that direction. The two factors lead to larger craters on the forward-facing side than on the trailing side. It's not unique—the same crater asymmetry has been noticed on other moons orbiting other planets in our Solar System.

Look carefully again at Figures 1, 2, and 3 and note the larger craters with longer rays on the leading side compared to the trailing side. Food for thought, the next time you are observing the Moon. ✶

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.

Reviews / Critiques

Unravelling Starlight: William and Margaret Huggins and the Rise of the New Astronomy, by Barbara J. Becker, pages 400, 25 cm × 18 cm, Cambridge University Press, 2011. Price $111.95, hardcover (ISBN: 978-1107002296).



Imagine a lifetime spent observing, pioneering a new field, and humbly receiving the accolades of the greatest scientists of your time. That in a nutshell describes the astronomical career of William Huggins, from a skilled but observationally jaded planetary observer to a trail-blazing spectroscopist. With a loaned telescope from the Royal Astronomical Society (RAS) and co-discoveries made with his wife and fellow researcher Margaret, the Huggins couple unravelled the mysteries of spectral lines in starlight.

Unravelling Starlight is a well-written biography and well-researched study of one of astronomy's greatest pair of contributors. Becker presents a factual, yet very human, story of how William—later joined by Margaret—began to take repeatable observations of starlight using high-quality prisms and measuring devices to reveal the chemical constitution of the Sun, brighter stars, and nebulae. Instead of doing astrometry or charting planetary surfaces as most of the RAS was concerned with at the time, our curious hero turned to unravelling the composition of starlight. He recorded spectral lines to a high degree of accuracy and began publishing his results. Margaret's skill in astrophotography was invaluable for the later stages of their joint research.

Huggins and his wife, 25 years his junior, turned their home observatory into a state-of-the-art science laboratory. Working with Margaret, he began using Geissler tubes to generate light from various elements and compare the emissions to those observed at the telescope. In effect, he was combining astronomy, chemistry, and physics to compare starlight to the glowing gas discharge in order to identify the chemical elements that must compose the distant stars.

Unravelling Starlight takes us through both the scientific discoveries and other elements of the Hugginses' life together. In time, William developed some clever instruments and methods of using them, and his published results led to rivalry with noted scientists such as Norman Lockyer, later the founding publisher of *Nature*. At the heart of the dispute were "problematic" measurements that the two argued over bitterly. Later, the spectra in question were discovered to be the so-called "forbidden lines" that could not be explained by the physics of the day, and Huggins was proven correct in his observations.

Many characters of the late 19th century enter the story, from Marie Curie, who helped with radium, to George Biddell Airy, the Astronomer Royal, with whom Huggins had a complex relationship—feeling at once accountable for the loaned telescope and yet frustrated by Airy's incessant focus on stellar positions. Huggins was at the heart of some of the most exciting times in science and built great friendships with figures such as George Ellery Hale, who later went on to build some of the great telescopes in America.

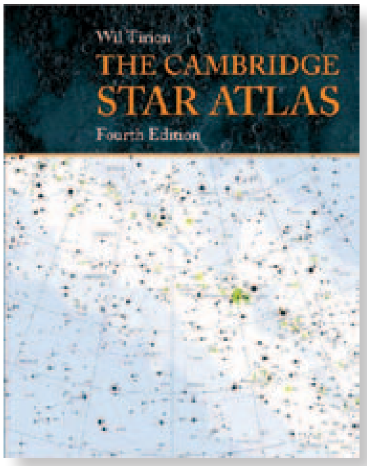
William and Margaret were both talented observers, and both had an uncanny knack for knowing when to move on to the next field of discovery, shifting from stellar spectroscopy to the riddle of emission nebulae. Even in his final years, William continued to be very active and to make new contributions.

This scholarly but well-crafted book is not only a joy to read, but a treasure trove of detail. Becker has skillfully managed the transformation of her doctoral thesis into an attractive monograph, a feat that has escaped many others. In addition to rich bibliographic information, the narrative powerfully conveys the spirit of discovery and the emotional challenges the Hugginses faced. Becker makes her case that William's contributions were many, extending beyond astronomy to antiquarian pursuits, and he is long overdue for a re-evaluation, as is the crucial role of Margaret in their joint scientific endeavours. Poignantly, after her husband's death, we hear of Margaret's desire to settle an issue of discovery credit, which was nearly impossible for a woman to do in the 19th century amongst the scientific elite. Fortunately, *Unravelling Starlight* makes the case in a very compelling fashion. The reader may be compelled to seek out more about the Hugginses, and hidden near the end of the book we are treated to Huggins's own words, a paper entitled "the new astronomy," which tells of his discoveries. One can truly appreciate how he opened up the Universe through spectroscopy and laid the foundation for modern cosmology. We are all his heirs.

Colin Haig

Colin Haig, M.Sc., enjoys the support of a non-observing spouse in his astronomical endeavours, and is 1st Vice-President of the RASC, founded during Huggins's time.

The Cambridge Star Atlas — Fourth Edition, by Wil Tirion, pages 96, 30 cm × 23 cm, Cambridge University Press, 2011. Price US$32.95, paperback - spiral bound (ISBN: 978-0-521-17363-6).



Can a master celestial cartographer improve on his prior work? In the new fourth edition of *The Cambridge Star Atlas*, Wil Tirion succeeds handily. A decade has passed since publication of the third edition of the atlas that set the benchmark for clear, detailed star charts down to magnitude 6.5. The new edition will be welcomed by both novice and more advanced observers who need a portable atlas to achieve more when using modest-sized telescopes or binoculars.

The charts in the fourth edition are better organized, the lunar maps are of substantially higher quality, and the old monthly sky charts have been simplified (with a more manageable set of eight seasonal sky maps). The atlas now features a spiral binding (long-awaited), which allows the charts to lie flat, making it better suited to actual observing sessions in the field. Armchair or desktop explorers will appreciate the way the pages sit with the chart toward the reader and the tables of variable and double stars, nebulae, galaxies, and open clusters available above. This reviewer discovered that the prior edition was sitting unused because of its cumbersome hardbound format, and is thrilled to have a set of charts that can be conveniently packed for field use.

The section on the Moon has a more realistic map and a crisper explanation of the view from the Earth, making it easier to understand lunar phases and how the appearance of our nearest neighbour changes with respect to our location. Tirion helps us visualize the Moon through both binoculars and astronomical telescopes by presenting both plain and mirror-reversed images that we would experience looking through either instrument.

The seasonal sky charts in *The Cambridge Star Atlas* are of great assistance in orienting the observer to the sky quickly, the explanation accompanying them is clear, the tables are useful, and the cartographical conventions used are easy to understand.

One minor criticism is that the font used for numbering the craters and expressing the coordinates on the Moon map continues to be an exceptionally small 5-pt typeface. That is also an issue in several of the tables, charts, and maps, where there is substantial white space available around the edges of the charts or tables, and the empty space could have been better used or larger type could have been employed.

In the explanation of the eight seasonal maps, the author tells us that the stereographic projection makes it "easier to regognize" [*sic*] the shapes of constellations and star groups. Once this reviewer recognized the problem, the benefits of the projection became apparent. Fortunately, page 11 also features a much-simplified chart explaining which seasonal sky maps to use based on month and hour of the evening. It is a major improvement over the prior edition's 24 maps. The black text on dark blue background is a bit hard to read because of the lack of contrast under a red flashlight, but the detailed sky charts that appear later in the atlas are truly excellent, and provide detail suitable for moderately dark suburban or rural skies.

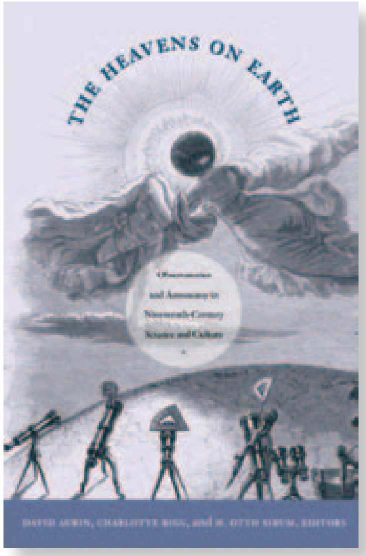
Another wonderful improvement is the presence of index arrows on every detailed chart, so you know which chart to flip to right away as you explore the sky. That eliminates flipping back and forth to the index charts or inserting one's own penciled notes in the margins. The all-sky charts toward the end include shading to help visualize the distribution of clusters and nebulae in our galaxy. We are also treated to a convenient listing of 72 stars with exoplanets, suitable for answering that question on where else life might exist in our neighbourhood. I can recommend this latest edition of a classic atlas for all active or armchair observers.

Colin Haig

Colin Haig, M.Sc., is 1st Vice-President of the RASC, can use uranography in a sentence, and enjoys exploring a good book, especially under starry skies.

The Heavens on Earth: Observatories and Astronomy in Nineteenth-Century Science and Culture, edited by David Aubin, Charlotte Bigg and H. Otto Sibum, pages 384 + xiii, 24 cm × 16 cm, Durham and London: Duke University Press, 2010. Price $84.95 and $23.95 (ISBN: 978-0-8223-4628-9 clothbound, 978-0-8223-4640-1 paperback).

Before beginning to read *Heavens on Earth*, I contemplated the title and what I would expect to find within its covers. The last word in the title, "Culture," suggested that I might expect to find a discussion of how observatories became a public symbol of a university's or a community's intellectual status and their commitment to studying our place in the Universe. As churches, cathedrals, and even clock towers had in an earlier time become symbols of a community's wealth and position in a country, so observatories became a status symbol in the 19th and early 20th centuries. I was largely disappointed in that expectation.



What I found on delving into the book was a series of studies focused primarily on the application, the science, and the science history rather than on the wider impact of astronomical knowledge on society or even on literature. Here one can learn a fair amount about the history of astronomy and some of its institutions (e.g. Pulkova, Paris, Collegio Romano), as well as information on the development of techniques and equipment related to the structures and organization of observatories. However, unlike a book by a single, or even two or three authors, the history is far from comprehensive and the thread based on "observatories" is not particularly strong. Indeed, there are sections on military applications of astronomy such as Guy Boistel's "Training Seafarers..." and Sven Widmalm's "Astronomy as Military Science," which investigates surveying in Sweden, and Martina Schiavon's "Geodesy and Mapmaking in France and Algeria...." Eclipses and special events such as Venus transits have for a long time generated public interest and nationally funded expeditions. David Aubin's "Eclipse Politics in France and Thailand, 1868" provides an account of one such expedition and its impact on the Thai royalty.

For a study of science-meets-politics, Simon Schaffer's well researched and written study of Thomas Brisbane's astronomical career is one of the more illuminating. Brisbane's battle with Parramatta's German observer Carl Rümker was long, bitter, and had international repercussions. But Schaffer did not comment on the larger view and its impact on the development of Australia's astronomical institutions. His chapter does look at international links between institutions, governments, and individuals, and is followed later by John Tresch's contribution, which focuses on Humboldt's "Cosmos," and its relation to an earlier work by Schiller.

One of the most interesting pieces for me is Richard Staley's account of the links between Simon Newcomb and Albert Michelson and their search for the speed of light in the last quarter of the 19th century. Staley shows how astronomy became astrophysics as a result of collaborations between astronomers and physicists and the adoption of the technology and techniques of physics, *e.g.* spectroscopy, to study the Sun and stars. It is probably the most significant paper in the book and one that makes the book worth the price.

Coming back to my opening comments, Theresa Levitt's "... the Observatory as Public Enterprise" and Charlotte Bigg's contribution, "Staging the Heavens...", which appear near the end of the volume, do address the cultural aspects, although one is left filling in between the lines in some respects. Bigg's paper is focused on later 19th-century observatories, but the two chapters did begin to address my initial expectations.

The 62 illustrations include many new or rarely found examples, with those from the late 19th century being the most engaging. Each paper has detailed notes, while the volume's bibliography runs to 21 pages and the index runs to 16 pages, making *The Heavens on Earth* a useful reference.

I have often commented in reviews that I am not a fan of works based on conferences; contributions are almost always of varying calibre and rarely follow the stated theme of the compilation closely. These days, authors rarely have time to do original research to ensure their contributions follow the theme of conferences as closely as they would like. At best, authors usually rework papers to add a few paragraphs in an attempt to link their work to the theme. The present volume suffers from the same limitations. Had the authors and editors succeeded in addressing the cultural acceptance of astronomy and astronomical science, it would truly have been a unique and interesting work. But, as I stated, Staley's chapter, "Michelson and the Observatory: Physics and the Astronomical Community in Late-Nineteenth Century America" makes it a book to acquire.

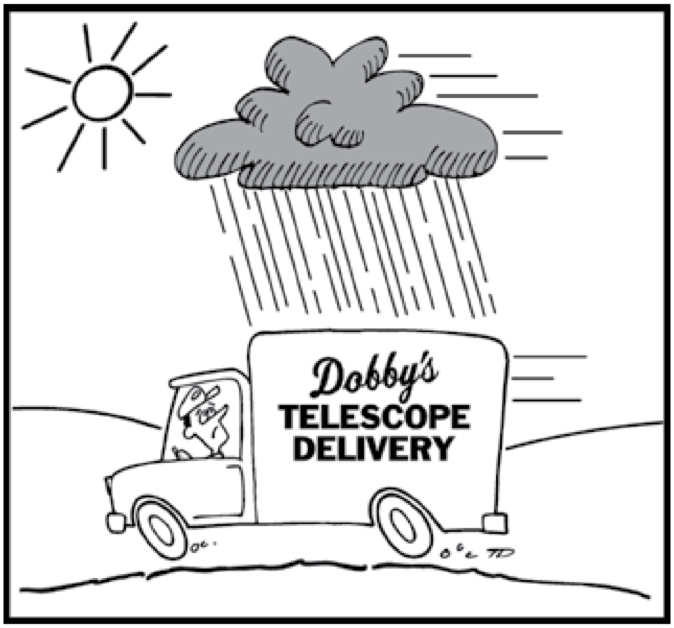
Randall C. Brooks

Recently retired to Windsor, Nova Scotia, Dr. Randall Brooks continues his research on the history of scientific instruments, and has resumed his position as editor of an electronic journal on the topic, eRittenhouse.

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.*

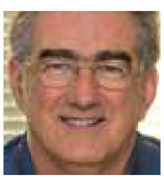
It's Not All Sirius—Cartoon

by Ted Dunphy



Society News

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



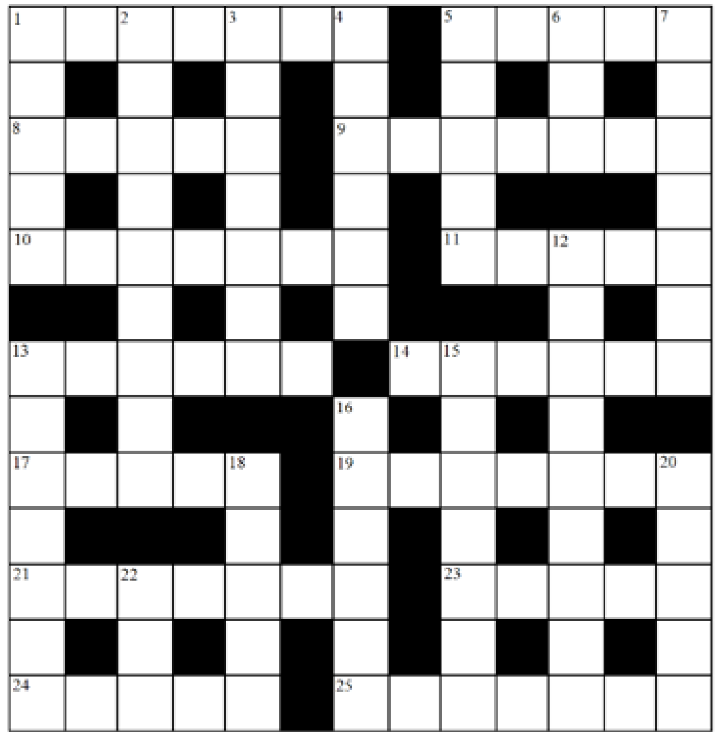
We have many outreach activities on the go throughout the Society. This particular weekend (as I write this) is the busiest for star parties—summer weather and the dark of the Moon do that! I personally have completed my weekend at two provincial parks here in Saskatchewan—Greenwater Lake and Good Spirit—showing campers the Sun during the day through my solar-filtered scopes, and the stars by night through my 10-inch Dobsonian. I counted the numbers with a mechanical clicker and totalled just over 450 viewers during the two days of splendid weather.

I know many other RASCals have been busy at various parks across the country, from the Atlantic provinces to the West Coast. There is no better way to reach the public than in a park setting. Kids particularly enjoy discovering the wonders of the night sky, and many adults have never looked through a telescope before, so use these opportunities to reach out and talk up astronomy.

Incidentally, do you occasionally check out the eNews on our site at www.rasc.ca/news? If not, why not? Make it a habit to give the site a look every now and then. You'll find interesting info, like the item on July 9 that our very own Randy Attwood was honoured with the naming of Asteroid (260235) Attwood. ✶

Astrocryptic

by Curt Nason



by Curt Nason

ACROSS

1. Diddley and his little brother loudly herald his atlas partner (7)
5. Here's to astronomy within (5)
8. Hope returned around the start of the century in 2000.0 (5)
9. DIY cons scramble during periods when planets align (7)
10. Algol was incomplete after hid behind an eccentric asteroid (7)
11. Optician Clark revealed his first in a galvanometer (5)
13. Small camera in Swiss river captures the river's double star (6)
14. One damaged Delos given to Tristan's beloved (6)
17. Nudist loses tail and flips over a constellation (5)
19. Destroy acre, etc.; then build up from collisions (7)
21. Odd blue rim seen around Uranus (7)
23. Eyeballed polar alignment described in Broughton's book (5)
24. Short, scrambled uplifted fault land on Mars (5)
25. Fornication browns a heavenly instrument (7)

DOWN

1. Martin studied comets at the seashore, I hear (5)
2. Bo and Brad scurry to filter the sky glow (9)
3. Unusual PEI halo detected around Uranus (7)
4. What it takes to be star when nothing is returned in fun (6)
5. Ursa Major's north or south star ain't returning around alpha (5)
6. Abbreviated princess at conjunction (3)
7. An acute mishap is within a billed constellation (7)
12. Reflected short wavelength light pollution prepares a clue for the location of M27 (9)
13. I'm following the alphabetical gamut to hut rotating in the horizontal direction (6)
15. A moon sounds ill or will fire (7)
16. Bust in the raven's chamber with an asteroid (6)
18. Saskatchewan's current discoverer of a comet (5)
20. Those broken eyepieces have raised the bar (5)
21. Bok's first are not finished in a pub (3)

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

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Great Images

Khati Hendry proved her artistic talents with this sketch while waiting for the transit of Venus from Black's Lookout, near Yellowknife. In Khati's words, "You can see that it was a line-and-wash sketch of the observation site during the transit, with Tom in his chair. I am an amateur artist, whose drawing got interrupted by a medical career, and I just started doing some sketches and watercolours in the past couple of years. It is a nice way to pay attention to the world and remember the time and place. The afternoon on Black's Rock with fellow transit-of-Venus observers is still a special pleasure to recall."