The Journal of The Royal Astronomical Society of Canada

Journal

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PROMOTING ASTRONOMY IN CANADA

June/juin 2011
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The Running Man Nebula

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Royal Astronomical Society of Canada

Société Royale d'Astronomie du Canada

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__On the cover:__ The collaboration of Paul Mortfield and Stef Cancelli has produced this colourful image of the Running Man Nebula (NGC 1977), which lies just above the Great Nebula in Orion. The image was acquired using a 16-inch RCOS telescope at f/8.9 from Sierra Remote Observatories in California. Exposure was a total of 10.9 hours in LRGB using an Apogee U16M camera. In their words: "The goal in processing this target was to reveal the intricate inner structures and accentuate some of the more subtle colour shades not often seen, but nonetheless there."

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

Mary Lou Whitehorne
President, RASC

It is with pleasure that I sit down to write a good-news column for this issue of the *Journal*. The recent National Council meeting held on 2011 March 26 had a very full agenda with many issues requiring decisions. The outcome of that meeting is a series of good-news stories. Here they are:

1) No membership fee increase. The 2010 fee increase of three dollars was only half the amount originally requested, so there were warnings of the likelihood of another small increase in 2011. Thanks to careful management and the tireless diligence of our Treasurer, we have been able to avoid an increase in membership fees this year. There is a budget deficit in the charity sector of our business, but the membership and publications sectors managed to break even. This enabled us to avert the anticipated fee increase.

2) We have applied for and received a $25,000 Business Innovation grant from the Canadian Periodical Fund, to refresh and redesign the *Journal*, and to market it more aggressively to increase subscriptions and readership.

3) The recent second print run of 100,000 Star Finders has been partly funded in the amount of $4000 through the existing Beyond IYA NSERC PromoScience grant, jointly held by RASC, CASCA, and FAAQ. Additionally, 10,000 English Star Finders and 5000 French Cherche-étoiles have been purchased by the National Research Council. The grant and large sale have produced a favourable impact on the charitable sector of our business, giving us additional leeway to carry out more charitable work this year.

4) Council voted in favour of our new strategic plan, giving the Society its first-ever planning document to guide it into the future. In truth, the Executive Committee and staff had been implementing parts of the plan prior to the Council meeting and already we are seeing the first positive results.

5) Council also voted in favour of our new marketing communications plan. Like the Strategic plan, this is also a first; it is also beginning to show early positive results for the Society.

6) Council ratified the Executive and Light-Pollution Abatement Committees' approval of the Jasper National Park Dark-Sky Preserve application. With a land area of 1.1 million hectares, Jasper is Canada's and the world's largest dark-sky preserve. Jasper National Park is internationally renowned and hosts many thousands of international visitors every year. This designation will help spread the word about preserving the nighttime environment around the

globe, multiplying our own efforts many times over in the years to come.

7) Transport Canada has expressed a willingness to work collaboratively with the RASC to help educate Canadians about the safe and responsible use of green-laser pointers, and to help reduce irresponsible and hazardous use of these devices. Transport Canada acknowledges the legitimacy of green-laser pointer use in astronomy education and outreach activities. Partnering with Transport Canada in this way gives us a golden opportunity to have a say in any future legislation that may be developed around the use of GLPs. Expect to see more about this collaborative work in the months to come.

8) Last, but definitely not least, we finally have a full complement of dedicated, competent, and talented staff in the National Office. Office procedures are being honed, and routine tasks are becoming, well, routine! This means we will be able to devote much more of our energies to the things we want to do, enjoy doing, and should be doing as a Society, instead of being focussed almost exclusively on "keeping the RASC lights on."

The RASC would not exist without its members, its Centres, and its volunteers, who work tirelessly at the local and national levels. It is your commitment and dedication that makes our Society what it is today – a Society internationally recognized for quality and integrity in its work. When I look at the list of success stories from the most recent National Council meeting, I am compelled to acknowledge here and now the superb volunteer work done by our members, Centres, committees – indeed, all of our volunteers. This last year has seen significant contributions from some very busy committees, most especially the Membership and Promotion, Light-Pollution Abatement, Green-Laser Pointer, Education, and IT committees (well, OK, the Executive Committee, too). My thanks go to everyone who has worked hard to make good things happen in and for the RASC over the past year.

I look forward with great optimism to what the next year will bring. I trust you also share in my optimism for a vibrant future in the RASC!

Quo ducit Urania! ✶

Feature Articles
Articles de Fond

The Grand Schism in Canadian Astronomy I: The Rise and Fall of Mount Kobau

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Figure 1 — Summit camp 1966 October 06: storage/workshop nearest yellow convertible with proud owner E. Pfannenschmidt; office/dormitory; commissary/dormitory. Mast rising above trees at upper right marks proposed location of dome for QEII Telescope.

1. Introduction

Feature articles in the *JRASC* 2008 October issue marked the 30th anniversary of "first light" for the Canada-France-Hawaii Telescope (CFHT) and the 90th anniversary of the 1.8-m Plaskett Telescope at the Dominion Astrophysical Observatory (DAO). The CFHT ranks high among the world's most scientifically productive optical telescopes. The success of the CFHT is one of the highlights in a string of major innovations over the past three decades that has transformed Canadian astronomy and elevated it to a significant international presence.

The scale of the transformation is astounding when viewed from our position in astronomy 40 years earlier. In 1968, optical astronomy was in a state of crisis. A project had just collapsed to build a 3.8-m telescope as a national facility on a British Columbian mountain bordering the west side of the South Okanagan Valley. The project had been initiated by the astronomers at DAO in the early '60s. They were intent on supplanting their 1.8-m reflector with a much larger modern telescope placed at a location in Canada with superior seeing conditions. The search for that superior site, spearheaded by Graham Odgers, settled on Mt. Kobau, which rises above the towns of Osoyoos and Oliver to an elevation of 1862 m above sea level.

When approved by the federal cabinet in September 1964, the project was at first entitled "The Confederation Telescope" in anticipation of Canada's Centenary. Shortly thereafter it was renamed "The Queen Elizabeth II Telescope" to honour Her Majesty the Queen during her visit to Canada the same year. The royal association failed as a talisman to ward off partisan bickering. The bickering parties, however, were not politicians as feared by Prime Minister Pearson; they were Canada's astronomers. By 1967, they were at loggerheads over the choice of Mt. Kobau as the proposed site.

Recriminations played out in public. Feature articles printed in newspapers from Vancouver and Victoria were notably virulent. The affair took on ugly East vs. West overtones. Predictably Canadian reactions to save the project ensued. First, venomous outrage was directed at those snubbing a prized regional asset; Toronto's astronomers were impugned with sinister motives (the "Let's All Hate Toronto" ploy). The same voices then vented their frustrations on Ottawa. They accused the federal government of hiding behind claims of financial stringency to justify the cancellation of an exceptionally worthy project (the "Let's All Sneer at Ottawa" ploy). That done, the aggrieved parties withdrew from public view to plot alternative strategies for preserving the project and to nurse their grudges (the "We'll Show 'em" gambit).

This Great Schism of Canadian Astronomy was a complex, multi-faceted affair overshadowed by a threat of dire consequences for the support of astronomy by the federal government. A detailed account of it appears as the final episode in a history of the Dominion Observatories (Hodgson 1994). The author, J.H. (John) Hodgson, was the last in a line of directors of the Observatories Branch, reaching back to W.F. King at the beginning of the 20th century. His version of the Great Schism is written from the perspective of a scientific director and a respected geophysicist, caught at the centre of a maelstrom of competing demands from university and government astronomers. His carefully researched two-volume history was published in a limited edition of a couple of hundred copies. Nowadays only knowledgeable specialists are aware of a work that deserves a wider audience.

In his summary, Hodgson speculates about the reasons behind the failure of the project and about the strength of disagreements between the bickering factions. He is much concerned about how the announcement of the project's cancellation to the press was handled, as if the project could have been saved by better bureaucratic procedures! He claims that Toronto's astronomers got their negative opinions directly to Prime Minister Pearson. That was true; surely, however, that tactic would have failed had the project been without a serious flaw. He is on firmer ground when pointing out an overriding political constraint placed on the government design team from the beginning – the telescope had to be located in Canada. Other astronomers dismissed that constraint outright, leading inevitably to an impasse. He is certainly right to point out that the project was given approval too easily and, once approved, moved too quickly to develop the site, given how little was known in 1964 about the year-round climate on Mt. Kobau.

So why revisit this sad episode in the history of Canadian astronomy? First, the QE II Telescope was to be the premier but not the sole instrument in the development of a multi-disciplinary national astronomical observatory on Mt. Kobau. As part of this development, a national astronomical institute was to be established at a leading university in Western Canada, most likely the University of British Columbia (UBC). These two elements of a broad vision for the development of astronomy in Canada are largely forgotten. That vision was a source of concern for DAO astronomers who wanted no distractions from completing the QE II Telescope; it became another source of dispute with eastern academic astronomers who espoused different priorities.

Second, there is no personal account of the Schism by anyone who actually worked on Mt. Kobau with the expectation that their future career as an astronomer might be tied to it. As one of the last survivors linked to this project, my perspective is based on the dozen weeks I spent, spread over a year, on Mt. Kobau and on attending many committee meetings. In my view, Hodgson's account underrates the effect the heavily overcast winter of 1966-67 had on opinion outside the core group of Mt. Kobau's proponents at DAO. Claimed to be the worst in 50 years at Victoria, that winter was portrayed as a one-off affair, presumably not to be repeated for another half-century. That belief is harder to sustain now that we are aware of the wide fluctuations in the El Nino/Southern Oscillation cycles of the Pacific Ocean and their effect on climate in southern B.C.

Finally, I wish to argue that the failure of the project had much to do with the unusual scientific composition of the Observatories Branch from its inception. The collapse of the project is historically significant; it marks the end of an era when major government-funded astronomical facilities in Canada were proposed by just a few senior persons in the Federal Civil Service. Thereafter a process evolved over decades in which the astronomical community at large had to achieve a consensus before Treasury Board would consider their application for capital funding of any major new astronomical facility.

In this article, I recall incidents that give a flavour of being on Mt. Kobau and of participating in heated debates about its merits. In a second article I shall examine how the Observatories Branch was established by strong-willed rivals, how its fortunes waxed and waned under different leadership styles during war and economic depression, and finally how insufficient critical oversight permitted the Branch to set off on the road to a humiliating failure.

Figure 2 — Expression of intense local enthusiasm for QEII Project.

2. Shrouded in Fog

At 5 p.m., it was already dark in the Okanagan Valley on a late October afternoon in 1966. A fine drizzle coated the windshield of our leased 4-wheel drive Scout as Aren Groen, electronics technician in our solar research group, and I left the radio observatory. I had spent the last two days attending a meeting of the National Committee for Canada of the International Astronomical Union (NCC-IAU). That body served as a professional society for Canadian astronomers prior to the formation of CASCA (Canadian Astronomical Society/ Société Canadienne d'Astronomie). I had discussed initial results from our solar site survey on nearby Mt. Kobau during the conference at the Dominion Radio Astrophysical Observatory (DRAO). Aren and I looked forward to a hot supper as we headed back to the site-survey camp. The camp had been set up on the summit of the mountain (Figure 1) in September 1966 by A.B. Sanderson & Co., engineering consultants to the Queen Elizabeth II Telescope Project.

The drizzle grew heavier as we made the westward hairpin turn at Osoyoos past the sign announcing "Gateway to the Queen Elizabeth II Observatory" (Figure 2). We drove up the Richter Pass Highway to the gate at the foot of the new road leading to the summit of Mt. Kobau. We felt no qualms about the weather as we locked the gate behind us and set off on the 18-km climb in pitch blackness. We were, after all, ascending a superb mountain road designed with public safety in mind. It had been constructed between November 1965 and May 1966 by Peter Kiewit Sons Co. to a maximum grade of only 7.9% and a width of 11.6 m, shoulder-to-shoulder.

The drizzle turned to light freezing fog after the first kilometre, but I remained unconcerned. By then, drifts of snow that had fallen sporadically over the past week appeared here and there in our headlights. But, the fog grew steadily thicker; soon our lights barely showed the edges of the road. I steered for the tracks left in the snow when Aren had made his descent in daylight. The higher we drove, the worse the fog became. Mindful that there were no guardrails anywhere, and few warning reflectors, I shifted down to the lowest setting in the gearbox. We crawled upward at a walking pace. Thoughts of a hot supper vanished as I focussed on finding the tracks in the snow. I had travelled that road in both directions many times. I thought I knew every twist and turn, especially those few spots where, if you went over the outer edge, you might tumble freely for 10 seconds before you crashed. This became the white-knuckle drive of a lifetime.

I was initially more angered than frightened by the fog. Unstable weather had plagued us ever since we had returned to the summit on October 6 for a campaign of site-testing by solar and stellar astronomers, together with a team of meteorologists. Unlike the calm summer weather when we set up a temporary camp and built two observing platforms for solar telescopes (Gaizauskas & Kryworuchko 1973), we were experiencing fall's fickleness: blustery winds, occasional snow, and few clear days. Instead of cumulus clouds lazily rising in the late morning off the upper flanks of the mountain, angry clouds arched over the summit and menaced us with snow (Figure 3). Gusty conditions often made it difficult for the

Figure 3 — Roiling clouds over the summit 1966 October 20.

Figure 4 — Radio astronomer John Galt and family advance on meteorologists attempting to launch a Kytoon on 1966 October 09.

crew of meteorologists to get their helium-filled Kytoon to tow aloft a cable with high-speed sensors for measuring thermal turbulence (Figure 4).

A forecast of rough fall weather was coming true. On 1966 July 25, I had arrived in Penticton with Mel Lytle, the Dominion Observatory's carpenter. We set up a small camp on the summit and, in steady blazing sunshine, we erected two observing platforms, 5-m high. My plan was to compare the quality of solar images photographed by a pair of 15-cm refractors on platforms that were spaced 1.5 km apart on the mountain's plateau. Two weeks of labouring at construction had landed me in Penticton Hospital on August 7 with muscular spasms gripping my back. Midway through a week of treatment, I commented to the physiotherapist that it had been cloudy that morning since sunrise, the first such day since I arrived from Ottawa. Her matter-of-fact response startled me: "Oh, that just means we're going to have an early fall." Her confident prediction was rooted in years of tending an apricot orchard on one of the westward-facing terraces rising above Okanagan Lake. She explained that there were years when the seemingly endless sunny days stopped abruptly; cloudy days then became commonplace and prevailed until spring.

This was my first exposure to any negative comment about fall or winter weather in the Okanagan. What I had been told earlier about winter conditions on Mt. Kobau emphasized positive aspects; the summit was sometimes seen rising through the cloud at night by pilots descending to land at Penticton, or during the day by skiers on higher slopes nearby. Conditions had indeed changed when I got back to the mountain a week or two later. Cirrus-streaked skies predominated. Even so we were encouraged by good days with short periods lasting approximately 30 minutes when image definition over a field-of-view of 6′ × 6′ was aperture-limited (Figure 5). On the next-to-last day of our campaign, August 30, we awakened to a nasty shock; heavy hoar frost covered our tents and trailer to the depth of a centimetre (Figure 6). There was no longer doubt about an early fall.

Back in our slowly ascending Scout, Aren and I disputed the number and sharpness of the turns we had already made and how many were left. The odometer was too coarse to indicate the remaining distance to the camp. Suddenly our headlights picked out through the fog two red taillights at the spacing of a large truck. I raged at the abandonment of a large vehicle where it blocked the road. I crept up to it, aiming a bit towards the side I thought was opposite to the mountain's edge. Moving gingerly, Aren got out to investigate. He came back doubled up with laughter, motioning for me to come and inspect the "vehicle." It was the storage/workshop trailer in the encampment of three large trailers! We had arrived at the summit in fog so thick that we could only see the end of that one trailer. We groped our way to the commissary, roused the cook, and wolfed down a hot supper before turning in for the night.

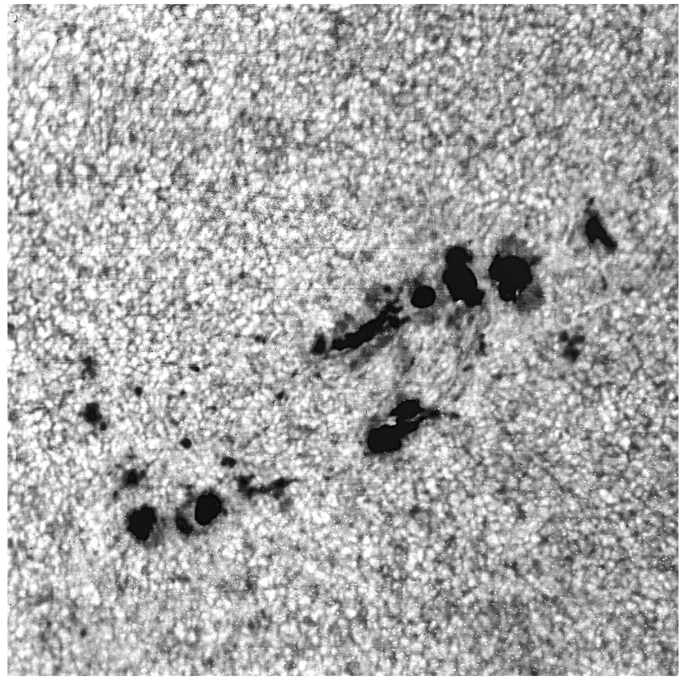

Figure 5 — Sunspot Region McMath 8454 as it was forming on 1966 August 24.

Figure 6 — Hoar frost covers the solar site-testing camp 1966 August 30. The all-white observing platform for the solar refractor is at upper left.

Figure 7 — Fog-bound journalists and photographers at the summit, 1966 October 23.

The next day, Sunday, 1966 October 23, was scheduled for an on-site visit by the National Advisory Committee on Astronomy (NACA). This body was appointed to advise the Minister of Mines & Technical Surveys (MTS), the federal agency then responsible for the operation of the Observatories Branch, on the development of a national observatory on Mt. Kobau. At mid-morning, the mountain was still shrouded in fog. That did not discourage a couple of carloads of newspaper reporters from making their way to the summit (Figure 7) to await the arrival of a busload of senior Canadian scientists and their guests. The site manager for A.B. Sanderson was reluctant to permit that bus to proceed up the mountain until he was assured by the meteorologist at Penticton Airport that the fog was lifting. After more than an hour's delay, the bus arrived in thinning fog (Figure 8). Its occupants were treated to hot drinks (Figure 9) before they set off to tramp over to the summit in ankle-deep sticky snow (Figure 10).

The visit did not convert doubters into believers that Mt. Kobau was the best site for Canada's major optical telescope. Neither were there any defectors from among the faithful at the next day's meeting of the NACA in Penticton. The virtues of Mt. Kobau were stoutly defended. But there was growing insistence by astronomers from eastern Canada for a national astronomical facility to be located in the Southern Hemisphere.

3. Early Impressions of Mt. Kobau

My initial impressions of Mt. Kobau had been favourable. I first visited the mountain on 1965 October 01 with J.L. (Jack) Locke, then Chief of the Stellar Physics Division at the Dominion Observatory, Ottawa. Together with R.M. (Bert) Petrie, Dominion Astronomer and Director of DAO, and his wife Jean, we bounced along a rough trail to the summit in a Land Rover driven by Graham Odgers. At the top, we found a long, broad ridge aligned generally north-south with its highest point at its SE corner on a knoll surmounted by a fire lookout. The slightly lower location for the QE II Telescope was on a large hillock a few hundred metres to the NW, marked by a small cement pad beneath the map that is the centre of attention in Figure 11. Most of the southern end of the ridge was boulder-strewn open meadow covered with sagebrush and various grasses that looked tinder dry in early autumn. Isolated stands of alpine fir dotted the landscape.

A large depression, called Testalinden Lake (Figure 12), about 0.5 km north of the primary site, had been scooped out decades earlier by local orchardists to impound water for irrigation. When filled by spring snow-melt, the lake covered over a hectare to a maximum depth of 2.4 m. Studies were underway about the practicality of sealing the lake bottom to create a reservoir for both agricultural and astronomical needs. The NW side of Testalinden Lake was heavily forested, but soon opened onto a broad, sage-covered meadow. Beyond that meadow, a thick forest of mixed conifers, including stands of tall lodgepole pine, covered the northern extremes of the ridge.

Figure 8 — Busload of distinguished scientists guided to a parking spot by Site Manager Jock Crawford.

Figure 9 — Future Nobel Laureate Gerhard Herzberg (extreme right) chats with future First Director of the Herzberg Institute of Astrophysics, Jack Locke (left), 1966 October 23.

A few hours spent tramping around the ridge that mild hazy day sufficed to pick several locations worth testing as sites for a solar tower telescope. I came away convinced that Mt. Kobau was a valid choice for a multi-disciplinary national observatory. My companions of that day felt otherwise. Odgers was bluntly pessimistic; he had spent enough days on the mountain to recognize a consistent upflow on its flanks by mid-morning that produced abundant local cumulus clouds above the ridge. I was already aware of this tendency at mountain solar sites in the U.S. southwest, specifically at Kitt Peak (Arizona) and Sacramento Peak (New Mexico). In each case, they counted on tower telescopes at sufficient height to be above the early morning inversion layers for optimum observing conditions. Estimation of the minimum tower height was to be part of my site investigations. Petrie was far more concerned with the distracting effect of other telescopes proposed for Mt. Kobau on the quick completion of the QEII Telescope.

Figure 10 — Scientists gather around the base of the 47-m tower erected at the location proposed for the QEII Telescope on 1966 October 23. Foreground L-R: Ernie Seaquist (newly minted U of T Ph.D. in radio astronomy); Prof. Sidney van den Bergh, U of T; John McLernon, senior technician, Meteorological Service of Canada. Background L-R: Carman Costain, radio astronomer DRAO (looking down)); Prof. Jack Heard, U of T (wearing fedora); Jean Petrie astrophysicist DAO (with head scarf); Mrs. Miriam Beals (wearing pillbox hat), wife of C.S. Beals, recently retired Dominion Astronomer.

Locke was even more conflicted. Aware from his personal experience of the poor conditions at the Dominion Observatory (DO) on the Experimental Farm in Ottawa for solar observations, he recognized the necessity for a new site. His real problem, however, was his discomfort at being relegated to a minor supporting role in the development of a national observatory. Unwilling to mark time for an undefined number of years before his division's needs were met, Locke resigned from the DO, effective 1966 April 01. He transferred to the radio astronomy group at the Radio & Electrical Engineering Division (REED) of the National Research Council (NRC). The exciting possibility for a world-beating success in microwave interferometry on a continent-wide baseline, involving the radio observatory he had founded at Penticton, was a potent lure that paid off handsomely for him in short order.

Just a week after Locke departed the DO, Bert Petrie succumbed to a fatal heart attack. The champion of a major new facility for Canadian astronomy vanished tragically from the scene. Petrie's stature as a scientist and a person was so high that his sudden departure left the Mt. Kobau project vulnerable to the kind of bickering that ultimately brought it down. He may not have been able to save his beloved project, but his presence would have reduced the level of rancour that followed its cancellation.

Construction of the access road began on 1965 November 02 and proceeded without incident throughout the winter. The snowpack on the ridge that year did not exceed 75 cm. When Mel Lytle and I were building forms in late July 1966 for concrete pads to support telescope pillars, excavated soil was bone dry (Figure 13). The shortage of water was a serious problem for curing concrete. The lack of a local source meant many trips up and down the mountain to fill 5-gallon jerry cans, which we then used to wet the pads and the telescope pillars after they were erected (Figure 14). The characterisation of the Okanagan Valley as "an arid region with high water-use demands" (*e.g.* Toews 2007) applies as well to the top of Mt. Kobau. We were about to learn, however, that arid terrain did not translate automatically into clear skies. My hopes for continued clear and dry weather during our October 1966 campaign went unfulfilled. Worse was to follow next winter.

4. Rime Ice 1966 – 1968

Two days after the VIP visit, Aren Groen and I disassembled and boxed a solar refractor for winter storage. The weather gave us a foretaste of winter, Mt. Kobau style. A layer at least 2 cm deep of miniature icicles, 2 to 3 cm long and about 3 mm in diameter, covered the southernmost solar platform and the steps leading up to it. Stepping on these randomly oriented icicles was like slithering about on a floor littered with roller bearings. It was no mean feat to stay erect while lowering boxes full of gear, one of them weighing over 40 kg, down 16 steps and loading them into a van.

This was our introduction to rime ice. Rime ice forms when supercooled microscopic droplets of water, suspended in air as a vapour, flow past an obstacle at or below the freezing point. A well-known hazard in aviation and communications (*e.g.* towers and radomes), rime ice is commonly observed on mountains in British Columbia. Crystallization begins on the upwind side of an obstacle and it grows into the wind. It produces different results depending on the water vapour content, the speed of the airflow, the size and shape of the obstacle, and the temperature differential between the supercooled droplets and the obstacle. Rime is usually associated with fog, but can form in clear weather as long as there is sufficient moisture in the wind-driven air.

Figure 11 — Standing on top of the proposed location of the dome for the QEII Telescope on 1965 October 01: (L-R) Graham Odgers, Jack Locke, Bert Petrie, Jean Petrie. The shiny roof between the heads of Odgers and Locke is the fire lookout.

Figure 12 — Bert Petrie changes film while standing on the rim of Testalinden Lake, 1965 October 01. A Lilliputian Graham Odgers explores the "lake" bottom.

During the winter of 1966-67, meteorologists on Mt. Kobau reported long, clear, horizontal icicles, an uncommon form of rime ice. Some, over a half-metre long, were attached to instrument housings where they caused little damage. Late in the spring of 1967, the 47-m tower (Figure 10) was replaced by another twice its height in order to extend the range of microturbulence studies. The new tower experienced severe icing conditions beginning in December 1967. Rime ice encased two of the three guy cables to a diameter of 25 cm, while very little ice or snow formed on the third cable or the tower itself. Removal of the asymmetrical ice load was tricky to avoid any sudden lurching of the tower from its leaning position. A report about this incident by the installer concludes: "Icing in this area at the elevation of this particular tower is very hazardous." How hazardous became plain a month later.

On the night of 1968 January 14, icing was severe in the extreme. During his daily visit to the summit next morning, the site manager for A.B. Sanderson, Jock Crawford, found that the top two-thirds of the tower had snapped off due to excessive ice loading. It had plunged top down into the snow and ice and planted itself in a nearly vertical position less than 2 m from the base of the shorter stump. The fog was too thick to photograph this astonishing chance alignment. There was still heavy fog when the tower's suppliers arrived to inspect the damage on January 16. Because ice kept thickening on both sections of the tower, the inspection team toppled both (Figure 15). This time the collapse was blamed on the accumulation of ice on the tower itself. According to McLernon (1968) "... rime ice built up on the SW edge of the tower (18-inch cross-section) to a width of 24 inches."

The consulting engineers for the QE II Observatory admitted rime ice was a serious problem. But, they were confident that technical solutions could be found to control its formation on large domes. A glance at the ice-encased cabin on the right side of Figure 15 suggests it was probably fortunate that the opportunity to pursue this matter did not arise.

When I returned to the mountain camp for a couple of weeks in late June 1967, I was astonished by the luxuriant knee-high cover of wild flowers surrounding the entire camp and our observing platforms (Figure 16). To my surprise, the forested area toward the north end of the ridge was devoid of once-conspicuous lodgepole pine. When I drove over to investigate, I found numbers of collapsed pine blocking my way. Reports of a snowpack over 4 m deep at the QEII site in early 1967 accounted for spring's luxuriant verdure. I imagined that a snow-pack of that depth in the forested areas would have supported the lower trunks of the lodgepole, while winter gales might have ripped off the foliage-laden tops. But, Mt. Kobau was not subject to gale-force winds. It is more likely that rime-producing fogs encased feathery clusters of pine needles with such a burden of ice that the slender upper trunks of the pines snapped, just like the metal tower.

Figure 13 — Mel Lytle builds a form for a cement pad to support a 4-m high concrete pillar for a solar refractor, 1966 July 29.

Figure 14 —Snagging the hook seen in Figure 13 with a ring-ended rod that will be used to compress the four concrete cylinders into a rigid pillar to support a solar refractor.

5. Observable Hours & Astronomical Seeing

Cabinet approval in 1964 of the QEII Project made clear that the telescope would be available to all qualified Canadian astronomers, not just astronomers in government service. The "brain drain" of Canadian graduates in science to the USA and elsewhere was recognized as a problem by the government of that day, and so the cabinet document stressed the importance of the new facility both to the training and retention in Canada of the most promising graduates. Assignment of observing time on the completed telescope was a matter of deep concern and frequent discussion between Petrie and C.S. Beals (Dominion Astronomer until his retirement on 1964 June 29). This issue was only tentatively resolved between them at the time of Petrie's death. They did, however, agree early on that astronomers in Canadian universities (and their graduate students) would have half the observing hours on Mt. Kobau allotted to them.

Two reports released during the spring and summer of 1967 changed the tone of the debate about Mt. Kobau from sharply critical to openly hostile. A lengthy feasibility study of the Mt. Kobau National Observatory prepared by A.B. Sanderson & Co. (1967) was released at the end of March. Its ambitious plans for a multi-disciplinary astronomical observatory ranged far beyond the single 3.8-m telescope already approved. For example, the architect attached to the consulting team presented a fulsome design for a Visitors' Centre near the summit to serve as a major tourist destination. Both academic and government officials were aghast at its lavish concept. Even harsher criticism by astronomers at the U of T was directed at the proposal to locate a national astronomical institute to house permanent scientific staff with their associated shops and laboratories in Western Canada, most likely in Vancouver, and to transfer all the astronomical activities of the federal government at great cost to Mt. Kobau. This aspect of the conflict was deeply rooted in competing visions of Canada's astronomical past and its future prospects. A companion article on the Great Schism will explore the roots of Beals's and Petrie's opinions, differing strongly from those of university astronomers, on how the creation of the QEII Telescope would affect the development of Canadian astronomy.

In the same document, Graham Odgers summarized the results of the studies of the climate and seeing on Mt. Kobau over several years. A great irony of the Kobau saga is that the estimations of observable night hours did not, in the end, differ substantially from those derived of clear daytime sky from sunshine records, widely available, that compared stations in the Okanagan Valley with Victoria. Had all disputants consulted these freely available records, none would have been blinded by the oft-repeated phrase: "the Okanagan Valley is the most northerly extension of the Great Southwestern American Desert." That phrase originated innocently enough at DAO merely to point out where the most advanced observatories in the USA were located. However, repeated flaunting of the desert-like qualities of the site had the effect of suppressing tough questioning. A prize example is the press release from Minister Wm. Benedickson's office on 1964 October 28 announcing the choice of Mt. Kobau as the site for the QEII Telescope. It is worth quoting in part: "In the dry belt of the B.C. interior, the area is a northward extension of the Great American Desert. Botany at the 3,000-foot level of Mt. Kobau is similar to the Mexican Desert at 1,000 feet. Cactus plants grow abundantly on the lower slopes and rattlesnakes are common." Thus when Odgers reported that the observable hours for desert-ringed Mt. Kobau were not radically different from those in the moist maritime conditions at DAO, eastern academic astronomers exploded with indignation. They had been grossly misled, so they claimed.

Odgers's best hand of cards was his visual observations of close double stars taken on 82 nights. He showed convincingly that the seeing on Mt. Kobau was better than at DAO (Victoria) by a factor of about three. Indeed, binary stars were occasionally resolved down to the diffraction limit of a 20-cm reflector on

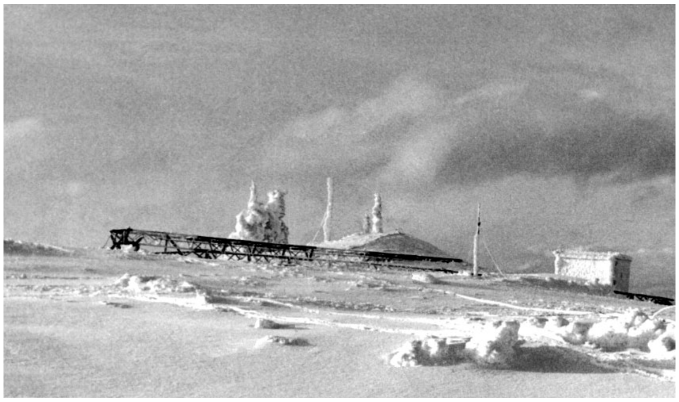

Figure 15 — The collapsed weather tower, 1968 January 16. Courtesy Library and Archives Canada. Pictorial record in RG48, Vol. 36, Folder 4.3.

Figure 16 — Summit of Mt. Kobau as a flower-filled meadow, late June 1967.

Mt. Kobau, but never at Victoria. This important finding meant that a 3.8-m telescope on Mt. Kobau would be at least 20 times more efficient in gathering data than the 1.8-m telescope at DAO. Still greater efficiency could be expected from improved precision of all optical surfaces of a new telescope. The results from the seeing survey were vital for setting tolerances on the figure of the primary, the primary-support system, telescope flexure, and thermal control of the dome. All of Mt. Kobau's protagonists hailed these seeing results as justifying the mountain's choice.

But, there was a catch. The 82 nights were concentrated in the months July–September for 1963 and 1964, *i.e.* during the shortest nights of the year. What about the rest of the year? At the time the QEII Telescope was approved, Petrie was concerned about the meagre amount of information about winter conditions on any of the mountains on his short list. He wanted to delay his choice for another season of winter tests, but was hard-pressed by telegram from his minister's office to announce his choice immediately. He complied by choosing Mt. Kobau. Seeing and data on cloud conditions during long winter nights remained scant for that mountain until 1966–67, when a habitable survey camp was built and staffed on the summit. It was not until mid-January 1967 that an all-sky camera, of the kind developed for auroral research by NRC/REED (Park 1961), began filming both night and day cloud cover on Mt. Kobau.

A report by Gordon Walker of the DAO staff on the latest data from winter and spring of 1967, dated 1967 July 12, was received by astronomers in Toronto four months after the feasibility study released by A.B. Sanderson & Co. In order to estimate observable hours Walker predicated his analysis on the following assumptions: the sky had to be 0.3 (or less) cloud-covered for a minimum of 2 h, the zenith extinction had to be less than one magnitude for at least 1.5 h, and that the wind velocity could not equal or exceed the 42 km/h safety limit set in the design study for the telescope and dome. On these grounds, Mt. Kobau had only 241 observable hours during the period, mid-January to the end of June 1967. For the same period, the log books at DAO revealed 414 actual observed hours, excluding nights with an hour or less of observations. Furthermore, there were 25 nights on Mt. Kobau when the sky was completely overcast or otherwise unsuitable for observing (Walker 1967). Walker's report confirmed the worst suspicions of Toronto's astronomers; there would be far too few observable hours year-round to satisfy their needs, no matter how great the optical efficiencies of a new telescope. For the unauthorized release of these data, Walker was very nearly sacked at the urging of the Executive Assistant to the Assistant Deputy Minister of Energy, Mines, & Resources (EMR, formerly Mines & Technical Surveys).

The rebuttal from DAO was that the winter of 1966-67 was the worst in a half-century, a unique event. Because the all-sky camera operated on Mt. Kobau for only a couple of years, there is no way to test that belief directly. But, a meteorological station did operate at the summit for 14 years, 1966-1980, gathering data on temperature and precipitation that can now be found in the National Climate Data Archive at climate.weatheroffice.gc.ca/climateData/monthlydata_e.html for station ID 1125223). From those data, it is possible to glean an impression about the variability of precipitation patterns in the immediate aftermath of the cancellation of the QEII project.

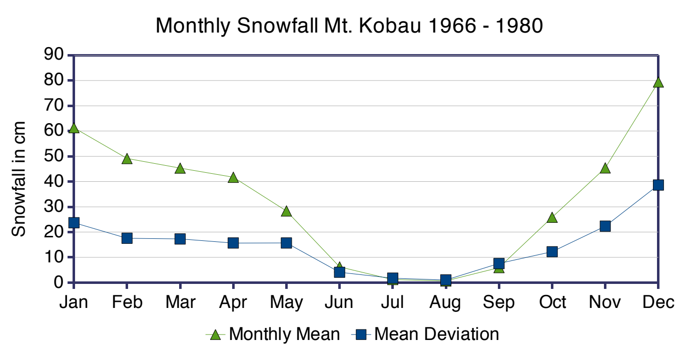

Figure 17 — Fourteen-year averages of monthly snowfall and deviations from the mean for Mt. Kobau (see text for explanation of symbols).

The graph of Figure 17 shows the 14-yr means of snowfall, month-by-month (triangles), and the mean deviation in snowfall, month-by-month (squares). Snowfall rises sharply with the onset of winter's long nights, with mean deviation in the amount of snow running from a third to a half of the mean from November through March. That degree of variability in the amount of snow, and hence unsuitable skies, from year-to-year would have made scheduled winter operation of a major national facility on Mt. Kobau a dubious enterprise.

While evidence piled up that Mt. Kobau was unsuitable as a national facility, the siren call of superb seeing sites in Chile grew louder. Site tests conducted by astronomers from the University of Chicago in 1960-61 had already led to the choice of Cerro Tololo as the future site of the Cerro Tololo Inter-American Observatory (CTIO), where a 4-m telescope would be completed by 1974. That joint Chilean-American facility inspired a consortium of European countries to plan a 3.6-m telescope for La Silla, Chile, the initial site for the European Southern Observatory (ESO). And then, quite unexpectedly, an opportunity was presented to Canadian astronomers to join in the Chilean bonanza. The dynamics of the conflict over Mt. Kobau were about to shift into a far more complicated phase.

6. The CARSO Offer

News of the growing dissatisfaction with Mt. Kobau leaked to astronomers engaged in big telescope design in the southwestern USA. They issued an invitation, informally at first, in the spring of 1967 to DAO to participate in duplicating on a Chilean mountain, the telescopes of Mt. Palomar Observatory: a 200-inch reflector, a 72/48-inch wide-field Schmidt telescope, and a 60-inch reflector. Soon after, it came in writing from Horace W. Babcock, director of the Mt. Wilson & Palomar Observatories, at the behest of the Carnegie Institution of Washington and the California Institute of Technology. They were seeking a partner to develop a major observatory in the Southern Hemisphere (Carnegie Southern Observatory, hence CARSO). The news was received enthusiastically by Canadian astronomers, none more so than Prof. D.A. (Don) MacRae, head of the Department of Astronomy at the University of Toronto (U of T), who would make the promotion within Canada of CARSO, or some version of it, his mission for the next five years.

In response to the growing criticism of the QEII Project, John Hodgson convened the third meeting of the NACA on 1967 July 26 in Ottawa. The top item on the agenda was discussion of Sanderson's feasibility study. But, the CARSO offer kept intruding on every topic, be it climate and seeing on Mt. Kobau, accessibility to graduate students at a national observatory for training, or photometric quality of Mt. Kobau. Prior to the meeting, Sidney van den Bergh, then a professor of astronomy at U of T but not a member of the NACA, distributed a paper to committee members in which he evaluated the QEII Telescope's likely rate of collecting astronomical data from Mt. Kobau. Taking Odgers's data on seeing and climate from the feasibility study, van den Bergh found that performance equivalent to that on Mt. Kobau with the QEII Telescope could be had in Chile with a much smaller telescope for 20 times lower cost. Negative comments about Mt. Kobau notwithstanding, the committee's first recommendation to the EMR Minister was to proceed immediately with the construction of the QEII Telescope and dome as described in the feasibility study. The same recommendation urged that site testing and site preparation on Mt. Kobau continue, and that an optical shop be constructed for figuring the mirror blank.

Unanimity on passing this recommendation rested, however, on an understanding that a vigorous attempt be made to accept the CARSO offer. In contrast, unanimity was unconditional when the NACA passed a second resolution. It urged EMR's minister to pledge resources immediately to grasp a unique opportunity for Canadian astronomers to share in the construction, installation, and operation of optical telescopes with CARSO. The emphasis on immediacy arose from a concern that CARSO might find a partner in the USA and withdraw its offer to Canada. The recommendation stressed that CARSO's instruments would be unsurpassed elsewhere, and that they would operate under the best observing conditions in the world. Taken together, the two recommendations made it crystal clear to those overseeing the funding for the QEII Telescope Project, that a single observatory site could no longer satisfy all Canadian astronomers. To underscore its intent regarding CARSO, the NACA recommended a series of cost-cutting measures for reducing facilities on Mt. Kobau other than the QEII Telescope. The third meeting of NACA thus marks an important turning point in Mt. Kobau's fortunes.

Present for part of the meeting was the Assistant Deputy Minister (ADM) of EMR, J.M. (Jim) Harrison, top administrator for the QEII Telescope file. Harrison was aware of the broad outlines of the CARSO offer; he had already met Babcock informally in May during a conference in the USA. While conversing with Babcock, he avoided making any promises. Insurmountable hurdles faced any new astronomical venture so long as the feasibility study for developing Mt. Kobau was under review. Back in Ottawa, Harrison sent a letter expressing EMR's interest in the CARSO offer, but he advised Babcock that no commitment was possible for several months. Now, faced with NACA's enthusiasm for the CARSO offer, Harrison arranged for EMR's Minister, Jean-Luc Pepin, to send a stronger expression of interest to Babcock. The intent was to buy time until the CARSO offer was brought before the newly created Science Council and while the universities sought the extra funding for CARSO from the provinces and the private sector. To that end, NACA set up a small working group, with Don MacRae as chairman, to expedite a search for funds.

The sub-committee met in October 1967 at Toronto with Drs. Babcock and E.A. Ackerman, Executive Officer of the Carnegie Institution of Washington. A formal invitation to participate in the project was later received from Dr. Ackerman in which the total cost for the observatory in Chile was estimated at $19 million US, with annual operating costs somewhere between $0.25 and $0.8 million. The Carnegie Institution would provide half the funds if Canadian sources could provide the other half, for half the observing time; a decision would be required by 1968 October 01. To put the capital cost in perspective, we note that the exchange rate was 8 percent in favour of the US dollar in 1968. The inflation factor since 1968 is 5.42 (Bank of Canada Inflation Calculator at www.bankofcanada.ca/en/rates/inflation_calc.html). Canada's share expressed in today's dollars comes to $56 million CDN, an attractive figure considering the vast scientific potential of the three proposed telescopes. But, who could put up that kind of money? EMR was already committed to finance the QEII Telescope; adding to astronomy's financial burden or switching horses in mid-stream would court political disaster. Babcock came to Ottawa in February 1968 to put the CARSO proposal before Dr. W.G. Schneider, President of NRC. Although enthusiastic about the idea, Schneider was not in a position to offer any funding. Nor did the fund-seeking sub-committee of NACA turn up any alternate sponsors during its brief existence.

Meanwhile, unbeknownst to NACA, MacRae was engaged in back-channel efforts to get his views on Mt. Kobau and the CARSO offer to the highest levels in the federal government. His displeasure with Sanderson's feasibility study prompted him to press his highly negative views of it on senior professors and officials at U of T who were known to have access, on a personal level, to Prime Minister Lester Pearson. MacRae also wrote a lengthy criticism, dated 1967 June 30, of the proposed Mt. Kobau National Observatory to O.M. Solandt, chairman of the newly formed Science Council. Solandt recorded MacRae's approach in an internal memorandum that was seen and commented upon by the Prime Minister. The approach to Solandt left a paper trail that was uncovered by Hodgson 20 years later when the relevant Privy Council files were opened at the National Archives of Canada. The attacks against development of Mt. Kobau eventually had their intended effect; on 1967 December 07, Finance Minister Edgar Benson curtailed government expenditures in several areas, including the QEII Telescope Project. The project was to be slowed down, not stopped; planning would continue. On the same day, EMR Minister Pepin requested the Treasury Board to authorize spending by either the Science Secretariat of the Privy Council or the Science Council on an investigation into governmental support of astronomical programs. A small working group appointed from interested government agencies and the universities would be empowered to question anyone it saw fit.

The stage was set for more than a probe of the QEII Telescope Project; astronomical research supported by the federal government across several departments was to be put under the microscope.

7. The Closing Chapter in the Mt. Kobau Saga

As 1967 drew to a close, Lester Pearson announced that he would step down in 1968 April as Canada's 14th Prime Minister and leader of its Liberal Party. He could look back with satisfaction at the celebration of Canada's Centennial Year, especially at the great popular success of Expo 67 in Montreal. There was a serious breach of protocol by General de Gaulle during his balcony appearance before an adoring crowd of Quebecers assembled at Montreal's City Hall. That politically charged event had enraged Pearson. The astronomers' fracas was small stuff compared to de Gaulle's "Vive le Québec libre!" But it must have rankled the PM nevertheless that squabbling astronomers were trashing his gift to the Queen. He wanted swift action to settle this conflict as quietly as possible before he left office.

His preference was to appoint a single non-partisan expert to examine all the facts and to submit clear-cut recommendations quickly. But, eminent Canadian scientists who were not astronomers shied away from this embittered controversy. Charged with the task of setting up the inquiry, Minister Pepin sought advice from various quarters, and finally recommended to the PM that a small working group of well-qualified Canadian scientists would be in the best position to deal with the astronomers' problems in the allotted time. The Science Secretariat of the Privy Council Office accordingly set up a working group in early June 1968 with orders to file an initial report by 1968 July 31 and a final one by 1968 August 31.

The chairman of the working group was Dr. D.C. Rose, a widely respected cosmic-ray physicist, recently retired as Associate Director of the Division of Pure Physics, NRC. As leader of a study group of the Canadian Association of Physicists, Dr. Rose had submitted their report on the status of physics in Canada to the Science Secretariat in 1967. Two Canadian astronomers provided the specialized expertise: Dr. C.S. Beals, former Dominion Astronomer, but still active as a scientific consultant, and Dr. W.H. Wehlau, Head of the Dept. of Astronomy at the University of Western Ontario. The organizing officer for the working group was Dr. D.I.R. Low of the Science Secretariat.

The objectives of the inquiry were:

- As a first priority, to evaluate the merits of the QEII Telescope, the CARSO proposal, and other astronomical projects of the Government from the point of view of scientific excellence and in regard to the total effort devoted to astronomy by both governmental agencies and private institutions in Canada;
- to appraise the allocation of resources in astronomy by all agencies in the context of the total scientific effort in Canada and in relation to the technical and economic capabilities of the country;
- to appraise the possible economic benefits to Canada of astronomical research in cooperation with other fields of scientific research;
- to consider the recommendation of the Glassco Commission that all governmental astronomy be combined under one agency.

The serious regard for the astronomers' problems by the Science Secretariat was clear from its decision to hire an eminent Dutch astrophysicist, Prof. H.C. van de Hulst of the University of Leiden, as a consultant to advise the group.

The working group moved swiftly. It held hearings between 1968 July 04 and 18 in six astronomical centres across Canada: Toronto, Vancouver, Victoria, Penticton, Ottawa, and Quebec. In those 2 weeks, a total of 56 briefs were presented, either verbally or written. There was ample opportunity for all interested parties to contribute, most notably in Toronto where a town-hall meeting was held with graduate students present. Dr. Babcock met with the group in Ottawa in late June before it set off on its cross-country tour. The working group submitted its final report to the Science Secretariat ahead of schedule on 1968 August 12. About two weeks later, its recommendations were rejected by the Cabinet Committee on Priorities and Planning, which was chaired by the new Prime Minister, Pierre Trudeau.

8. Down, But Not Out for the Count

It would be another 18 months before the full contents of that report were made public. This was ample time for fear and confusion to set in among Canadian astronomers about the working group's exact recommendations and the reasons for their rejection. The initial press release announcing the cancellation of the QEII Telescope Project and the disposal of its assets implied that the government was abandoning "big-telescope" astronomy entirely. That level of drastic action was, in fact, never intended. But, its threat galvanized the contending parties into a rare display of unity to protest strongly against the threatened loss of the mirror blank, grinding and polishing machines, and the talented team of optical designers and technicians. The mirror blank was later handed over to a consortium of five western universities (WESTAR) who endeavoured, unsuccessfully, to save the project by raising funds from provincial governments and private sources. The campaign to preserve the optical team and its equipment was ultimately successful. Had it not succeeded, it would have been the deathblow for DAO. As it turned out, this group of experts and their equipment became the key ingredient in the negotiations between Canada and France that convinced the French astronomers to accept the Canadians as equal partners in building the CFHT.

No one had expected or wished for such a Draconian outcome, least of all C.S. Beals. His appointment to the working group had come as a surprise because he could hardly be considered a non-partisan by Canadian astronomers. We knew that he had played a major role in laying the administrative groundwork for the QEII Telescope and for a national observatory in Western Canada before he retired as Dominion Astronomer. But, Beals was respected as a fair-minded, straightforward man who did not tolerate humbug in any form and who had an outstanding ability to focus sharply on the essential facts of any case. He later admitted that he came to the inquiry with the conviction that the original plan for building a national observatory on Mt. Kobau was a sound one. But, he changed his opinion completely in the course of the intensive discussions held by the working group in Toronto.

As the dust settled from the announcement that further work on the QEII Telescope was cancelled, his former colleagues at DAO were stunned to learn that the working group's first recommendation had been to build the telescope on a suitable site in Chile, not on Mt. Kobau. At that time, I was even more startled by the alternative recommendation: to join in the CARSO project *and* to complete the QEII Telescope on Mt. Kobau. Both choices involved additional spending beyond existing estimates for developing Mt. Kobau, but the second one more than doubled the cost. How Beals, battle-hardened by years of struggle with Treasury Board to keep down his spending estimates for the Observatories Branch, could have endorsed this second proposal baffled me.

Left contemplating the smouldering wreckage of four years of hard work on their dream project, the DAO staff felt bewildered and betrayed. Beals himself was so aghast at the outcome that he was too shocked to communicate with anyone about it for over a week. In a letter to K.O. (Ken) Wright, who had replaced Petrie as Director of DAO, Beals explained: "There were deep and irreconcilable divisions within the Committee and I wished many times that I was on some other planet. In the end it came to the point where each had to give up something or end in complete indecision that seemed certain to be fatal. I refused to accept any solution that did not involve the use of the 157 in. mirror, the optical shop and the experience of the [optical] group.... The other side refused to accept any solution that did not involve a Chilean or comparable site…." This goes only part way to explain Beals's change of heart. The full story is contained in other correspondence that will be presented in my sequel.

The days and months following the cancellation were filled with anxious manoeuvrings in Victoria and Ottawa to preserve the assets of the QEII project in case it could be revived. Dwindling hope was accompanied by boiling anger at the chief opponents to the Mt. Kobau site. The nadir in the loss of collegiality between the Victoria and Toronto astronomers came at a meeting of the NCC-IAU at UBC on 1969 May 02–03 at which I was the recording secretary. Ken Wright, in an emotional outburst, made verbal accusations against Sydney van den Bergh that were not only uncalled for but blinded by prejudice. This did not bode well for future cooperation.

Events, fortunately, forced changes in everyone's attitudes. A slow healing began with a major transformation of Canada's astronomical landscape. The final recommendation of the Rose working group had been to combine all astronomical activities of the federal government under a single authority – the National Research Council. The implementation of that decision required a division of major departmental assets, changes to the NRC Act by Parliament to reflect a new policy, and the reappointment of many employees – an upheaval that accounts for the 18-month delay in releasing the full report of the Rose working group. The change took effect on 1970 April 01 when most of the astronomical activities of the former DO and DAO were absorbed into the new Astrophysics Branch headquartered at NRC/REED in Ottawa under the supervision of J.L. Locke. With a different management style at NRC came different modes of interaction with astronomers at the universities. EMR's National Advisory Committee on Astronomy was disbanded and steps were taken to absorb its role and that of the NCC-IAU into an Associate Committee on Astronomy (ACA), a structure that existed for other divisions within the NRC.

A more consequential change was prompted when, at a conference held in Ottawa in late July 1969, Canadian scientific and engineering societies proposed to form an association that would play an active role in matters affecting national science policy. To ensure that astronomers had adequate representation in such an organization the NCC-IAU reconsidered forming a society of professional astronomers. That issue had preoccupied Canadian astronomers throughout most of the 1960s. Prof. V.A. Hughes of Queen's University had been a strong proponent of an Astrophysics Division within the Canadian Association of Physicists, but he could not muster a large enough following. The results of a survey by the NCC-IAU on forming a professional society, presented at the May 1969 meeting at UBC, had revealed a large measure of indifference.

With personal relations damaged, many came to realize that a permanent forum open to all astronomers, and especially to graduate students, was essential if the community was to work its way out of a deep crisis. The meetings of the NCC-IAU had been subsidized by the federal government through a grant from the Observatories Branch arranged initially by C.S. Beals. At the NCC-IAU's meeting in Ottawa on 1970 October 23, Don MacRae argued that this source of funding inhibited criticism of government policy on astronomy by university astronomers; he urged formation of an independent, self-financed society. Jack Heard was deeply concerned about the effect such a move would have on the RASC. Nevertheless, in May 1971, attendees at the ACA meeting in Victoria laid the foundation for the Canadian Astronomical Society (later CASCA). A road to recovering civility had been found that made cooperation on the CFHT possible, once that opportunity arose.

Large questions about the schism still go begging. How was it that the tight and friendly community of Canadian astronomers of the early 1960s, initially supportive of DAO's venture, fell out so badly that they were hardly on speaking terms by the end of the decade? Did the CARSO offer ever stand a chance of being accepted in Ottawa? What converted Beals to favour a Chilean site? These questions will be examined in a concluding article against a backdrop of long-term trends stretching over most of a century in the development of Canadian astronomy.

Acknowledgements

Beginning in 1964, the officers of the RASC were called upon by senior Canadian astronomers several times through the rest of the decade to provide letters supporting the QEII Telescope Project as evidence of public enthusiasm to present before decision makers in Ottawa.

They did so and their contribution was recognized by the politicians. But, I have felt ever since that the general membership of the RASC was inadequately informed by the professional astronomers of the complicated background to the Mt. Kobau story. This personal account is my belated attempt at a corrective. To that end, I do not wish to burden the general reader (or the *JRASC*'s Editors) with a historical document bristling with sources. Those with specialized interest can find over 100 citations in Hodgson (1994). In this narrative, I have sign-posted my personal recollections as distinctly as possible from statements I have based on the copious documents stored in Library and Archives Canada (LAC) in Ottawa. For those who might wish to check my version of events, the relevant documents can be found in boxes with Archival Reference Numbers RG48, Vols. 1, 2, 11, 35, 36, 37, 38, 39, 40, 48. I am indebted to the staff of the LAC for their unfailing patience and courtesy in tutoring me in the ways of archival research. I am especially indebted to Reference Archivist Alix McEwen for uncovering 18 boxes of the C.S. Beals papers (Reference Numbers MG30 B-32 Vols. 1-18), which had lain undisturbed since their deposition over 25 years ago. I thank Drs. Ian Halliday (secretary to NACA) and Gordon Walker for kindly communicating personal recollections of events.

The colour photographs are all from the personal collection of the author. ✶

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Granite Gap

Figure 1 — The standard observatory is 4.5 m (15′) square with two piers and a warm room at the roll-off end. These will be ready to use after power and Internet have been connected. The view is to the southeast.

By Don Van Akker, Victoria Centre
(dvanakker@gmail.com)

New Mexico is ribbed by ranges of rugged mountains that rise abruptly from flat desert plains. It has a lot of clear sky, a lot of wind, and not a lot of people. At night, it has a lot of stars. Elizabeth and I spent much of the winter snow-birding there. We did a lot of travelling but eventually wound up as guests of Gene Turner at Rancho Hidalgo. Gene is an ex-Florida developer who apparently made his fortune paving paradise and putting up houses. I suppose he became disenchanted with the Florida he helped to build, and in 2002 decided to move to New Mexico. The attraction was the sky, for Gene is an avid amateur astronomer.

He is not a tall man and he doesn't need to be. His stocky frame and friendly open face give him the kind of commanding presence that dominates any conversation. His blue eyes look straight at you and he bubbles with enthusiasm for his current projects. He runs cattle and horses on an enormous ranch that includes a lot of property he owns, and grazing rights to thousands of acres of adjacent government land. But, he is a developer and promoter to the core, and when he came to New Mexico, he hit the ground running.

The first project, and the one that brought him here, was Arizona Sky Village near the town of Portal on the Arizona side of the Simon Valley. There he partnered with Canadian Jack Newton to build a community of like-minded people who wanted to live under dark skies filled with stars. The result is a scattering of homes against the foothills of the Chiricahua Mountains, each with an observatory beside it; each with shades that prevent white light from spilling into the night.

The next project was Rancho Hidalgo, his own place near the town of Animas. There the scope is broader. Astronomy remains a central theme but hand-in-hand with the stars are riding, birding, rock hounding, archaeology, and even a hand in a vineyard yet to be planted.

Figure 2 — These are the first of many planned small cottages. They will be sold as six-month time-shares with a 99-year ground lease.

Figure 3 — This is the first of a system of lakes that will stretch up the valley. Already it is attracting a great number and variety of birds. The water comes from an aquifer.

The results so far are impressive despite the current economy. The planned properties have been subdivided and all are sold. Some homes have been built and more are under construction. The first of six triplex time-share units is now complete. There are seven leased observatories around the home ranch area, and the centrepiece of all of it is the raised platform around the inclined lattice frame of Clyde Tombaugh's home-built 400-mm (16-inch) telescope.

Figure 4 — Astronomers are not the only ones that wait for the night. This Great Horned Owl roosts in a tree beside the lake.

Figure 5 — Binoculars get a workout both day and night.

The project is ongoing, but it is not the one we came to see.

Gene gets really enthusiastic when he talks about it, and he will bend your ear for as long as you will stand still to listen. He calls it Granite Gap and it is about 30 km north of Rancho Hidalgo.

The concept, as far as I know, is unique. For a one-time flat fee you lease, for 99 years, 6 months of annual use of a space in a serviced RV park. Not a specific space but not a specific time either. Like at any other RV park, you drive up and take your chances, or you reserve beforehand and you are assigned a space. While you are there, you pay a small daily fee for power and Internet (Gene tells me it will be in the order of about three dollars). If you don't have an RV, you can buy a half-time share of a furnished 400-sq-foot cottage and stay in it on the same basis.

That much is more or less conventional. What makes this interesting is that it is aimed exclusively at astronomy and nature lovers: a non-stop star party – that with every lease, comes the exclusive use of a half-acre site in an adjacent observatory area where, if desired, Gene will build you a roll-off for probably less cost than you could do it yourself *[about $11,000 – Ed.]*.

A roll-off observatory under New Mexico skies with power and Internet so that it can be operated from Canada, all at a price we thought we could afford. Tempting.

The RV park and observatories are only half the concept. The other half is an educational centre that brings together people from a wide variety of disciplines to teach and to learn about the sky and the environment. Plans include birding facilities and a resident bird expert, a planetarium and science centre, a mineral museum, and even, further up the valley, a model-rocket launch site to capture the imaginations of the young.

What is there now? Not enough to open the doors yet but enough to see what's coming. There is an old ranch house on the land. The manager will live there. The roads are roughed in and the RV areas are laid out. Trenches are open and ready for the electrical services. An earthen dam that, years ago, enclosed a lake has been repaired and the water level brought back up. Birds are beginning to discover it again; we saw a lot of varieties there that never make it to Canada. The observatory field has been laid out; seven roll-offs are near completion and as many more have been started.

Yet it is a big piece of land and it dwarfs the improvements made so far. The real wealth of the place lies in the crystal-clear skies above it and the magnificent scenery around it. The Chiricahua Mountains are fierce and grand, the beauty of the desert seeps into your bones and the birds make it sing.

Figure 6 — Omega Centauri never gets north of 49° but is fantastic from Granite Gap. Sagittarius comes up far above the horizon and no, those are not clouds rolling in, that's the Milky Way!

Figure 7 — Clyde Tombaugh's telescope silhouetted against mountains from Rancho Hidalgo. This telescope is fully functional and needs only the usual tinkering to make it ready to observe.

Will it all get built the way Gene describes it? Maybe. Maybe not. Dreams have a way of colliding with reality, but he has the track record and he has the skills, and he is determined to make it happen.

We decided to bet on him. ✶

Details about the Granite Gap project can be found at www.granitegap.com.

Things That Go Bump in the Night

by Mike Wirths, Ottawa Centre
(mwirths@starband.net)

News of the upcoming GA photo contest and in particular the "cell phone" category got me to thinking of a story that happened to us here in Baja California, Mexico. My wife Pamela and I made the escape from the harsh Ontario winters three years ago to start a completely new adventure in life. We were horse farming for about 15 years, but now it was time to fulfill a totally different dream, an astronomy B&B. A serendipitous series of events led us to a 500-hectare ranch in the mountains of the Sierra San Pedro Martir near the national observatory of Mexico. While our house was being built, we lived on site in a travel trailer to supervise the progress.

Because we live near sources of water, very small-time marijuana growers sometimes try to plant tiny plots in the area. Consequently, the military occasionally makes sweeps through the region in groups of 12-14, in their Hummers. We have a good working rapport with them, as we like them to make sure nobody is on our ranch (kinda hard to check out 1200 acres!). Now that we live here and traffic is regular, we no longer have any "unwanted" campers.

These guys are career soldiers as Mexico no longer has mandatory service for young men; they are very serious and polite. So we had a group of them camping out for a night on their way past our place on a very rough road. I had the 18-inch Starmaster Dob set up and the Moon was at first Quarter. I asked the officer in charge if the squad would like to see the Moon craters through the scope? They heartily agreed and all of them made their way over to my scope, which was set up in the flat area in front of our house. The seeing was pretty nice and I showed them the Moon at various magnifications.

The normally professional demeanour was replaced by very enthusiastic expletives as they saw a telescopic view of the Moon, probably for the first time in their lives! A few of them had their cell phones with them and asked if it was okay for them to try to take some pics. Of course I said yes, and the guys who had their AK-47s with them laid them up against my observing table and got to imaging the Moon in earnest. The two or three who tried got some respectable shots, not too overexposed, and you could make out some decent detail! I imagine when they got back home after their several-month tour of duty, they would all be showing the pictures to their family and girlfriends.

The main paved road to Ensenada (and San Diego) has a permanent military checkpoint, where they conduct inspections looking for arms and smuggled drugs. More than once we have been recognized by one of the guys from that night and we get asked "what's interesting in the sky" at the time. Of course our car does not get searched! ✶

You can learn more about Mike and Pamela's astronomy B&B in Mexico at www.bajadarkskies.com

Cosmic Contemplations

An Averted Glance at Three Decades of *Sky & Telescope*

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

For Christmas last year, I bought myself seven decades of *Sky & Telescope* magazine on DVD, because I knew my wife wouldn't. My wife simply doesn't get my astro thing. So, for my birthday, I've started leaving hints about Campo del Cielo meteorites, but it's a hard sell I'm afraid! I thought it would be interesting to read through the preceding three decades of *S&T* for basic knowledge useful to observers and imagers that we may have forgotten – or things we were told to believe in without really knowing the scientific basis behind them.

Now I understand what Carly Simon was singing about in the song "You're so vain." The March 7 total solar eclipse passed right over Sydney, Nova Scotia (April 1970). The magazine remains tight lipped about the identity of her scorn. But, here are some of the highlights in my 30-year overview:

Technical aspects of Bernard Schmidt's mysterious vacuum method (he never wrote it down) of producing the aspheric Schmidt corrector plate were discussed in great detail: namely a glass plate was deformed in the centre by a vacuum and then ground spherical. When the vacuum was released, the plate sprang back into the desired corrector profile. Celestron refined this process for mass production, allowing the proliferation of commercial SCTs (June 1972).

Details of a revolutionary new focuser invented by English amateur J. Wall in 1971 – the now ubiquitous Crayford focuser – were described in September 1974!

Cooling film cameras improved their sensitivity, leading to amateur-built custom boxes to immerse the camera body in dry ice during imaging, foreshadowing cooling of DSLRs with modified TEC iceboxes (August 1975).

Perkin-Elmer (the folks who goofed on the *Hubble Space Telescope*) advertised their microdensitometer, which could scan a 35-mm negative at one-micron intervals. Unfortunately, that would result in 864 million pixels recorded onto 124 reels of magnetic storage tape, but their data acquisition system could handle it! Today's amateurs can buy an off-the-shelf FLI Proline PL50100 CCD with 52 million pixels that any laptop can handle. Proscope was selling their 12-inch Ritchey-Chretien scopes for $8750, which is about $34k in today's dollars. Today, AstroTech will happily sell you their mass-produced 12-inch RC for only $4k. There was commentary on the wonderful increase in light transmission from the application of state-of-the-art MgFl2 lens coatings and 97-percent reflectance mirror aluminization (May 1976).

The very best amateur planetary film photography was showcased and they were (with no disrespect) worse than my first fumbling attempts with Webcam imaging. The article concluded that good seeing is the single most important determinant for success (September 1976).

At that year's Stellafane, a homemade digital setting circle that stored the coordinates of 256 celestial objects was showcased. It was comprised of over 110 integrated circuits and cost $250 to make (October 1976)!

Adrien Poncet of France described his revolutionary idea: a flat platform that pivoted along a sector resulting in an equatorial movement that could be located well below the plane of the optical train. Poncet or equatorial platforms are now widely used by owners of large Dobsonians to enable RA tracking without the expense of servo-controlled GOTO systems (January 1977).

Mike Simmons explored the age-old question of what is the best 8-inch scope design for film photography based on the performance criteria of optical speed, off-axis performance, and size of the flat field. He ran his designs through self-written ray-trace software on his home computer and came up with some interesting conclusions and three winning designs at f/5.6. One design was a concentric Schmidt-Cassegrain that modified commercial SCTs by placing the corrector plate at the centre of the curvature of the primary mirror, and having both primary and secondary mirrors share the same centre of curvature. The downside is that the OTA became three times the length of conventional SCTs. The Simak-Maksutov-Cassegrain was modified by making all four surfaces spherical, freeing the secondary from the corrector, and moving it inward toward the primary. A simple plano-convex flattening lens can be used to further improve star sizes, and a short tube length is preserved. Finally, a design familiar to us all: a refractor with four elements in two groups including a fluorite or extra-low-dispersion (ED) element similar to the Petzval design found in some Tele Vue scopes. Now, as in the 1980s, an 8-inch scope of this design remains prohibitively expensive (July 1980). The Simak design reappeared briefly in the early 2000s as an AstroPhysics Maksutov-Cassegrain with Russian-manufactured optics. Slightly more than two dozen were made; they have an incredible planetary imaging performance, and command steep, used prices of over $30k.

A perfectly made scope operating in perfect conditions will still have its performance limited by the diffraction effects arising from the wave nature of light. A star test under high magnification will reveal a central circular Airy disc surrounded by fainter concentric rings, a phenomenon that is a consequence of that diffraction. English astronomer G.B. Airy showed mathematically in 1835 that the diameter of a star's disk is inversely proportional to the aperture of the scope. Larger scopes resolve stars as finer points of light. In a refractor, the Airy disc contains 84 percent of the light energy and the first ring contains 7 percent. In a 30-percent obstructed scope like an SCT, the Airy disc contains only 68 percent of the energy and the first ring 22 percent, causing a reduction in contrast of an object (February 1983). This is the reason why a 4-inch refractor in less-than-ideal seeing will often visually outperform a much larger reflector or SCT, especially for planetary viewing.

I was eagerly anticipating the start date of the CCD-imaging revolution and found it with French amateur Christian Buil's image of Jupiter taken with his homemade CCD (January 1985). Christian (who is still very much active in the field) used his Apple IIe computer to generate the clock pulses necessary to read out the pixels, but, to simplify matters, he constructed a single-line sensor of 1700 pixels, each 13 microns square. He constructed two-dimensional planetary images by stopping his mount's clock drive and letting the image drift across the sensor to produce a natural scanning effect. Incidentally, Christian's scope was none other than the 40-inch at Pic du Midi, so amateurs everywhere pay heed: professionals do respect us.

John Richter introduced the idea of curved spider vanes to eliminate diffraction spikes when imaging through a Newtonian scope. The optimal configuration was a set of three equally spaced vanes, each describing a 120-degree arc (May 1985).

Stephen Larson shows how a simple high-pass filter image process can bring out the detail in a single 0.1-second CCD image of Mars taken with a 61-inch scope. Amateurs would soon produce images rivalling those taken by space probes, when it was understood that post-processing techniques were as important as careful preparation during data acquisition (May 1989).

Our own Peter Ceravolo commented on the frequently inflated claims of optical performance by scope manufacturers. Scopes advertised with diffraction-limited optics imply that any defects will be masked by its diffraction pattern, which was generally regarded as 1/4-wave. This tolerance may be too loose, especially for planetary observing/imaging, where the loss of contrast at 1/4-wave is considerable. He noted that there has been a reduction in planet watching coincident with the rise in popularity of SCTs and large-mirror Newtonians. He believed it was due to a combination of large central obstructions and the spotty optical quality of popular commercial instruments that reduced contrast and rendered planetary observing a less satisfying pursuit (December 1989). In the end, you get what you pay for, but also undeniable is the unprecedented and excellent value we enjoy even with less-than-perfect instruments today. The smoothness of the optics is also important because a well-corrected but rough mirror will generate so much light scatter that it reduces image contrast. Dennis di Cicco attempted to settle the ongoing battle between Meade and Celestron as to who made the best 8-inch SCT, but, in doing so, shattered some myths – the SCT is a compromise instrument. It's a scope optimized for aperture size and portability that can do many things but does them merely adequately. Largely unknown was the fact that even a perfect set of SCT mirrors must be placed within a single millimetre of their designed separation distance to maintain diffraction-limited performance. The problem arises when focus is achieved by moving the primary mirror back and forth.

Shigemi Numazawa of Japan pioneered the use of a CCD video camera to record planetary images. The CCD had a greater sensitivity than film, and he could use exposures as short as 1/30 second. He discovered that if he played back the frames at a slow rate, he could detect large changes in seeing that were not obvious when played at the normal 30-fps rate, deducing that poor planet imaging resulted from the collective blurring of bad seeing during long exposures. To improve the roughness or poor S/N ratio of a single video image, he chose 20-30 of the best frames (using a high quality VCR) and shot multiple exposures onto a single frame of Kodak TMax B&W film right off the TV monitor, allowing for careful alignment of each frame.

Despite a process fraught with many technical difficulties, his results were superior to film, and, although taken with a C11, rivalled those from a large observatory reflector. He theorized that frames could be digitally grabbed and processed by computer that could effortlessly make a composite from hundreds of frames (February 1992). Today's amateurs capture three channels (RGB) of data in 1/120- to 1/30-second exposures, often comprising several thousand frames, of which hundreds are stacked with increasingly sophisticated software and with minimal hardware.

Peter Ceravolo returned to an S&T-sponsored telescope shootout to determine if 1/4-wave optics really were diffraction limited as scope manufacturers would have had us believe. He constructed four identical 6-inch, f/8 reflectors with mirrors figured to 1-, 1/2-, 1/4- and 1/10-wave, and with diagonals flat to 1/10-wave or better for the best three. Testers easily dismissed the 1- and 1/2-wave scopes but found it difficult to choose between 1/4- and 1/10-wave optics unless the seeing was stable and good. Since scope manufacturers often tout consumer satisfaction as the golden measure of quality, the typical amateur probably will be happy with 1/4-wave optics under average seeing conditions. From a statistical point of view, there will often be units that fall below this level if 1/4-wave is the manufacturing goal. Under excellent seeing conditions, observers and imagers alike will appreciate diffraction limits that exceed 1/4-wave (March 1992).

(continues page 116)

Figure 1— Blair MacDonald of the Halifax Centre captured the edge-on galaxy NGC 4565 in Coma Berenices using an 8-inch Schmidt Newtonian telescope and a Canon 350D camera. Exposure was 11 × 5 minutes at ISO 400 from the Centre's observatory at St. Croix, NS. The galaxy, discovered by William Herschel, lies 30 to 50 million light-years distant and shines at 10th magnitude.

Figure 2 — Lynn Hilborn captured this deep image of the well-known Leo Triplet (M65, M66, and NGC 3628) over three days in March and April this year. Exposure was 4 hours in L and 45 minutes each of R, G, and B using a TEC 140 telescope at f/7 and FLI ML8300 camera from his WhistleStop Observatory at Grafton, ON. The three bright galaxies lie about 35 million light-years away.

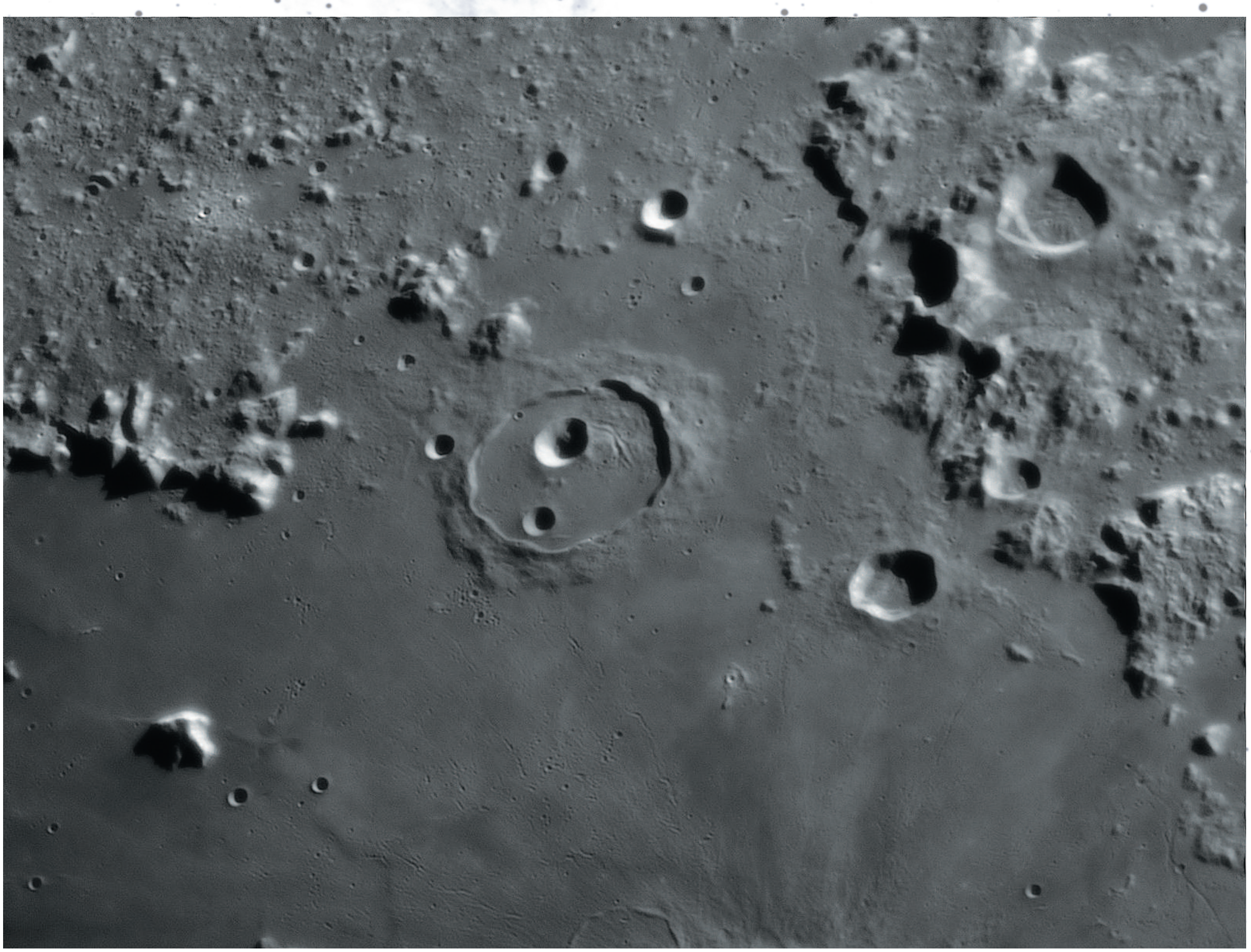

Figure 3 — Mike Wirths (who contributed "Things that Go Bump in the Night" in this issue) continues to amaze with this exquisite high-resolution images of the Moon, taken on April 12 from his Equuleus South Observatory, at Sierra San Pedro Martir, Baja, Mexico. The image shows the 57-km-diameter crater Cassini at centre with Mount Piton in the lower left. Mike used an 18-inch Starmaster Dob and a Lumenera Infinity 2-2 monochrome camera. This image is a stack of 140 frames from a total of 1100.

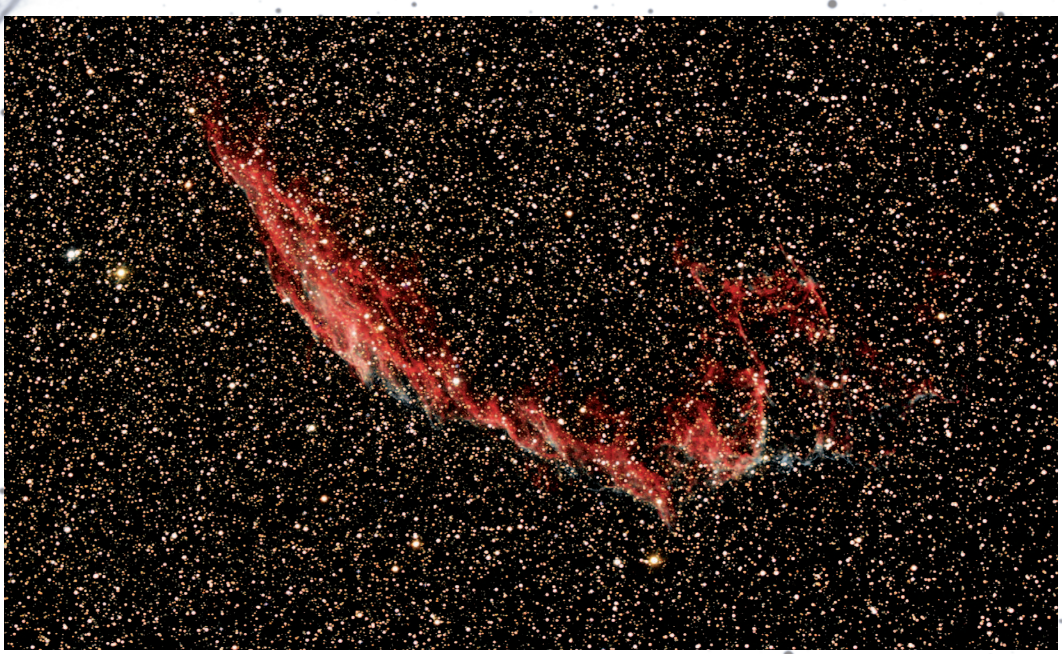

Figure 4 — Jay Anderson used a newly acquired Hyperstar capability on an ancient C11 to gather enough photons for this image of the eastern part of the Veil Nebula on the morning of April 2. Exposure was 16 × 3 minutes using a Starlight Express SXV-M25 one-shot colour camera. The Veil Nebula lies about 1500 light-years away in Cygnus and is a remnant of a supernova that exploded 5- to 8-thousand years ago.

Bill Kelley introduced one of those fascinating ideas that somehow failed to bear fruit even 20 years later. He epoxied a screw bolt to the centre of a spherical 6-inch f/5 mirror and then mounted the mirror on a plywood disk with a ring of carpeting supporting its periphery. When he tightening the single central mounting bolt with a wingnut, the mirror deformed enough to become a paraboloid. More tightening resulted in a hyperboloid figure. Although Ronchi tests confirmed the change in figure, the degree of mirror warping required could be easily determined in the eyepiece by simply sharpening the stars down to a pinpoint. Other advantages of this system included the ease of manufacturing a smooth accurate spherical mirror, no requirement for a mirror cell, and, when temperature dropped and a mirror naturally tended to become overcorrected, the ability to quickly re-adjust the figure (June 1992).

Bill Zmek answered another age-old question: is an unobstructed scope design superior for planetary observation? He devised an equation to show that the contrast in an obstructed scope had the same characteristics as a smaller scope with a diameter equal to the difference between aperture and secondary-obstruction diameter, despite the transfer of energy from the Airy disc to the first diffraction ring of an obstructed scope. Reflectors were perceived to be inferior because they are more susceptible to wavefront errors emanating from poor collimation, mirror-cell strain, and thermal gradients from the open tube. If these factors are well controlled, then performance could be expected to be equivalent to a slightly smaller refractor but at a substantially lower price point (July, September 1993).

My journey from the 1970s through to the 1990s saw issues grow from about 70 pages to over 150 pages, much of that in increased advertising space. A strong astro marketplace is good for *S&T* and for the amateur community. It appears that over our past decade, globalization, the recession, and the rise of Internet commerce have shrunk ad revenue and the size of recent issues. I suspect that articles and columns also get shrunk, merged, or eliminated. Certainly, articles about film photography have vanished completely, never to return. Articles about ATM and astronomical calculations used to involve making your own electronic circuits and programming your home computer. I think these talents still exist in our community, but both electronics and software are getting so complex as to require engineering degrees. We are also enjoying an unprecedented era of affordable astronomical gear, which removes a lot of the motivation to make it ourselves.

Articles are becoming increasingly complex, which is good for the *cognescenti* but difficult for beginners starting out in the hobby. This portends that astronomy may mature into a science to which amateurs will no longer be able to contribute. Magazines such as *S&T* often have a backlog of articles to publish and cannot compete in a timely fashion with the dissemination of cutting-edge techniques or equipment reviews such as those on Cloudy Nights and similar Internet sites. But, like newspapers, there will always be a role for professionally trained journalists, fact checkers, and proofreaders that cannot be eclipsed by the lone blogger. ✶

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

On Another Wavelength

M13 – The Great Globular Cluster in Hercules

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

There are many great deep-sky objects to look at all through the summer months; a favourite one on any clear night is in the constellation Hercules. Look high overhead for this constellation, and check out the globular cluster Messier 13 (Figure 1). On a moonless night with clear skies, it is barely visible to the naked eye, but it is readily viewable in small telescopes. Look between the two stars Eta Herculis (η) and Zeta Herculis (ζ): it is about a third of the way along the line from Eta to Zeta (Figure 2). There is also a nearby galaxy, NGC 6207, that lies edge-on at 28 arcminutes directly northeast of M13. They are actually not close, since NGC 6207 is millions of light-years farther away.

M13 is one of the most prominent and best known globular clusters in the Northern Hemisphere. It is estimated to have several hundred thousand stars (perhaps more than a million) stuffed into an angular diameter of about 20 arcminutes. At a distance of 25,000 light-years, this corresponds to a diameter of 145 light-years. Toward the centre of this globular cluster, stars are packed at a density more than 500 times that of our solar neighborhood. There are no night skies in M13!

All globular clusters are a spherical collection of stars, bound by gravity, and are very different from their looser cousins, the open clusters. Globulars are much older, and contain many red-giant stars, often called Population II stars. Open clusters are often composed of hot, young OB-type stars that are

Figure 1 — M13 – The Great Globular Cluster in Hercules, courtesy of Ron Brecher, K-W Centre. Image acquired using QHY8 camera (Gain=0; Offset=125) with UV/IR filter and an 8-inch f/8 Ritchey-Chretien telescope on an MI-250 mount. Calibration was done in **ImagesPlus 3.0. Photoshop CS4** was used for final processing.

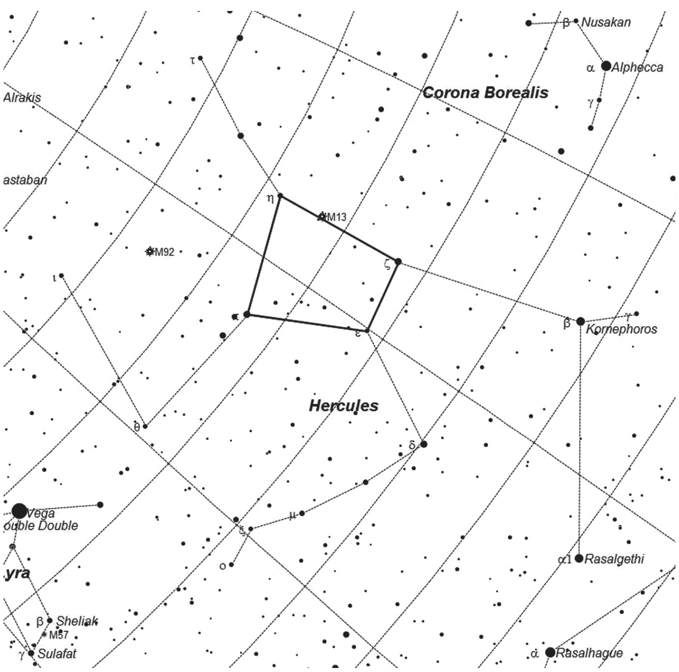

Figure 2 — A map of the constellation Hercules.

recently formed, whereas the stars in globular clusters are some of the first stars produced in our galaxy. None of the known globular clusters display active star formation.

Globular clusters are found around most large galaxies. Of the 150 or so within our Milky Way, the majority are found in the halo orbiting the galactic core. In 1918, this spherical distribution of globular clusters was used by Harlow Shapley to determine the overall size and shape of the galaxy. By assuming that the clusters were centred on the core of the galaxy, he was able to estimate the relative position of the Sun with respect to the galactic centre. Contrary to popular belief at the time, the Sun was found to be well away from the centre of our galaxy. Figures 3 gives you an idea of our position in the galaxy – in one of the spiral arms – and the location of M13. The show-piece globular of Hercules, like most other globular clusters, is in the halo surrounding the plane of our galaxy.

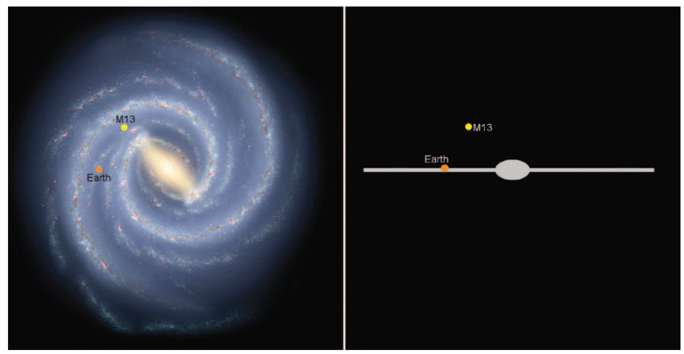

Figure 3 — Our Sun, M13, and their positions within the Milky Way. Image courtesy of Think Astronomy, www.thinkastronomy.com/M13/index.html

Interestingly, M13 was selected in 1974 by Frank Drake and Carl Sagan as a target for one of the first radio messages to hypothetical extra-terrestrial intelligent life-forms. The Arecibo radio telescope was used to transmit the message, but it won't be received by any Herculeans for another 25,000 years.

M13 was discovered by Edmond Halley (same name as the comet) in 1714, and later catalogued by Charles Messier in June of 1764. Now, you can find it at RA $16^h\,41^m\,41.44^s$ and Dec +36° 27′ 36.9″. Also check out an interesting video about this cluster at YouTube: www.youtube.com/watch?v=rHqKaL74GwY. ✶

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

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.

A Moment With…

Dr. Catherine Robin

by Phil Mozel, Toronto and Mississauga Centres (dunnfore@gmail.com)

For much of history, our view of the sky has been coloured by the idea that the terrestrial and celestial are separate and distinct. Never the twain would meet. The lights in the sky were made of some ethereal matter, were perchance gods. Even in modern times, there was a great divide, with Earth existing in splendid isolation from the rest of the Universe; existing in it, certainly, but not sharing any relevance. The situation is increasingly different now as typified by Dr. Catherine Robin's movement between these two realms.

Dr. Robin's career may be traced to Grade 12, when a chemistry project involving elements in stars fired her imagination. The further encouragement of a physics teacher eventually launched a path to a degree in astronomy and physics. However, the astronomy seemed, well, rather dry and not very conceptual. By her third year, though, the *Magellan* spacecraft was exploring Venus, and theories about plate tectonics on the planet (or its surprising lack of them) began circulating. She took some geophysics courses and did work in fluid mechanics (which was something tangible in that it could actually be seen at work in the field). Then, in 2010, a Ph.D. and off to Venus.

Our "sister" planet is so-called because it is almost exactly the same size as Earth. Beyond that, the differences are striking. The atmosphere is searingly hot, crushingly dense, and unbreathable. Volcanic mountains are scattered widely and so are strange, unearthly landforms such as *anemonae* (volcanoes with petal-like lava flows), *arachnoids* (volcanic domes surrounded by a spiderweb tracery of fractures and ridges), *ticks* (volcanoes whose sides have partially collapsed leaving ridges that resemble splayed insect legs), *tesserae* (rugged, tectonically deformed areas), and *coronae* (volcanic features surrounded by circular fractures). It seems clear that, at least at some point, Venus was geologically active. But, what precise process could have formed these features? It may all boil down to syrup.

As any pancake-eating Canadian knows, syrup is viscous. Because of its fluid nature, syrup's uses have extended beyond the breakfast table. Along with other researchers, Dr. Robin has used it in fluid mechanical experiments to model the motions of molten rock in the Venusian mantle in an effort to explain its surface features. That there has occurred some sort of upwelling from deep in the planet seems clear. But, it is difficult to reconcile the coexistence of features such as volcanic highlands and coronae. So, take a glass tank and fill it with syrup. Heat the bottom (the planetary "core") and cool the top (the planet's "crust"). One will see currents developing with hot syrup "plumes" (or, in planetary terms, solid rock slightly less dense than the surrounding mantle) rising from the bottom and cooler material sinking from the top. Small, rising "thermals," upon reaching the surface, represent the uplifted coronae of Venus. Now, move the lid of the container in a conveyor belt-like fashion (representing a massive overturn of the once stagnant surface). This time, in addition to the thermals, large plumes push their way to the surface that, on Venus, would presumably form the large highland regions. The type of circulation, and relative plume sizes seen in the tank depend on such factors as the temperature contrast between the interior and bottom and whether the surface is in motion. Something similar may have happened on Venus.

And, may be happening still. But, while Venus's insides may actually be hotter than Earth's, there is no hard evidence for current volcanism. Doing crater counts to date the surface (more craters equal greater age) is tricky on Venus because of possible gradual resurfacing by volcanism in the perhaps not-so-distant past. Nonetheless, the European Space Agency's *Venus Express* has returned tantalizing data indicating that volcanic activity may have occurred not so long ago. Dr. Robin's work may also find applicability on worlds such as Europa, Enceladus, and Miranda, all of which show evidence of having had, or still having, rising plumes of warm material.

Why, given its Earth-like dimensions, has Venus turned out so differently from our planet? Dr. Robin explains that this is a consequence of Venus' dryness. We don't know why it is dry or when it might have dried up, but the bottom line is that without water to act as "grease," there can be no plate tectonics as on Earth. Having more "ground truth" would be nice, and Dr. Robin decries the fact that too few landers have been sent to the surface. The few that have reached the surface landed on lowland basalt instead of on the highlands, where granitic rocks might have been found (Venusian continents?). Granite would be evidence of past water and plate tectonics. The tesserae may be evidence of a humid past since they are found largely in the highlands – *i.e.* the putative continents.

With the departure of her supervisor, and a lack of Venus data to work with anyway, Dr. Robin switched gears and planets. Returning to Earth, she decided to explore a major similarity between the two: like the modern Venus, the ancient Earth had very different tectonics. This was because Earth's early heat meant the crust and lithosphere were likely too soft and mushy for nascent plates to be pushed or pulled as they later would be.

Evidence of this time on Earth may lie in the four-billion-year-old *granite greenstone belts* of the *Archaean* period. Reminding Dr. Robin of Venus and its circular volcano-tectonic features, greenstone belts are large volcanic areas, suggestive of vertical crust overturn. Dr. Robin is interested in learning if these areas could be formed by vertical tectonics,

Dr. Catherine Robin

with the aid of abundant mantle plumes as might be found on Venus. Fortuitously, the largest Archaean real estate is right here in Canada.

Part-way through her study of Earth, Dr. Robin was drawn to problems facing the terrestrial environment and so joined the Collaborative Program at the Centre for Environment at the University of Toronto. The centre is an educational and research-based institution covering a wide range of environmental topics from climate change to chemical pollution in the Great Lakes to, well, the internal constitution of Venus. Dr. Robin's move was quite natural, as her project used computational modeling similar to what she had been using in her Archaean work. This, in turn, led her to climate science again, a natural fit, since climate is part of the world of geophysics.

Certain aspects of nuclear energy have also drawn Dr. Robin's attention. Canada has been generating nuclear power for half a century – and generating the concomitant waste that must be stored somewhere. Ontario Power Generation has been actively developing plans for a *Deep Geological Repository* (DGR) near the Bruce nuclear power station on Lake Huron. The idea is to bury the waste, up to 200,000 cubic metres of it, some 680 metres deep below thick layers of limestone and shale. Dr. Robin has studied fluid flow in a DGR in-situ experiment carried out by Atomic Energy of Canada Limited aimed at evaluating different seals to be used in the repository in the event of waste-container leakage.

Next on the radar, she hopes, is post-doctoral research on the melting of polar ice shelves.

Dr. Robin appreciates the difficulty researchers often have in finding the time and finances to conduct outreach, but knows it is important. She has taught students from a wide range of disciplines, such as environmental studies, economics, and religion, and was the coordinator of the national physics test for a recent International Physics Olympiad. Prompting these educational activities is her wish to "make people appreciate what we are destroying so they will fix it."

Leaving out Mercury for the moment, the inner Solar System can be seen to contain three similarly sized worlds that have gone down different evolutionary paths. Like the bowls of porridge from the Goldilocks story, one is too hot, one too cold, and one just right. With the work of scientists like Dr. Robin, we may clarify why our world, among all the rest, is indeed just right. ✶

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

Orbital Oddities

Saros Start

by Bruce McCurdy, Edmonton Centre
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This Canada Day marks a somewhat-rare astronomical event that few reading this will have experienced in their lifetimes. The occasion is the start of a new Saros family of solar eclipses.

Saros 156 kicks off on 2011 July 1 with an insignificant partial solar eclipse that will be visible over a tiny area of the Antarctic Ocean south of Africa. As Fred Espenak writes in the *Observer's Handbook 2011*, "Such a remote and isolated path means that it may very well turn out to be the solar eclipse nobody sees."

This is how Saros families always start, with a small partial eclipse visible from a very high latitude, north or south. But once one gets underway, its subsequent steps can be predicted like (very complex) clockwork. It's an extremely safe bet that in 6585⅓ days – 18 years plus ten or eleven, occasionally twelve days, depending on the fall of leap years – there will be another not-quite-so-small partial eclipse, visible from a similar latitude.

The "extra" ⅓ of a day results in successive eclipses falling on a different *longitude*, with the point of maximum eclipse crudely 120° along from one to the next. Through 70+ iterations over a dozen or more centuries, successive eclipses will gradually work their way from one polar region of the Earth to the other. Once a Saros starts, its progress is inexorable. Excellent forecasts of future eclipses can be drawn on backs of envelopes based just on the information in this paragraph.

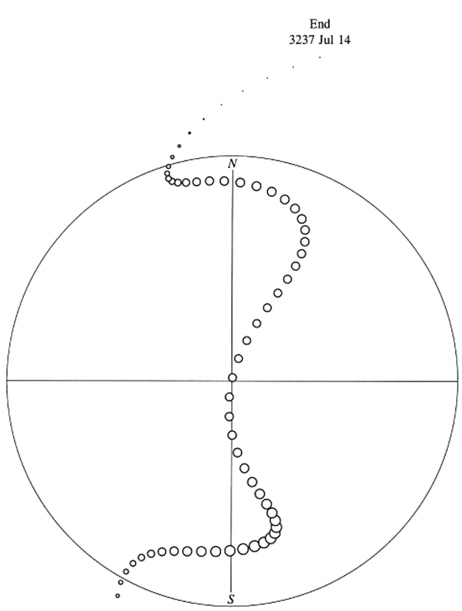

Figure 1

During the Saros interval there are 19 eclipse years and 38 eclipse seasons, each of which contains at least one solar and at least one lunar eclipse of some type, and very occasionally, two eclipses of the same type and one of the other. After one Saros, the initial conditions are very similar and the whole pattern largely repeats with very subtle changes.

What makes the Saros clock tick? In his outstanding *Observer's Handbook* article "Eclipse Cycles," Roy Bishop writes:

[T]he Saros…is a consequence of a remarkable commensurability between three average lunar periods:

Synodic month (S) (new to new) = 29.530 589 d, $223S$ = 6585.3213 d

Draconic month (N) (node to node) = 27.212 221 d, $242N$ = 6585.3575 d

Anomalistic month (P) (perigee to perigee) = 27.554 550 d, $239P$ = 6585.5375 d

Importantly, the number of years in a Saros – ~18.03 – is very nearly an integer value as well. Thus after one Saros interval, the three bodies, Sun, Earth, and Moon, all return to very nearly their same positions and relative distances. The period applies to many different lunar cycles, not just to do with eclipses. For example the recent "supermoon" of 2011 March 19 was the closest full Moon since 1993 March 8, exactly one Saros earlier, and the two shared similar attributes, such as libration.

None of the periods involved have true integer relationships, however, which is why, over time, Saros families evolve and die and new ones are born in their place. Such is the case with Saros 156, which will eventually replace Saros 118 within its eclipse season. For now, the two will share a single eclipse season, forming an eclipse duo. The first such duo will occur this year, when the 68th eclipse of receding Saros 118 occurs on June 1, one lunation before the first eclipse of brand-new Saros 156. (Note the difference of 38 in Saros numbers, matching

Figure 1 — A schematic of Saros 156 shows the points of maximum eclipse as seen from the Sun against the disc of Earth (more accurately the "fundamental plane" that bisects Earth perpendicular to the shadow cone). The series begins with 8 partial eclipses (outside the circle at bottom), then 52 central solar eclipses inside the disc, and closes with 9 more partials at top. The central solar eclipses in this family are all annular, represented as open circles. All even-numbered Saros occur at the descending node of the lunar orbit, and the successive members always work their way from south to north. Note the bunching of eclipses in the vertical dimension when gamma is around -0.8 or +0.9, and the stretching around gamma = 0 as well as at the beginning and end of the family. This Saros portrait was provided by Jean Meeus, based on an idea of Kurt Leingärtner of Kassel, Germany (Meeus 2009).

Saros 118	Mag.	Gamma	Saros 156	Mag.	Gamma
1993 May 21	0.7352	1.1372	1993 Jun 20	[no eclipse]	
2011 Jun 01	0.6010	1.2130	**2011 Jul 01**	**0.0971**	**-1.4917**
2029 Jun 12	0.4576	1.2943	2029 Jul 11	0.2303	-1.4191
2047 Jun 23	0.3129	1.3766	2047 Jul 22	0.3604	-1.3477
2065 Jul 03	0.1638	1.4619	2065 Aug 02	0.4903	-1.2759
2083 Jul 15	**0.0168**	**1.5465**	2083 Aug 13	0.6146	-1.2064
2101 Jul 26	[no eclipse]		2101 Aug 24	0.7337	-1.1392

the exact number of eclipse seasons in a Saros.) For the next five iterations, there will be a duo in this eclipse season (see chart above).

By the end of this changing of the guard, that eclipse season will have effectively shifted later in the calendar by one lunation. Such a shift change occurs in any given eclipse season every eleven or twelve centuries, a very interesting period that is manifest in a remarkable clustering of eclipse types every six centuries or so (the semi-period).

One by-product of an active duo of eclipses of one type is that they always bracket a central eclipse of the other type. In the current instance, there will be a deep central lunar eclipse on 2011 June 15 with a gamma value of just 0.0897. Alas, this one will be best seen from the other side of the world – with the eastern and especially southern hemispheres favoured.

When it comes to seasonal cycles of Saros families, the key is that mantissa of .03 of a year. From one member of a Saros to the next, the change is but gradual – just those 10 or 11 days – but over its 70+ iterations, a given Saros family will gradually work its way forward through the calendar a couple of times. This reflects some very interesting seasonal effects.

For starters, the length of a Saros period is itself not a fixed value. The cited value is an average, just as those lunar periods cited above. Each is unique one to the next, subject to the eccentricities of its main dance partners. Thus the shift of the lunar nodes from one eclipse to the next, commonly cited as 0.48° eastward, is also an average value, but the true shift fluctuates around that mean.

Meeus (2004) found that, in the period 1901-2200, the interval between two successive eclipses in any Saros ranges from 6585.2668 to 6585.3700 days, a difference of about 2½ hours. Pretty tight constraints, but the latter value is much closer to the mean value of 242N governing the position of the node. It follows that longer Saros periods result in a much smaller nodal shift. In such cases, the gamma value – the centrality of the eclipse's path – changes relatively little and the successive eclipses occur at similar terrestrial latitudes.

Earth's own elliptical orbit is the key player. When consecutive Saros family members are occurring near Earth's perihelion, the planet is near its maximum velocity and moves a little further during those "extra" ten days. The Moon too must move a little further to realign, which takes a little more time, thus those longer intervals between Saros tend to happen in the winter months around the time of Earth's perihelion. The variation in the changes of the gamma value is graphically represented in Figure 2.

The beginning of Saros 156 is the end of a deep minimum of just 39 active Saros that has been the case since Saros 116 ended back in 1971 July 22. Since then there has been just one active eclipse duo – Saros 117 and 155, in 1982 and 2000 – with single solar eclipses taking place in every other eclipse season in the cycle. It is instructive to note those duos also

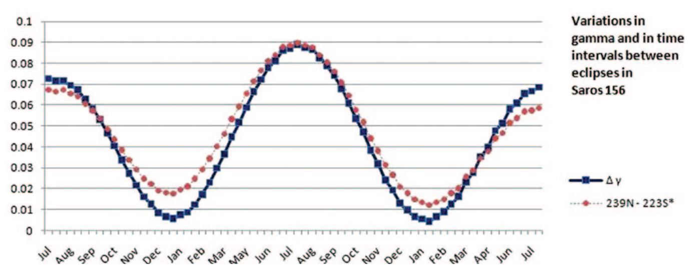

Figure 2 — The variation in the gamma value (Δ γ – square data points [blue]) from one member to the next of Saros 156 ranges by a factor of 20, from as large as .0890 in July 2642 to as small as .0042 in January 2967. The rise and fall of this value is tied to the apsides of Earth's orbit – smallest at perihelion, largest at aphelion. This cycle holds for the 1226-year life cycle of this Saros family. The second curve ([red] dotted line with circles) was derived by calculating the difference between 242 mean draconic months and the known but slightly variable duration of the 223 synodic months in a given Saros interval. The very good but not perfect fit seems to indicate that subtle differences in the elapsed time of that interval accounts for most but not quite all of the variation in gamma. Presumably, the differential between the two curves lies on the other side of the equation 223 S ≈ 242 N, in some subtle variation between actual and mean draconic months. In the time-honoured words of my mentor and inspiration, RASC Honorary Member Jean Meeus, I will leave that as an exercise to the reader.

took place in June and July, which is the hot spot on the calendar for emerging and receding Saros just now.

Saros 156 is distinctive in that it is the first Saros family in more than 20,000 years to have fewer than 70 members. Families catalogued all the way back to Saros -400 contain between 70 and 91 members. Gradually, though, the number of eclipses per family is diminishing as the orbits evolve and the Saros period becomes less perfect. With 69 members, Saros 156 is not quite long enough to survive two forward passes through the anomalistic calendar (the one governed by Earth's advancing perihelion), and thus represents the very first outlier in a new class of shorter Saros families (Meeus 2009).

On average, a new Saros will start every 30 years or so, but this distribution is irregular, with clumps and voids in that familiar 6-century tide. In fact, Saros 155 was the last one to start way back in 1928 (June 17); the next, Saros 157, not until 2058 (June 21). I'm planning to be dead by then, so for me this is a once-in-a-lifetime event.

It might seem natural that Saros families should be born and die around Earth's aphelion, when the delta gamma value is at its highest and the co-alignment of the three bodies is changing by the largest possible increment. Indeed, every single one of the examples cited above show Saros beginning or ending dates in June and July, which provides strong support to that supposition. However, to some extent that is a mirage, just the current arc of a longer-term cycle of Saros births and deaths that is fascinating in its own right. We'll explore that next time.

In the meantime, I hope somewhere there's an intrepid astronomer who will attempt to observe this remote but nonetheless significant event that is the earliest outlier of a whole new family of eclipses. Nothing like a good observation to support all that theory! ✶

Bruce McCurdy returns to JRASC *and Orbital Oddities after his brain took an unplanned sabbatical for the past 18 months. As you can probably tell if you waded through the foregoing, he's still working out some kinks.*

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Bishop, R. (2010). Eclipse Patterns. In P. Kelly (Ed.), *Observer's Handbook 2011*, 126-129. Toronto: RASC

Espenak, F. (2010). Eclipses in 2011. In P. Kelly (Ed.), *Observer's Handbook 2011*, 130-150. Toronto: RASC

Meeus, J. (2004). *Mathematical Astronomy Morsels III*, 103. Richmond, VA: Willmann-Bell Inc.

Meeus, J. (2009). *Mathematical Astronomy Morsels V*, 91. Richmond, VA: Willmann-Bell Inc.

Figure 3 — This Bargello-style quilt uses blocks of varying heights to give the effect of stretching in places and compressing in others. The pattern (known as "The Long and Winding Road") reminds the author of the accordioning intervals between consecutive members of the same Saros family. A random item (call it a "data point") dropped on the quilt would be much more likely to land on a tall block than a short one, similarly eclipse thresholds are more likely to be crossed when the nodal shift is greatest. Quilt art by Anna McCurdy.

Imager's Corner

Stretching Images

by Blair MacDonald, Halifax Centre
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This column begins a group of Imager's Corner articles that will focus on a few of the techniques that are the most useful in processing astrophotos. Over the next several editions of the *Journal*, I will give a guide to image stretching, background correction, SIM (Screen Inverted Mask) processing, and any other technique that I happen to find useful. All the techniques discussed will be useable with nothing more than a standard image processor that supports layers and masks. No special astronomy imaging software will be required.

This edition will deal with image stretching using a curves adjustment function. While there are many built-in image processing functions that stretch or brighten an image, none of them provide the control and flexibility of the curves adjustment. The curves adjustment allows you to specify a transfer function that will be applied to your image data. A transfer function is just the relationship between the input (usually the x-axis) and the output (usually the y-axis). In the real world (as opposed to the computer world), the input is the photo in your camera and the output is the image you want to show your friends and colleagues.

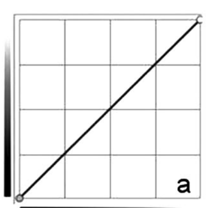

Figure 1a

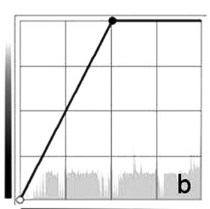

Figure 1b

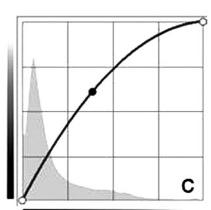

Figure 1c

Consider the following curves adjustment in Figure 1a:

Here there is no change in the image, since for every point on the line, the output value equals the input value – the "curve" is a straight line from lower left to upper right. For reference, the bottom left has the coordinates 0, 0 while the top right is 255, 255; the "0" represents black (minimum brightness) and the "255" is white (maximum brightness). The straight line represents the transfer function and the output is just the original image (Figure 2, upper left).

Now let us look at a curve that brightens an image, in Figure 1b.

Here the input and output values are quite different. The scale is the same as the previous example, so you can quickly see that the output value for any input above zero is significantly increased. In fact, the image saturates (has an output of 255) for any input value greater than 128 and brightens all values between 0 and 128. This type of stretch is the equivalent of using the brightness and contrast adjustment. The effect of applying this adjustment to an image can be seen in the views of the Lagoon Nebula (Figure 2, upper right).

The problem with this simple brightening is that the brighter areas of the nebula have saturated and lost all detail. A simple modification of the stretch that brightens the fainter parts while holding back in the brighter areas will help substantially.

Figure 2 — The Lagoon Nebula under various stretching processes, as described in the text.

This type of stretch can be seen in Figure 1c.

This transfer function approximates a logarithmic stretch that will compress the output range of the brighter data but limit saturation.

The result is a more pleasing image of the nebula. The faint outer areas of the nebula are now visible and the central core is less washed out than in the example produced with a simple, linear stretch (Figure 2, lower left).

You can apply multiple curves adjustments to your images to control the results precisely. You can even apply them to each of the RGB colour channels individually to change the colour balance of the image. When used as an adjustment layer, curves can be combined with masks to provide the ultimate in control. The adjustment can be applied only to sections of the image leaving the rest untouched. Familiarity with the curves adjustment function in your image-processing software will greatly improve your ability to extract faint structures from your astronomical photographs.

The ultimate image-stretching method is a pseudo HDR (high dynamic range) technique called a layered, masked stretch or LMS processing. This method can produce stunning images by brightening the dimmest areas while preserving all the detail available in the bright ones as shown in Figure 2, lower right, but discussion of that technique must await a future column.

Remember, this column will be based on your questions so keep them coming. You can send them to the Halifax RASC email discussion 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. ✶

Astronomical Art & Artifact

Corrigenda et errata

by R.A. Rosenfeld, RASC Archivist
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To error is not alien to the human condition, as I am sure a well-disposed and just-superior-enough extraterrestrial would delight in reminding us, should SETI ever succeed beyond error in proving the existence of such an annoyingly smug entity. So it goes with this column – in what is destined to be the briefest Astronomical Art & Artifact to date, and in a true spirit of archivally Lenten contrition (I write this in early April), I list errors of commission and omission, which have somehow intruded into recent columns, and one recent paper to which I contributed. The next Astronomical Art & Artifact is on something altogether less dry and much more visually appealing, but to know what it may be you will have to wait till August. It is not giving away too much to say that it will arrive in time for the Perseids. To the chagrin of the Editor-in-Chief, it will also make up for the brevity of this contribution, with the usual riotous surfeit of footnotes and other apparatus.[1] It may even prove to be relatively error free.

Corrigenda et errata

1. Paris 1675: The Earliest Known Drawing of the Mare Orientale complex. JRASC 104, 5, 178-190

   In the RÉSUMÉ on p. 178, the coma following "lunaire" should be omitted, "l'extrème" should read "l'extrême," and "rapportées" should read "rapporté."

   In the section "The MOC, the Lunar Drawings, and the Large Moon Map of Cassini I," column A, 8th line from the bottom, "Dominque" should be "Dominique."

   In the section header on p. 183, "Oriental" should be "Orientale."

   In the final paragraph of the "Conclusion" on p. 185, the definite article preceding the quote from Chuck Wood should be removed.

   In the "Manuscripts" section of the "References," the start date for Cassini I's *Journal des observations* should be 1671 September 14.

   Under "Books and Articles," the page reference for Abbott (2009) should be 33; the first word of the title of Goldfarb (1989) should be italicized; in de la Hire (1730), the volume number (9) should be italicized; in Lalande (1769), "anées" should be "années" and the volume number should not be in bold; in Launay (2003a and 2003b), "*L'astronomie*" should be "*l'Astronomie*;" in Ryan (1966), "In" should be omitted from the journal title; Sheehan & Rosenfeld (2010) should be "Rosenfeld, R.A. & Sheehan, W.P. (2011); How an Artist Brought the Heavens to Earth. Astronomy 39, 1, 52-57,"; in Whitaker (1989), "Cambridge" before the page numbers should be omitted; in Wilkins (1938) the volume number should be italicized; and in Wood (2003), the final "Cambridge" should be omitted.

2. Audouin Dollfus (1924-2010). JRASC 104, 6, 251-252. On p. 251, column B, second line from top, "atmospheric" should read "atmospheres," and on p. 252 mid-way down the page, "Lyot coronograph" should be "Lyot coronagraph."

3. RASC Catalogue of Meteorites – Second Supplement. *JRASC 105*, 2, 80-82.

   In the introduction on p. 80, the Tagish Lake meteorite is referred to as a "find" and the Whitecourt meteorite as a "fall," whereas in the actual catalogue entries the terminology is correct, Tagish Lake is the "fall" (19.2) and Whitecourt is the "find" (20.2).

That is enough humble pie for now. I would, of course, be delighted to receive corrections to anything I write.... ✶

(Endnotes)

1. The Editor-in-Chief will doubtless have his revenge on the Archivist at this year's GA. That is reason #11 to attend the event this year; http://winnipeg.rasc.ca/ga-2011-home.

Second Light

Ringing the Red-Giant Bell

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

About five billion years in the future, our Sun will become a red giant like Arcturus, as the hydrogen fuel in its core is depleted. Hydrogen will still be burning in a shell around the core though, and sometime later, the helium ash in the core will start burning to carbon. All stars with masses >0.4 $M_\odot$ will burn helium eventually. How can we tell the difference between a red giant burning helium in the core, and one that is burning only hydrogen in a shell?

Tim Bedding of the University of Sydney, and a large team of collaborators, have used data from the *Kepler* satellite to clearly distinguish between the two types (see the March 31 issue of *Nature*). *Kepler* is a satellite designed to look for planets that transit the faces of their parent stars, measuring accurately the tiny drop in the light visible from the star. The mission is staring at a patch of sky in the constellations of Cygnus and Lyra, continually measuring the brightnesses of ~150,000 stars. The team recently announced the discovery of many candidate planets (see http://kepler.nasa.gov).

But, the data being collected have many other uses as well, including studying the oscillations of stars.

Stars ring, something like bells, and the waves that pass through the star can tell us about the interior structure, because the characteristic frequencies depend upon that structure. Movies of the surface of the Sun show it to be "boiling," as energy is carried up from the interior to the surface. The surfaces of red-giant stars do the same thing, but on longer timescales. The turbulence from this convection can set up standing waves that cause a star to oscillate in brightness, with the period of oscillation depending upon the size and mass of the star.

More technically, the standing waves outside the core are known as p-modes (because the restoring force in the wave is the pressure in the gas). G-modes (where gravity is the restoring force) that are trapped inside the core can interact with the p-waves outside, producing "mixed" oscillation modes that carry information about the core. It is these mixed modes that Bedding and his colleagues have studied in hundreds of red giants.

The period spacing between the modes (ΔP_{obs}) is the critical observed quantity. When plotted against the p-mode frequency spacing (ΔP), the stars clearly break up into two separate groups (Figure 1), one clustered around ΔP_{obs}~60 seconds (blue circles), with the second having ΔP_{obs} in the range from about 100-300 seconds (red diamonds and orange squares). The blue circles are stars burning hydrogen in their shells, while the red and orange points are stars that are also burning helium in their cores.

The subdivision between the red and orange points tells us about the evolutionary path that the stars have taken to get to that point. The red clump is composed of stars much like the Sun (up to almost twice its mass), where the core was at one point "degenerate," and underwent a "helium flash," in which the ignition of helium burning happened very rapidly. The degeneracy is like that seen in a white dwarf, where matter is very compact. In the more massive stars – the orange points – helium burning was triggered more gradually, without the helium flash.

There is therefore an amazing amount of information that can be extracted from observations of the oscillations of stars. I firmly believe that the *Kepler* mission will usher in a renaissance in stellar astronomy.

Observations like this have been attempted from the ground, but to no avail. The precision needed is only available in space. The next time you turn your telescope to Arcturus, give a thought to its oscillations and what we can learn from them. ✶

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.*

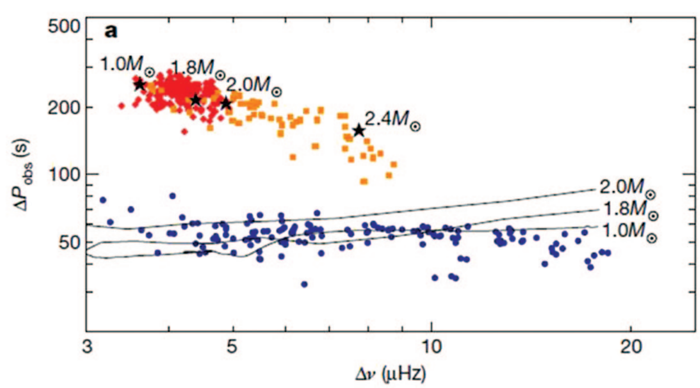

Figure 1 — The blue circles are giants burning hydrogen in their shells, while the red diamonds and orange squares represent giants burning helium in their cores. The black lines and stars show model predictions for various masses.

Through My Eyepiece

Raising Arizona

by Geoff Gaherty, Toronto Centre
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As some of you may know, I had to go on kidney dialysis a few years ago. This requires that I spend quite a bit of my time hooked up to a machine that does the work my kidneys are capable of no longer. It also prevents me from travelling far from my dialysis centre at Orillia Soldiers' Memorial Hospital. Recently I rebelled against cabin fever and escaped from the cold of Coldwater for a couple of weeks as a "transient" at DaVita Dialysis, West Tucson. I received much the same treatment as at home, and the rest of the time Louise and I enjoyed 20 °C weather and sunshine almost every day.

Arizona is, of course, a Mecca for astronomers, and I took advantage of my time there to renew my acquaintance with two of my oldest and best friends, David Levy and Klaus Brasch.

David is, of course, well known to many of you. When I first met him, he was a tall string-bean of a kid, keenly interested in astronomy. We reconnected at the Toronto GA in 1999 and have kept in contact ever since. Last time Louise and I were in Arizona, we visited David and Wendee at their home/office/observatory in Vail, just southeast of Tucson. This time, we met for dinner at a Chinese restaurant in Tucson owned by another amateur astronomer.

Klaus Brasch and I have been best friends for over 50 years. In the late 1950s and early 1960s, we spent many hours observing central-meridian transits on Jupiter, comparing notes by phone the next morning. Klaus was always a better sketch artist and astrophotographer than I was. I wrote a bit about Klaus in my column in the April 2010 *JRASC*. Originally Louise and I planned to drive up to Flagstaff, where Klaus and Maggie have retired, but the weather there resembled that in Coldwater too closely, so Klaus instead came down to Phoenix to have lunch with us on our way back to Canada.

Klaus and I were part of an active group of "young Turks" in the Montréal Centre back in those days. When I got back from Arizona, Klaus emailed me asking whether I had ever reconnected with another of our group, Ken Chalk. I did a bit of Internet research and discovered to my dismay that Ken had died from cancer in 2005.

Ken Chalk

Ken, pictured here at the 1963 solar eclipse near Plessisville, Québec, was the youngest of our group. For a number of years, he was Lunar Meteor Recorder for the Association of Lunar and Planetary Observers. He later lectured at the Montréal Planetarium and Concordia University. He was always fascinated by things mechanical, and eventually went into the business of repairing and restoring old clocks, phonographs, and other instruments.

The fourth member of our little group was George Wedge, pictured here on a sunny day in July 1960 using a Herschel Wedge (no relation) to observe the Sun with the Montréal Centre's magnificent 110-mm Zeiss achromatic refractor.

George Wedge

George had emigrated from the U.K. shortly before joining the Montréal Centre. He was particularly interested in the Moon, and was instrumental with Isabel Williamson in establishing the Montréal Centre's lunar-training program. George and I would meet at the observatory every Saturday morning to observe the Sun and listen to *Jazz at its Best* on CBC Radio. He eventually returned to England, became engaged, and seemed to be settling in to a good life. Then, in the spring of 1967, he went on a holiday in Spain, and his plane crashed with no survivors.

Aside from our mutual love of astronomy, George, Ken, Klaus, and I shared a love of classical music and British humour, notably the *Goon Show*. Klaus and I both celebrated our 70th birthdays recently, but it's sad to realize that only half of our "gang of four" survives today. ✶

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.*

Gizmos

Eyeball Newtonian

by Don Van Akker, Victoria Centre
(dvanakker@gmail.com)

Imaging is the flavour of the month in the astronomy world, and it often seems with all the pretty pictures and the hoopla that imagers give and get, that observers get left behind. This certainly appears to be the case with hardware. Every second ad in the astronomy magazines is aimed at imagers, pushing incredibly expensive gadgets at a group of people that seems to have incredibly deep pockets.

Some of them do.

There is a second, probably much larger group of imagers who don't have pockets quite so deep. Aimed squarely at them is something called the "imaging Newtonian." This is a short, fast reflector scope with a good beefy two-speed focuser and an oversize secondary that puts the focus far enough outside the tube to allow you to hang a camera on it. Apparently, identical models are sold under different brand names and they have a very good price.

I'm almost embarrassed to admit that I won one at the Winter Star Party.

The reason this is a little embarrassing is that I already have an imaging scope, one for which I had to pool the contents of several pockets, and this scope is not going to replace it.

The irony here is that Elizabeth could really have used a new Dob. The one she travels with has a nice mirror but it has a cardboard tube that, because it is old and because it has been the test bed for so many of my little projects, is getting decidedly ratty. The end of the tube is full of old bolt holes and doesn't hold the spider well enough to stay collimated all night, and the focuser has been dropped once too often.

I wondered if this "imaging Newtonian" could be brought down to earth to do service as an "eyeball Newtonian?"

The first thing was going to be to get it mounted. Elizabeth's old Dob was built with a pair of 4-inch sewer-pipe caps for altitude bearings. These rode on nylon furniture glides mounted in cut-outs in the sides of the rocker box. The new scope had two rings, both with flats at 3 o'clock and 9 o'clock. In the centre of each flat was a threaded hole, so the sewer caps were a natural. Once I found the right size of metric bolts and some fender washers, it was a piece of cake, and the 10-inch imaging Newt became a perfect fit on the rocker box of the old 10-inch Dob.

A new problem though. The Dob was f/6. That made the focal length and also the eyepiece height about 60 inches – a very good height for Elizabeth. The Newt was f/4, the focal length only 40 inches, and much of that projected out of the side of the tube; the eyepiece height was about 3 feet, a very good height for Elizabeth at age 5.

We were not at home but staying at Rancho Hidalgo in New Mexico, so I had to improvise – a few scraps of 2×4 and oriented strand board (OSB) built a riser that brought it up to where it was wanted.

So far, so good.

The next step was an eyepiece, and here the thing almost fell flat. The eyepiece wouldn't come to focus. With the focuser fully out, it wanted about another inch. The solution was an eyepiece extension (like a Barlow with no glass), and so, finally, with an eyepiece that focussed, we pointed it at the sky. First light! (I have never understood that term. Do they build them in the dark?) Actually, it wasn't bad. With a Plossl, the centre of the field showed decent stars and the edge of the field was only a little fuzzy. With a wide-angle Nagler, it was gruesome. Nobody claims these things don't make coma, and before us was the reason why. Sharp in the centre, the stars at the edge of the field were shaped like little tiny searchlights.

Next step, the Paracorr. If you've never tried one of these, they are magic on short-focus Newtonians. In fact, they are what make today's ultra-short-focus Newtonians possible. They are also two-thirds the price of this particular scope.

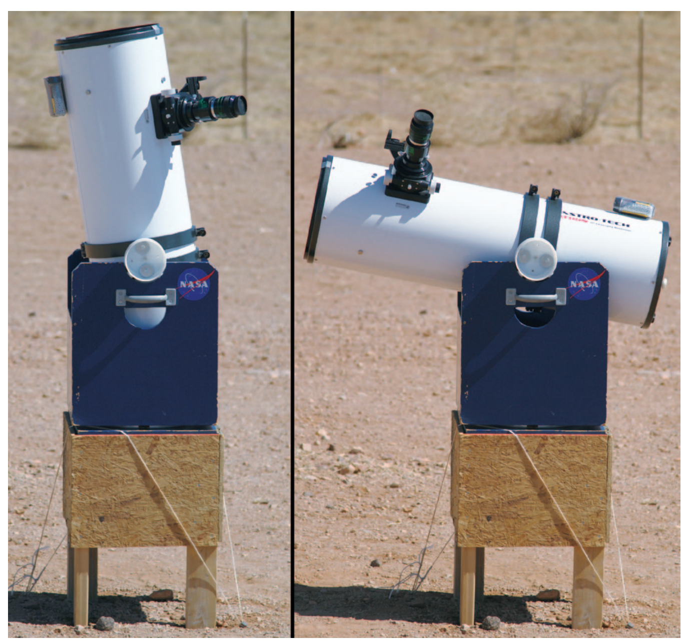


Figure 1 — Look at how the eyepiece height stays almost the same no matter how you tilt the scope. If it is at eyelevel at the zenith, then you will bend only your head, not your back. The rocker box is the one we had, but building one for the purpose would not be a big job.

The views are very good. Not great like you would get from a mirror with a longer focal length, but very good. You can work with this scope. The Messier list and the NGCs are almost in your pocket.

But the problems weren't over.

There was no way to balance it. I slid it up and down in the rings, but when it was balanced in one position, it flopped in another. The culprit was the big focuser and the Paracorr and the heavy eyepiece that together formed a massive turret that projected a full 12 inches from the side of the tube. The solution was a plastic can full of air-gun pellets. Two rare-earth magnets duct-taped to the can made it a counterweight that could be moved instantly to anywhere on the steel tube. It took only moments to get a feel for where it should be.

So how does it work now? It's actually a pleasure to use. That big turret is horizontal at the zenith but as the tube swings down the angle of the turret turns up. That means the difference in the eyepiece height from zenith to horizon is only a few inches. This telescope is always at a comfortable height. It is a real back saver!

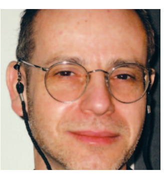
The oversize secondary is said to reduce contrast, and it may under poor conditions, but under the dark skies of Rancho Hidalgo, we didn't see it.

Will we ever use this scope for imaging? Yes, we will, but not for a while. Nothing I have done to it will prevent that from happening but meanwhile, if you have been considering one of these but decided against it because you don't want a scope that can only do one thing, think again. ✶

Don and Elizabeth Van Akker are having the time of their lives on the road. Don still answers email though: dvanakker@gmail.com

Obituary

Ralph B. Baldwin (1912–2010)



by R.A. Rosenfeld
(randall.rosenfeld@utoronto.ca)

"...there are philosophers...[who] dare to climb to the moon, or strive to investigate the nature and motions of the heavenly bodies. Of the human race, the smallest fraction consists of philosophers; of philosophers, barely one or two exert themselves to enlarge the boundaries of astronomy" – Johannes Kepler (1967, 71)

Kepler's words seem an apt description of professional selenography in the 1940s when RASC Honorary Member Ralph Baldwin undertook his fundamental work on lunar impactcratering. His research eventually overthrew the presiding theory of the mechanisms that shaped telluric body surfaces in our Solar System, clearly establishing the dominance of impact cratering over volcanism. Some influential RASC members played a significant rôle in furthering the professional acceptance of his work in the crucial period of the 1950s and '60s. Baldwin's labours in turn provided the theoretical impetus for the highly successful Canadian Impact Crater Programme. Few scientists in any period can be said to have ushered in a successful paradigm shift in a field beyond that of their primary training. Among astronomers of the last 100 years, the claim could be made for both Ralph Baldwin, the formally trained astrophysicist who revolutionized selenography, and A.E. Douglass, the professional planetary observer who founded dendrochronology.

Ralph Baldwin's early attraction to astronomy was nurtured by his family. His grandmother actively kindled that interest through familial instruction under the stars, access to books, and, about the time he progressed from primary to secondary school, the gift of a quality instrument. Looking back on observing "the planets, the Moon, double stars, and nebulae" with his 80-mm O.G. Bardou refractor, he could say "my parents knew when I went to bed, but never knew whether I was still in bed" (Baldwin 2000, A13). Serious amateur cultivation of the art of observation led him to the serious pursuit of astrophysics at university, culminating in a Ph.D. from the University of Michigan with a thesis on the spectrum of Nova Cygni III (1920) (1937), under the supervision of the redoubtable Heber D. Curtis, Shapley's skilled opponent in the legendary Great Debate of 1920 on the scale of the Universe.

The 1930s were not an auspicious time to seek employment. A disheartening paradox for astrophysicists is the unfair contrast between the inflationary tendency in the number or nature of topics requiring investigation, and the seeming stasis or contraction in the quantity of decently remunerative positions for astrophysicists. After an interesting and inadequately recompensed stint of several months labour on the minima of TT Herculis at the Flower Observatory of the University of Pennsylvania, he secured a better but still under-paid position as instructor in the astronomy department of Northwestern University, through the good offices of his former doctoral supervisor.

At Northwestern's Dearborn Observatory, he worked with colleagues on Oliver Lee's project to compile a new catalogue of faint red stars (types K, M, N, R, and S) of the Northern Hemisphere, a major undertaking (Lee, Baldwin & Hamlin 1943). This was still remote from the forces that shaped the face of the Moon.

Ralph Baldwin's serious interest in lunar geological processes arose through happenstance, and is a classic example of chance favouring the prepared mind: "throughout my entire life, fate has always seemed to step in when needed" (Baldwin 2000, A13). His marriage in 1939 had an impact on his not-quite-adequate academic salary. Help appeared in the form of Maude Bennot, the first professional woman planetarium director in North America (and possibly the world) (Marché 2005, 55-57), who hired him as a presenter at the Adler, to be paid by the lecture – a much-needed supplement to his Northwestern salary. To arrive at the Adler on time meant arriving early, which left him

> *…with extra time and I spent it wandering the halls of Adler where numerous beautiful, illuminated astronomical transparencies were mounted.… For quite some time, I would walk past several photographs of the Moon. Sometimes I stopped and looked closely, because I had often seen similar sights through my 3" telescope or even the 18" at Dearborn or the 18½" at Flower.… Suddenly I realized that there were markings on these photographs that I could not understand. They were valleys and ridges. The valleys were usually depressed but some were filled with the dark material. Their long sides were raised.* (Baldwin 2000, A14)


Ralph Baldwin. Photo by J. Wood.

Research in the secondary literature unearthed few accounts to explain how these features formed, and certainly none that struck Baldwin as plausible. He looked for a pattern in the visual evidence, and found it in the radial features emanating from Mare Imbrium, features that were reminiscent of nothing so much as ejecta from powerful explosions. Through comparison and contrast with terrestrial structures, he became convinced that volcanism was not the mechanism that made the visible lunar craters. Only other Solar System bodies acting as impactors could deliver the necessary force.

His superior at Northwestern displayed a complete lack of interest in selenography, a not-untypical professional attitude of the day (see the comments in Wilhelms 1993, 22-23 on the low standing of Solar System studies in the US during the 1940s-1950s). It was made clear to Baldwin that research on lunar cratering mechanisms would not become an official part of the Dearborn Observatory's research programme. He was free, however, to pursue the Moon on his own time. An even more dramatic demonstration of professional disinterest was provided for Baldwin at one of the famous Yerkes Colloquia in 1941. The young researcher had been invited by Otto Struve, Yerkes' dynamic and formidable director, to speak about his findings.

Thoroughly prepared, armed with good visual aids, and certain that the weight of his arguments could convince a sufficiently intelligent and interested audience, he addressed the likes of Jesse Greenstein, Philip Keenan, W.W. Morgan, Struve, George Van Biesbrock, and their junior colleagues. His audience was certainly not lacking in intelligence, but Selene's visage was a great bore to those stuck in the lethargy of lunar volcanism. For all the impact his words had, he might as well have been speaking on the Moon, literally. When it came time to publish, only *Popular Astronomy* would accept his heretical lunar papers. Baldwin saw the positive side of the reigning orthodoxy; he and the geologist Robert S. Dietz had the field virtually to themselves for nigh on two decades.

His economic position was improved by WWII, when he was recruited for classified war work as a senior physicist at what was to become the Applied Physics Laboratory (APL) of Johns Hopkins University. He also functioned as a liaison between his fellow scientists and the military brass who were to use the physicists' inventions in the field. For his contributions to the development of the radio proximity fuse, he was awarded the Army Chief of Ordnance Award, the U.S. Naval Bureau Ordnance Award, and the Presidential Certificate of Merit (Baldwin 1980; 1999). He worked for the APL from 1942 to 1946, during which, in his words, his astronomical work "was put on hold for the duration," yet he managed to have librarians at the United States Naval Observatory and the U.S. Geological Survey procure many valuable references for his selenography.

Due to family reasons, he then moved back to Grand Rapids and joined the family machinery company, with the assurance he could pursue astronomical research on his own time. In his corporate career, he became an influential executive in the field of industrial machinery, which was acknowledged by the naming of a major award in his honour, The Ralph B. Baldwin Award of the Wood Machinery Manufacturers of America. It was while in leadership positions with the Oliver Machinery Company that Ralph Baldwin wrote his important research monographs on lunar geology, *The Face of the Moon* (1949) and *The Measure of the Moon* (1963), as well as the highly respected textbook *A Fundamental Survey of the Moon* (1965), the last appearing less than a year before the start of the Apollo Program test flights.

The *Face of the Moon* is a work of theoretical inventiveness, thorough analysis, and sure conclusions. It remains a classic. Unfortunately the reception that the book received was icily similar to that accorded Baldwin's talk at Yerkes eight years before. The Nobel Prize-winning chemist Harold Urey, then at the University of Chicago, was one of the few established American scientists to be convinced outright by Baldwin's book, which ignited his selenographical interests, and paid dividends for the Apollo Programme. There are legends about how he encountered *The Face of the Moon*:

1) he noticed a copy at a scientific meeting; or,

2) taking it from a coffee table, he read it at a single sitting while a party happened around him; and finally,

3) he read it to pass the time on a trip by train to Canada (Wilhelms 1993, 19 for legends 1 and 3, and *LPOD Faces of the Moon* for 2).

Another American who was swayed by Baldwin's account was a 21-year-old researcher at the U.S. Geological Survey named Gene Shoemaker (Wilhelms 1993, 20-21). Urey and Shoemaker weren't alone in their admiration, however. It is at this point that Canadian astronomers and the RASC enter the story.

Those who read the press release about the establishment of the Ralph B. Baldwin Professorship in Astronomy at the University of Michigan (the gift was Baldwin's) in 2008, or who read his obituary in *The Grand Rapids Press* would have been struck by the warmth of the references to the RASC. The former reported: "Today, Ralph Baldwin is highly regarded in the scientific community because, as the Royal Astronomical Society of Canada has noted, 'he got so much so right, so early' (UMich media release quoting RASC Honorary Members), while the latter accords a prominent place to his RASC honorary membership among his awards" (obituary, *Grand Rapids Press*).

The key to the development of that relationship of mutual respect is best told in Ralph Baldwin's own words:

> *In the late 1940s and early 1950s, very few scientists accepted the meteoritic impact theory. Peter Millman of Canada read the book and then contacted C.S. Beals, another Canadian. Beals knew that much of Canada is an ancient craton, called the Canadian Shield. If the Earth had been bombarded from space, the shield should still show remnants of ancient and modern craters. It does. Beals and his group discovered numerous pits, some of which were much larger than the well-known crater in Arizona* (Baldwin 2000, A16)

Peter M. Millman, a specialist in meteoritics, was a major figure in Canadian science and the RASC (President 1960-1962), and his colleague Carlyle S. Beals was a Canadian astrophysicist of world importance, and the last Dominion Astronomer (RASC President 1952). Beals spearheaded the highly successful Canadian Impact Crater Programme to which Baldwin refers. Baldwin acted as a consultant to the programme, and remarked on one occasion that:

> *"Beals invited me up there [to Ottawa] early in their program. They had a large picture on the wall and he took me over to it without saying a word. The feature was so eroded that only somebody who believed in the meteoritic impact theory could see a crater in it. I saw one; it was Manicouagan in Quebec"* (Marvin 2003, A170)

To measure the success of that programme one has merely to search the Canadian entries in the Earth Impact Database now at the University of New Brunswick's Planetary and Space Science Centre (Earth Impact Database).

In 1981, the Society conferred an honorary membership on Ralph B. Baldwin for his contributions to what is now known as astrogeology (Halliday 1981). It was one of many well-deserved recognitions his important work received. The honorary membership formalized a most productive scientific relationship, and was one of the honours of which Ralph Baldwin was most proud. He considered those who proposed him to be friends. In truth, it can be said that his acceptance of honorary membership in the RASC conferred distinction on us. ✶

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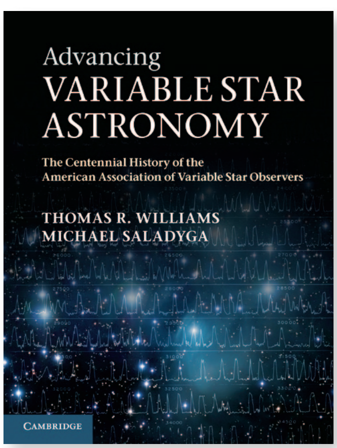
Reviews

Critiques

Advancing Variable Star Astronomy: The Centennial History of the American Association of Variable Star Observers, by Thomas R. Williams and Michael Saladyga, pages 350+xvi, 19 cm × 25 cm, Cambridge University Press, 2011. Price $99 US, hardback (ISBN-13: 978-0-521-51912-0).



Advancing Variable Star Astronomy is an insightful history of the development of variable-star observing in America over the past century that is wonderfully imbued with the feelings and motivations of the various individuals involved in the conception and evolution of the American Association of Variable Star Observers (AAVSO), dating from prior to its creation in 1911 to the present. Authors Tom Williams and Michael Saladyga, with their lengthy personal involvement in the AAVSO, have drawn upon available documents and correspondence to infuse the contents with their impressions of the feelings and motivations of the various individuals involved, thereby breathing life into what might otherwise have become a mere recital of names, numbers, and dates from the past.

But *Advancing Variable Star Astronomy* is not simply a historical rendering of the AAVSO's first century; it also provides a fascinating glimpse into the development of the various branches of observational astronomy, particularly as they apply to the study of variable stars, and the interpersonal relationships that arose between individuals of often disparate temperament. Many of those involved with the AAVSO over the years read like a Who's Who of observational astronomy and optical instrumentation, several labouring as unpaid volunteers or underfunded staff with the common goal of advancing the field of variable-star astronomy, or collecting and harmonizing the vast collection of observations made over the years by AAVSO members, including its growing international membership base. The picture presented is that of an organization more dynamic and useful today than it was a century ago, when it began as a gentleman's club of mostly amateur observers with small refracting telescopes, interested in making observations, initially of long-period variables, that would be useful for learning more about the nature of stellar-light variability.

Advancing Variable Star Astronomy was written by Williams and Saladyga as a centennial project for the AAVSO, which is celebrating 100 years, of a sometimes perilous existence, in 2011. It includes an interesting foreword by long-time and well-known AAVSO member Owen Gingerich, as well as answers to every possible question you may have wondered about concerning why the AAVSO is such a larger organization than the RASC in terms of head office staff and why it is so different in its outlook. It was not always so, but you must read the book to find out why. The rift between the AAVSO and Harvard College Observatory (HCO), forged during

Donald Menzel's era as director of HCO, brought a very difficult period to the AAVSO, which it has now survived, mainly through the extreme generosity of long-time member Clinton B. Ford. It is a fact of which even I was mostly unaware until I delved into *Advancing Variable Star Astronomy*.

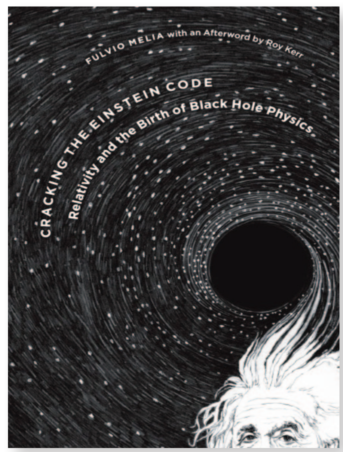
Advancing Variable Star Astronomy traces the history of the AAVSO from its early roots at Harvard College Observatory through the eras in which it was directed by William Tyler Olcott, Leon Campbell, Margaret Mayall, and Janet Akyüz Mattei, through the brief interlude of Janet's terminal illness when Elizabeth Waagen became acting director, to its present direction under Arne Henden. The gradual change in observing techniques, from visual observing, which is still in style, thank goodness, through the photographic era, the era of photoelectric photometry, and the current CCD era, is described in rich detail, and it is interesting to see what events occurred at each of the stages and how they were connected to what was happening on the professional scene at the time. The constant attention to personal details contained in the writing makes *Advancing Variable Star Astronomy* more than a simple history of the AAVSO (several brief histories of the AAVSO had been written previously). It allows the reader to see into the very soul of the organization, and to see what "makes it tick."

The nature of the variable stars studied by AAVSO members is not covered in the depth one would find in a specialty text in the field, but that is to be expected. I have often wondered why the AAVSO seemed to concentrate so much of its resources on observations of Miras and semiregular variables. But, historically it all makes sense, given that a century ago, those objects were the most poorly understood variable stars. Thus the original concentration of the "gentleman observers" organized by HCO director Edward Pickering, and later fostered by his successor Harlow Shapley, was on exactly those stars. Keep in mind that, a century ago, many types of variable stars had not yet been discovered, while most were poorly understood, at best. The AAVSO and its self-motivated observers throughout the world had a lot to do with rectifying that ignorance during the organization's first century of existence, and they should continue their good work for many years to come. A plethora of innovative changes to what the AAVSO does and how it collects observations of variable stars has poised it to be a leader in the field of variable-star astronomy for years to come. Keep in mind that variable-star observing is one area of astronomy where amateur astronomers can have as much impact as professionals, since observations are the science drivers in the field.

Advancing Variable Star Astronomy is an excellent, if rather lengthy, read for those interested in tracing the sometimes-tortuous past of a charitable organization that was often fighting for survival against great odds, both of a monetary and personality-clash nature. It also contains wonderful insights into the dynamical friction so common in any organization, and how it can be resolved (or not!). Like the RASC, the AAVSO has managed to survive a century of continued existence, while many other astronomical clubs and groups have appeared and disappeared during the same period. So, it is of interest to see if the historical evidence provides any insights into such longevity. Support variable-star astronomy and get your own copy of the book!

David G. Turner

David Turner is a stellar astronomer who specializes in the study of open clusters and variable stars: Cepheid variables mainly, but more recently including eclipsing binaries and Type C semiregulars (M supergiants). He is also a member of AAVSO council.



Cracking the Einstein Code: Relativity and the Birth of Black Hole Physics, by Fulvio Melia, afterword by Roy Kerr, pages 150, 15 cm × 23 cm, University of Chicago Press, 2009. Price $25.00 US, hardcover (ISBN: 978-0-2265-1951-7).

This slim volume with a shiny black hole depicted on the cover gives an account of how Roy Kerr developed a very important solution of Einstein's equations of general relativity, as well as giving a non-technical (no equations) introduction to general relativity. Although Einstein wrote down the deceptively simple equations for general relativity in 1915, solutions that might be applicable to objects in the real world were very difficult to come by. It was not until 1963 that New Zealander Roy Kerr developed probably the most important such solution, which describes the space-time around a rotating compact object such as a black hole.

Cracking the Einstein Code is written by Dr. Fulvio Melia, who is a practicing astrophysicist specializing in black holes, and who has written a number of books on the subject. The book shines in providing a lucid explanation of the basics of general relativity, and how it came about that, although Einstein wrote down the four equations governing general relativity in 1915, it was not until almost 50 years later that a solution applicable to real-world objects was found.

The dust jacket of *Cracking the Einstein Code* perhaps strays into hyperbole when it touts the book as an "eyewitness account," as Dr. Melia was all of seven years old in 1963 when Roy Kerr came up with his solution. Melia, nevertheless, undoubtedly does know Roy Kerr well, and Kerr contributes his own afterword to the book. Still, despite the clear description of his science, and numerous details of his personal life, Roy Kerr the man seems to remain somewhat of a mystery.

It is not because Kerr is an uninteresting character; aside from his work in general relativity, he has boxed for the University of Canterbury and has been New Zealand's national bridge champion. He seems, however, to generally avoid being pinned down: many of the details of his scientific work, for example, were published by others rather than in Roy's own short papers. We are also told in the book that Roy sold his home and purchased a sailboat in the early 1990s in order to sail the seas and visit colleagues, but then we are only told that he no longer sails, and left hanging as to what happened – did he sail around the world?

The elusiveness of its central character notwithstanding, the book does present a nice overview of the development of general relativity since Einstein wrote down the equations in 1915, painting a portrait of the curious situation that, despite general relativity being almost universally accepted as the best description of gravity and spacetime, finding actual solutions to its equations remains even now a considerable challenge.

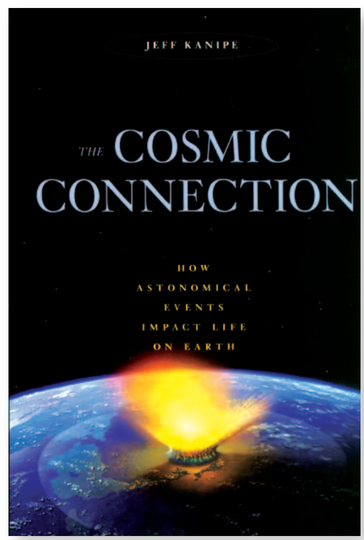
Michael F. Bietenholz

Dr. Michael F. Bietenholz is a radio astronomer affiliated with the Department of Physics and Astronomy, York University, Toronto, and the Hartebeesthoek Radio Astronomy Observatory, South Africa. While he has done innovative work on gamma-ray bursts (GRBs), and other startling supernova phenomena including black holes, he also maintains a lively and active interest in the relationship between art and astronomy. As well as producing some himself (astronomically inspired art, that is, not black holes), he was the curatorial team chair of the highly successful IYA 2009 Canadian Astronomical Images Database (www.galaxydynamics.org/iya2009/).

The Cosmic Connection: How Astronomical Events Impact Life on Earth, by Jeff Kanipe, pages 296, 23 cm × 16 cm, Prometheus Books, New York , 2008. Price $ 27.98 US, hardcover (ISBN: 978-1-59102-667-9)

I remember hearing once, many years ago now, an interview with British author, radio, and TV host Frank Muir (now sadly no longer with us). On being asked the question, "what it was like doing the round of chat shows after publishing his latest book?" Muir replied that it was a bit like asking an elephant to balance a bun on the end of her trunk after just giving birth to a new baby pachyderm following a 22-month pregnancy and gestation period. The metaphor seems very apt. After a seemingly endless struggle against deadlines, near endless corrections, re-writes and compromises over content and style, a new book emerges – kicking and screaming for attention. And then, after all the gestation and eventual printing, along comes a reviewer. From the book author's perspective, the bun-balancing act has begun. All the above being said, Jeff Kanipe need not worry greatly about dealing with any onerous post-publication prandial gymnastics, *The Cosmic Connection: How Astronomical Events Impact Life on Earth* is both an interesting and highly readable book that has been well researched and written. I did spot a few typos (balance that bun now), but they were trivial and in no way detracted from the read. In short, I thoroughly enjoyed reading this book, which leads me to ponder whether I am already a head-burying ostrich or that I should start becoming one. Indeed, *The Cosmic Connection* is the hypochondriac's compendium from Hell. The end message being mostly along the lines of "if it ain't got you yet, it will eventually." There is no apparent escape from our cosmic doom.

The Cosmic Connection proceeds from the local to the remote, taking the reader on a nine-chapter sojourn beginning at Earth's orbit and ending within the deep reaches of the cosmos, with a brief detour to the world of exotic physics in between. Within these chapters, we learn of the dangers derived from wayward comets and asteroids, a faltering (and then aging) Sun, a faltering geomagnetic field, orbital drift, close stellar encounters, supernova and hypernova explosions, and gamma-ray bursts. It is amazing that we are here at all. But, the list of our would-be assassins is far from complete: our future may yet be governed by galaxy collisions, black-hole annihilation, vacuum metastable events, and even invasion by extraterrestrials. Remarkably, given all this apparent woe coming our way, the Earth, Solar System, galaxy, and greater Universe, it would seem, are not only fit for us to evolve in, but they are also fit for life to flourish in. Paraphrasing Blaise Pascal, however, we seemingly find ourselves teetering on the precipitous brink of oblivion that divides the very small and very large – and yet, in spite of the apparent odds against it, we are here and our world hasn't ended yet. If nothing else, *The Cosmic Connection* reminds us that the apparent harmony of the present world is fleeting, and we flourish amid the transitory quiet times.



For the entire enjoyable read that it presents, there are larger issues that *The Cosmic Connection* brings to mind. There were numerous occasions within the text where the concluding comments are along the lines, "but more research needs to be done to clarify this idea." This, of course, is not the fault of the author, but it seems to me that it is symptomatic of a growing problem faced by scientists as a whole as they attempt to grapple with the ten-second attention span, media-crazy world in which we live. Some of the ideas discussed in *The Cosmic Connection* are nothing more (and in some cases even less) than half-baked, but since they have been appropriately associated at some stage with a snappy, sound-bite rich, good colour picture, doom-and-gloom-oriented press release, they have received over-hyped media attention. Perhaps the best thing that can (or indeed should) be said here is don't believe all that you read, and if some of the "end-of-days" scenarios that are presented in *The Cosmic Connection* seem just too ridiculous to be true, then it is entirely because they are too ridiculous to be true. This being said, there is nothing wrong with speculation, provided it is made clear that it is speculation (idle or otherwise), and one should always allow for the improbable to occur. Recalling the lines penned by the British pop poet John Cooper-Clark, with an additional nod towards T.S. Elliot, "for us this is how the world will end, not with a bang but a whimper."

Of all the chapters within *The Cosmic Connection*, I found chapter 9 the least satisfying – which is a shame given that it begins by outlining the reasons why Kanipe set out to write the book in the first place. I found the philosophy and discussion within this particular chapter to be muddled and far from convincing – indeed, in some places I felt that the practice of science, the role of religion, and the workings of Darwinian evolution were greatly over-simplified, and in some instances entirely misrepresented. Again, this is a shame, since Kanipe is trying to construct a modern-day version of the medieval ideal in which the microcosm is inherent within the macrocosm. This idea has an ancient heritage, has much going for it, and is only tempered in the modern era by a better knowledge of the content and number of the cosmos. Kanipe is right in saying that Darwinian evolution (to which one is inclined to ask, is there any other kind of evolution?) works within the quiet moments between catastrophes. But the Universe and many historic cosmic catastrophes have not steered nor directed evolution – natural selection operating on random mutations (with an allowance for random environmental change) has brought the world to where it is today – there is no direction or steering towards any specific goal when it comes to evolution. Evolution is unapologetically capricious, totally uncaring, and 100 percent self-serving: it worms through the cracks and works around any barriers (cosmically driven or otherwise) that it encounters – provided, of course, there is some adaptation advantage to be had.

Be that as it may, perhaps, my biggest gripe with chapter 9 is the way in which Kanipe introduces the Anthropic Principle, only to later dismiss it as some sort of religious, non-scientific chimera. This is plain wrong. Within the statement of the Weak Anthropic Principle (WAP), there are very clear explanations for why we see some things as they are – the context is neither religious, nor does it bring into question any scientific "beliefs without consensus" issue. The problem with the way in which the WAP has been used in modern literature (both popular texts and supposedly refereed research articles), and I think Kanipe falls into this trap, is that it is used entirely inappropriately and within a context to which it was never intended to apply. The banal quip and quotation attributed to Heinz Pagels (page 256-7) is true in the exact opposite, self-agrandizing manner in which he made it. Again, be that as it may. My point, however, is that, for me, chapter 9 was at times irritating, at times plain wrong, and overall not particularly enlightening.

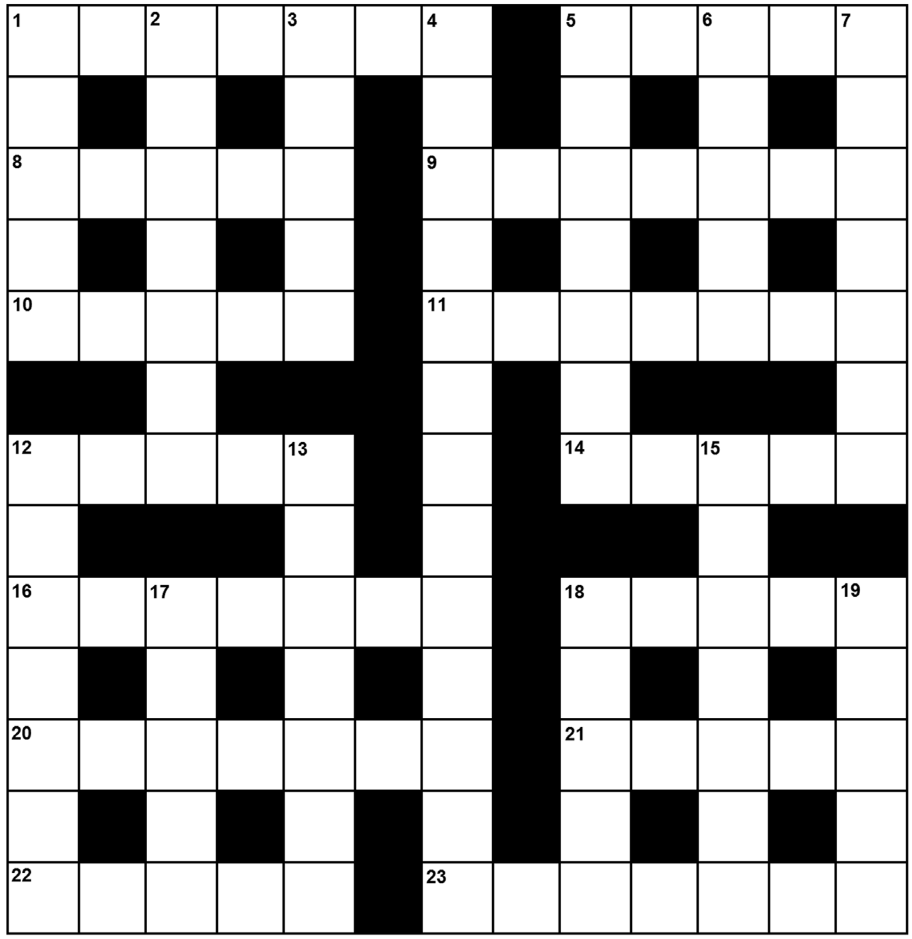
Not wishing to end on a negative note, however, *The Cosmic Connection* admirably achieves its primary goal of capturing the big picture and unearthing our cosmic heritage (and potential doom). The narrative is well constructed, engaging, and often soars to great heights of the imagination – and, indeed, imagination is one thing that this world desperately needs more of. The fact that we, even the Earth and Solar System exist is an incredible turn of good fortune. It is amazing we're here and, if nothing else, *The Cosmic Connection* reminds us that we should try to take better care of what we have before the metaphorical greater Universe uncaringly takes it away from us.

Martin Beech

Martin Beech is a professor at Campion College, University of Regina, and a familiar contributor to the Journal. *His research interests tend to be related to bits and pieces of space debris that impact the Earth, some from the asteroid belt and others from various planets and the Moon, which might explain the engaging and slightly esoteric approach to book reviews. When he's not dabbling in meteorites, he's dabbling in the history of science, which makes his Web site a particularly interesting place to explore.*

Astrocryptic

by Curt Nason

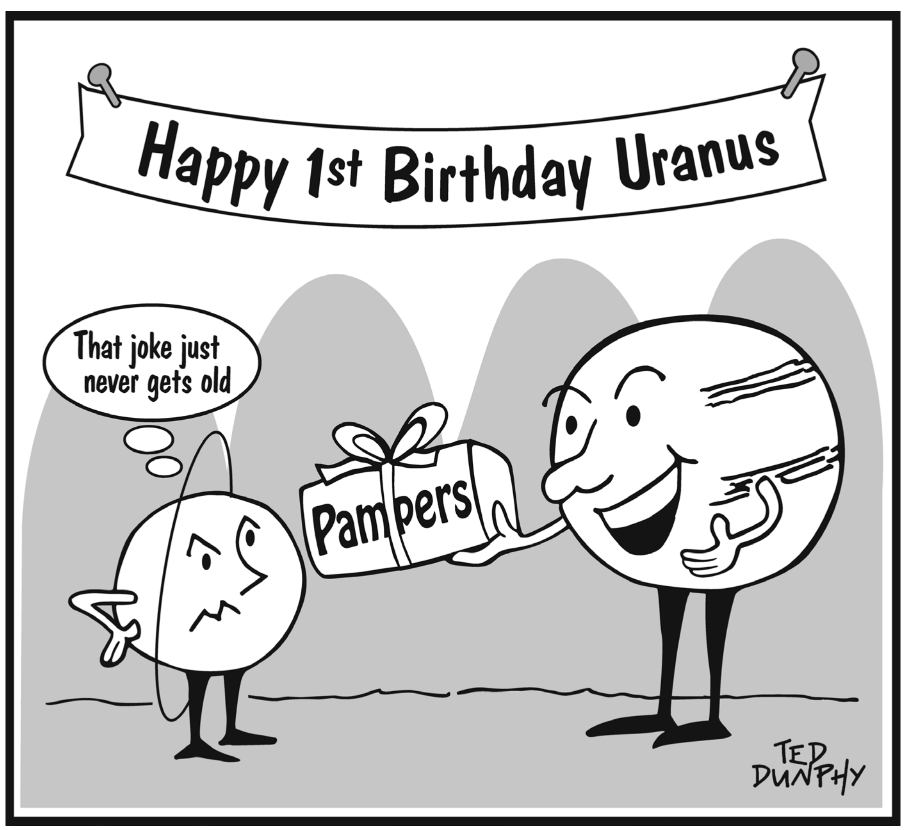


ACROSS

1. Two guys to edit a handbook (7)
5. On-line talk about new starter of a handbook (5)
8. She put Bok's head in ruin with her galaxy studies (5)
9. Cluster of busy activity (7)
10. Lunar cycle discovered in pulsar oscillations (5)
11. Humility, endless and dispersed, detected in T Tauri stars (7)
12. Watery ale in Neptune's outer ring (5)
14. Bishop and Whitman create our charter (5)
16. Ritchey-Chrétien in C11 case imaged something from the compasses (7)
18. Carbon and Fe_2O_3 form on a planetary surface (5)
20. Mixed oil cuts someone who fixes poor seeing conditions (7)
21. Bad thing for galaxy observing time (5)
22. Duck down during Perseid eruption (5)
23. Variable star rarely turns after first rising (1,1,5)

DOWN

1. World Series sound-alike (5)
2. Where Calgary Centre is located right in a turntable (7)
3. Tidal basin where the main roils south (5)
4. OIII device brings out lunar fire belt (7,6)
5. Unstable reactor exposes controversial Big Bang alternative (7)
6. A prism turns mica to iodine (5)
7. Equilibrium desired in another MallinCam (7)
12. Shape clay by one bullish sister (7)
13. Black eye around one comparison of Venus to Earth (7)
15. Compare a crater within a crater as you fly north over part of Germany (7)
17. Planetary requirement bought in a pub (5)
18. Disputed Martian feature recorded in an American almanac (5)
19. Let it rearrange Patrick Moore's in Sirius (5)



Society News

by James Edgar
(jamesedgar@sasktel.net)

We have a new Designer for the *Journal*! In fact, we have two!! Following the advice of our Executive Director, Deborah Thompson, we issued a Request for Proposal (RFP), expecting to get some applicants from within the RASC, and a few from outside the Society. With one exception, all the applications were from the "outside." That one exception is our new design team of Mike Gatto and Grant Tomchuk, both in the Halifax area.

I believe I speak for many on our Executive and the Publications Committees when I say we are pleased to have the team of Gatto and Tomchuk working with us, taking us to higher levels of excellence in our flagship publication. We are very pleased with the new look of the *Journal* that appeared with the April issue – thanks to the innovation and talent of Mike Gatto, we have a basis that will serve us well for some time. Mike offered to act as the interim designer following Brian Segal's untimely passing. And, now he and Grant have the job on contract for three years.

More good news! We have obtained a grant from the Canadian Periodical Fund to enhance the look of the *Journal* and increase our readership. Watch for upcoming changes as a result of this initiative.

We welcome back Bruce McCurdy's column *Orbital Oddities* after a brief hiatus. I know I speak for many readers when I say "Bruce, we dearly missed you and that wonderful orrery in your brain! Please keep your articles coming."

We also welcome a new cartoonist in Ted Dunphy, who has contributed once or twice already, and he promises to give us a regular chuckle. We look forward to many more!

Phil Mozel, after many years as a regular contributor to the *Journal*, introducing readers to a wide-ranging set of Canadian astronomers in his "A Moment with…" column, has decided to replace deadlines with other projects. Phil's column was probably one of the hardest to write, having to interview, write, review, and rewrite columns and then extract photographs from sometimes reluctant personalities. We will miss him and the people who were the subjects of his biographies.

Finally, at National Council meeting NC111 on March 26, the proposed Strategic Plan was formally adopted. This is a milestone for our Society – our minutes are riddled with attempts to formulate and follow such a plan. Now we have one, and we are already following through with the commitments made therein. If you're not sure what the plan entails, have a read at the RASC Member's Only section at www.rasc.ca/private/reports/StrategicPlan_2011-2013.pdf. ✶

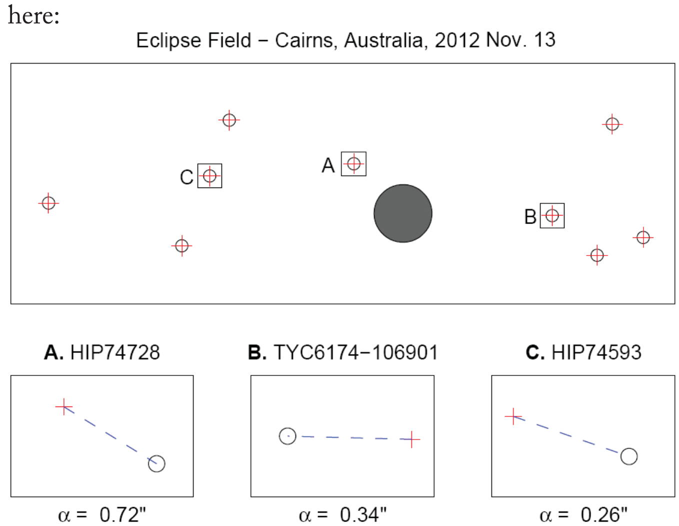
Errata

In the April issue, page 66, the figure caption should read:

Commander Brett and "Astronuts Kids' Space Club" resident astronomer Francois van Heerden of the RASC's Toronto Centre, prepare for a space mission.

On page 62, equation 5, the minus sign under the square root should be positive.

On page 63, the Figure 3 image should have been as shown here:



On the outside back cover, Lynn Hilborn is a "he" not a "she"! ✶

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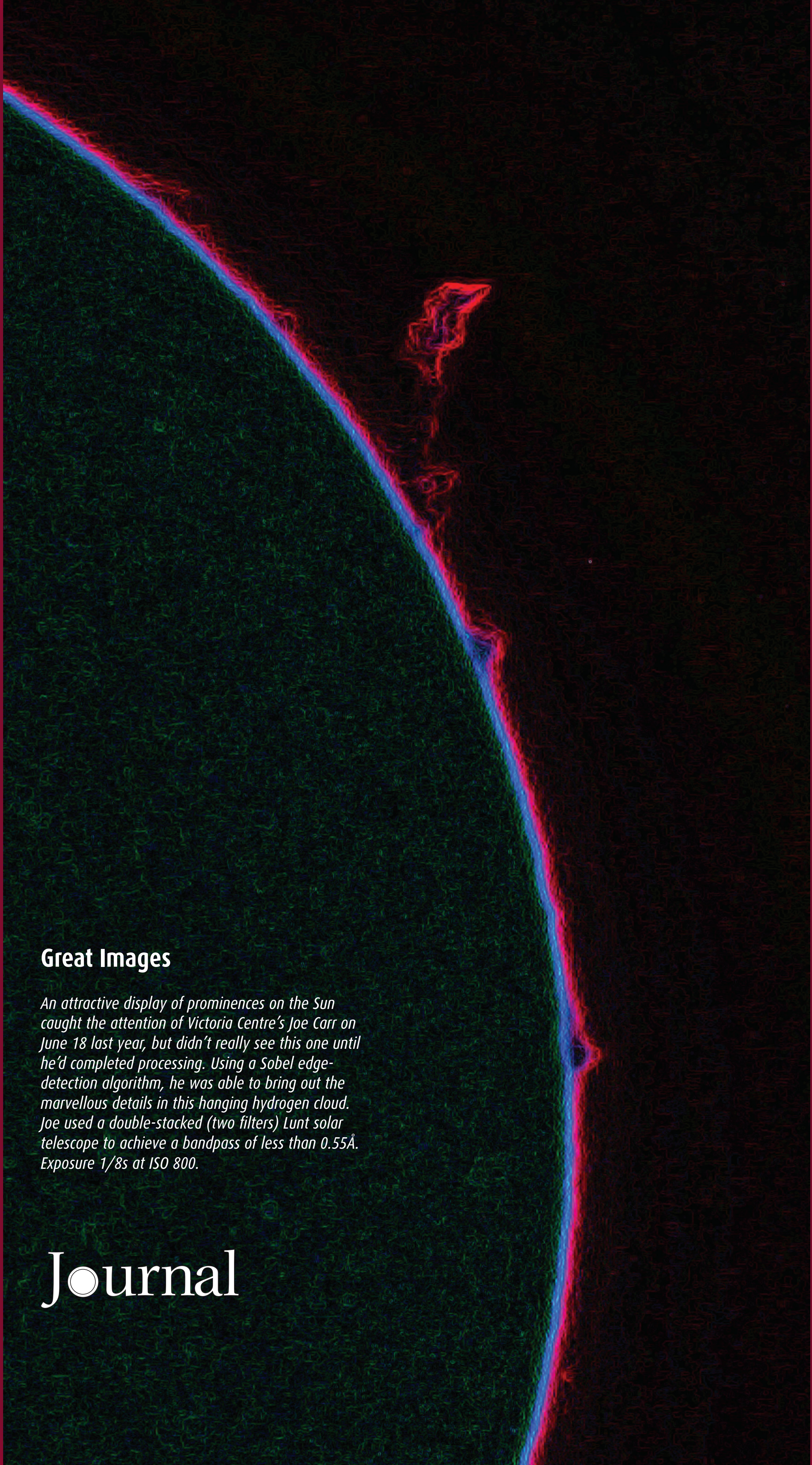

Great Images

An attractive display of prominences on the Sun caught the attention of Victoria Centre's Joe Carr on June 18 last year, but didn't really see this one until he'd completed processing. Using a Sobel edge-detection algorithm, he was able to bring out the marvellous details in this hanging hydrogen cloud. Joe used a double-stacked (two filters) Lunt solar telescope to achieve a bandpass of less than 0.55Å. Exposure 1/8s at ISO 800.

Journal