FEATURING A FULL-COLOUR SECTION!

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Journal

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Building for the International Year of Astronomy (IYA2009)

June / juin 2008

Journal

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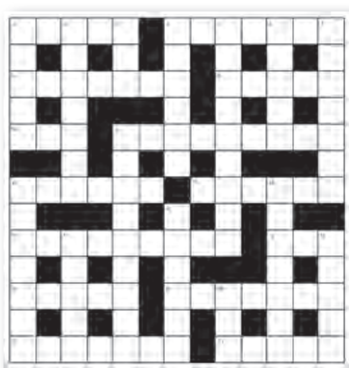

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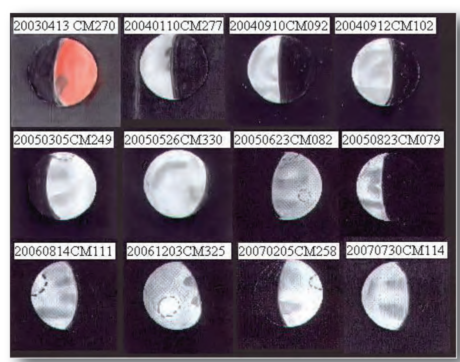

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DEPARTMENTS

Cover photo:
Chris Appleton took all of the sub-exposures for this image of M64, the Black Eye galaxy, from his magnitude 3.5 to 4 backyard in Toronto. He constructed the image from 12 x 10 min unbinned exposures through a clear (IR) Astronomik filter & Lumicon Deep Sky LP filter and 3 x 15 min for each RGB 2 x 2 binned using Astronomik Type 2C and a Lumicom DS LF filter. The total time involved was 4.25 hours. Chris used a 9.25-inch f/10 Celestron with a 6.3 reducer/flattener and an SBIG SXV-H9 camera. Images were flat calibrated only. M64 lies at a distance of 19 M ly and has a visual magnitude of 8.5.

COLUMNS

Feature Articles

Creating a Relationship with the Sky - The Horizon Effect Project

by Kathleen Houston, Earth Balance Art (e.b.a@sasktel.net)

I have questions about how the horizon affects us and what meaning is embedded in our experience. Here is my story.

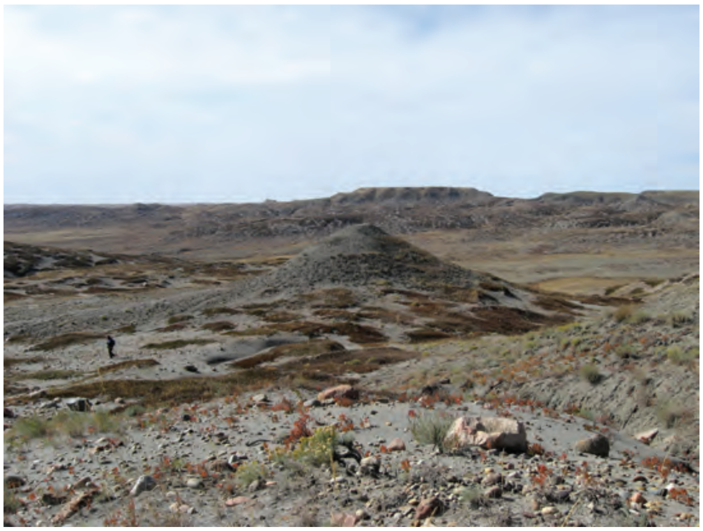

Figure 1 — Grasslands

I am a stargazer and art-maker, and I love to walk. In September my friend Shirley and I went on an all-day trek into Grasslands National Park, in southern Saskatchewan. We were heading for an extraordinary tipi ring site. Somewhere between markers, I stopped for a moment. I looked around to notice some familiar hills and situate new landmarks on the next leg of the journey. I was thinking about the me-in-the-land encompassed-by-the-sky experience. I stopped and squinted at the Sun and lowered my gaze to the horizon. What is happening? What am I experiencing? I wonder "What effect does the horizon have on me?"

It is hard to translate my experience into words. My thinking, energy, and well-being are changed by the land. What am I connecting to that is usually silenced? Is there such a thing as the Horizon Effect? Away from conventional mapping and habitual life, I feel different.

After consulting the map numerous times together, Shirley and I came to realize that *the* path does not exist. It is a bonus to find one of the mapmaker's markers. Usually trails would fizzle out into rocks and sand and lose legibility. There

Journal

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are many kinds of maps — land maps, star maps — and they provide orientation and support memory. The process between location, map, and user is to fill in the gaps when the path is truly invisible. I love maps but I hate getting lost.

Figure 2 — Kathleen at a Grasslands marker

On my Grasslands six-hour solitary walk in April, missed and missing markers kept me on the verge of feeling lost. I read the land frequently for clues and stayed on task. This experience reminds me of a stargazing session out at our Sleaford Observatory, east of Saskatoon, where I became lost in the Virgo Cluster of galaxies. My star map locates the deep-sky objects to the east of Leo's butt. At the telescope, it is hard to identify which *fuzzy galaxy* is in the eyepiece. I became disoriented and frustrated. Repeated efforts were fruitless; I even tried detracting myself with familiar Messier objects. I needed to find alternate routes to the star destination I was looking for. Ask anyone who got lost in the Virgo cluster…and survived!

Out on the recent September walk, the earth and stones crunch under my hiking boots. We are heading east past Eagle Butte, where multiple pathways are created organically. The animal and human footprints and water-carved ruts become the vocabulary of the land. The hike in April took me on a snowy east-west route, where general textures of the land stood out, but I lacked detailed footpath information. This alternate west-east fall route to the tipi rings is teaching me to connect both experiences to create an internal map. My Virgo-cluster skills are improving!

In April on the Grasslands plateau, I connected to the idea of geological alignments. The native groups must have used the horizon as a calendar. I thought of Chaco Culture in New Mexico and their use of the horizon as a calendar marker. They also created a lunar/solar observatory up on Fajada Butte, at a central valley location.

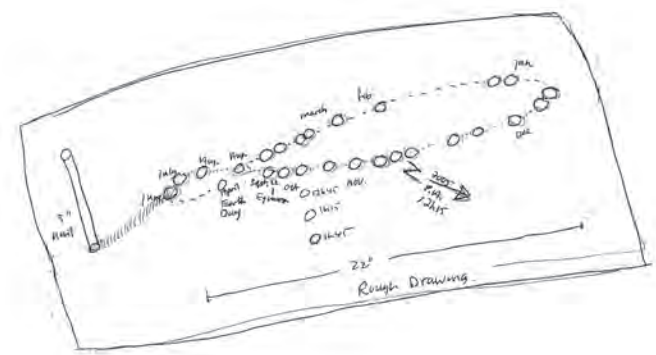

Figure 3 — Analemma drawing

Two years ago in Prince Albert, I completed an analemma drawing. I drew the Sun's shadow on clear days (or when I remembered!) at 12h15 p.m., on a board with a 5-inch nail, several times a month. I followed the Sun's shadow for one year, to create a wonky figure-8 drawing. There are gaps, but the shape holds together as a continuous curve. It sounds simple and it is, but an analemma recreates a powerful connection to the Sun/Earth rhythm. Photographs of the Sun's analemma pathway in the sky, found on the Internet, are a complete year at a glance.

Two years ago I started to create what I call my "flashlight drawings." I camped at Birch Lake, Alberta, and created drawings on the salt beaches, and videotaped the work. At night I began experimenting with time-lapse images with my trusty 35-mm SLR camera on a tripod. The moonlight illuminated me enough so that photographically I appear to be translucent, yet retain the light drawing around me. The solar analemma images taught me to think into the sky. My stargazing and art-making practice found a way to co-exist.

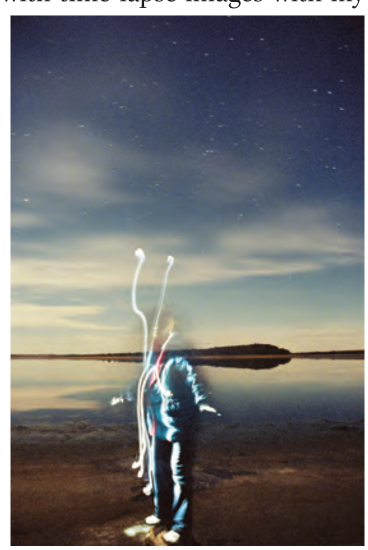

Figure 4 — Birch Lake, Alberta, 2007

My obsession continues to evolve. Recently I included my six-year-old daughter Marael in the experience, here at the urban river access in Saskatoon. I invited her to create her own light drawings and experiment with coloured gels over the flashlights.

Figure 5 — Marael, Saskatoon, Saskachewan, 2007

Since June, I have a living room window sunrise "calendar." I created a watercolour pencil drawing on the glass that shows the local horizon line and sunrise locations. Marael draws on the same window at her height, and I fear that one day she might erase my drawing by mistake! The glass drawing sprawls northeast to southeast. Sunrise will progress southward until winter solstice in December, to solar "standstill."

Sometimes I miss the stars I cannot see in Saskatoon. Feeling disconnected from starlight is especially obvious after a return from the Saskatchewan Summer Star Party. In southwestern Saskatchewan in the Cypress Hills, the Milky Way is luminous and touches the horizon. You can lie down on the ground and experience the full light-path arch. You feel it in your cells.

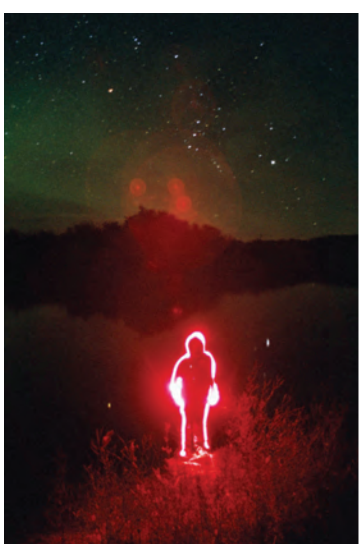

Figure 6 — Black Nugget Lake, Alberta, 2006 Northern Prairie Star Fest

The Horizon Effect Project

A friend related to me his ocean-horizon experience, where it took several days for him to relearn to gaze that far. My visiting Montreal friend Celine remarked on how the horizon affected her; "C'est reposant pour les yeux," (the land is relaxing for the eyes). The more I talk to people, the broader the understanding of what the horizon experience is.

I invite you to share your insights and questions. You can include text, images, and drawings. In your mind, travel back to places that have a strong memory for you, or night-sky experiences that expanded your energy. I concept-mapped, drew, wrote, and talked to friends. Networking creates a dialogue I really appreciate. In the future I want to create a blog site.

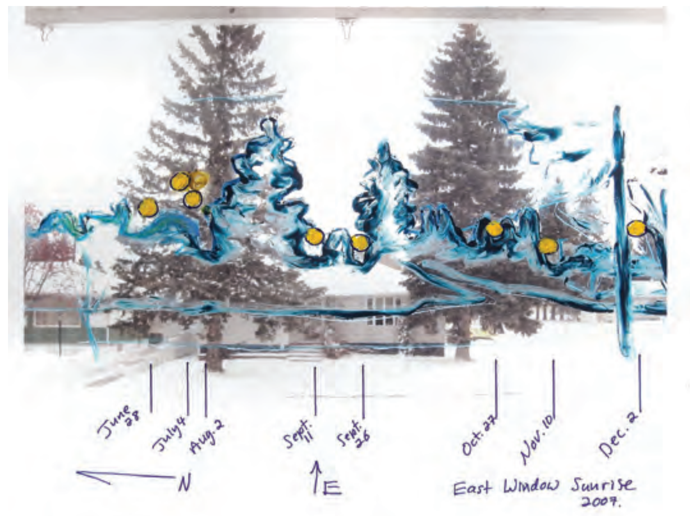

Figure 7 — East window drawing

When Kathleen Houston moved out to Saskatchewan ten years ago from Montreal, a telescope came with the deal, and she became a member of the RASC Saskatoon Centre. Last year, she was co-registrar for the SSSP Summer Star party. "My artwork became more land-based, and I linked creativity with the sky with photography and video," she explains. Presently she is a University of Saskatchewan student in education, and this article is a writing-to-learn experience.

"Look WAAAYYYY Up!" – Travels to Mauna Kea

by Judy Anderson (janders@ms.umanitoba.ca)

While we've delighted in global-travel adventures during our solar-eclipse expeditions, the notion to visit Hawaii hadn't really dawned on us until recently. So with the goal to see volcanoes and experience some warm weather in mid-February, plans were hatched.

Of course a visit to the telescopes on Mauna Kea was an essential part of the itinerary. Those of you who know Jay, my partner and the Editor of this *Journal*, will understand completely! I suppose I was surprised when thoughts of sandals and summer clothes were swayed by the need to withstand temperatures down to about minus 10°C, walking in snow, and having little access to typical tourist facilities for the long day on the mountain. It gets cold at 4000 m, and there's only one stop between Hilo and the peak for hot chocolate and a washroom. However, the ultimate destination was tantalizing, so the imagined conditions were manageable: everyone from Manitoba has a full range of mitts, long underwear, footwear, and sweaters, so suitcases were packed and off we went. With sunscreen too — useful in touring the island and the peak, where we'd be surrounded by the white reflective surface of snow (like home!).

The touring was marvellous: lava flows of curvaceous, glass-coated pahoehoe, sparkling in the Sun, and sharp-edged, brittle-sounding ahah (looks like coffee grounds) that cuts if you rub against it; fantastic tree ferns with cat-fur softness on the fiddleheads (the new fronds, curled up in the crown of the plant); serendipitous observations from an ocean-side field or beach, of humpback whales, spouting and breaching, over and over; smelling flowers in February, and tasting the salty air with friends over a glass of well-chosen wine; hiking across an ancient volcanic crater, hoping privately that new activity was predictable; flying by helicopter over Kilauea and hoping out loud that the most recent new activity would suddenly let loose and dramatically open up lava tubes and eruptions; and watching the eclipsed Moon rise out of the sea and clouds, over the black-black lava surface that had met the ocean centuries ago. All this was exotic and intellectually stimulating, without question! But the goal to see the observatories was always floating in our minds.

On the way to Hilo on the east coast of the Big Island of Hawaii, we caught sight of the mountain top with its "pimples" rising at the peak. As uninformed as I am about technicalities of observatories (notwithstanding osmosis about the subject from RASC members, astronomy professors, eclipse chasers, and skilled international amateurs for the past 30 years or so), I knew there were more domes up there than I could see from sea level. But the first views, from the hotel balcony on the night before our drive to the peak, showed three or four small white bumps on a very snowy platform, poking through the afternoon clouds, then rising above the landscape in a rosy sunrise glow. I was excited to get going! Fortunately, our travelling companions, Drs. Richard and Helen Bochonko, were just as eager. We assembled cameras, batteries, rental car approved for travel to the peak, and a feast of staples: fruit, cheese, chocolate, nuts, and water.

Our early start was in perfect weather, and we marvelled at the ride upward, seeing only a few other vehicles on the road. We stopped frequently for photographs of the rising peak, changing vegetation patterns, lichens, and the vista back toward the ocean, covered on and off in sparkling, dancing clouds, or displayed in full view.

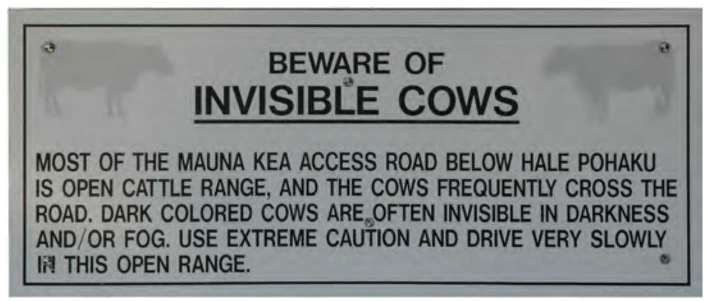

Figure 1 — One of the hazards of travel on Mauna Kea.

When we turned right from the Saddle Road, which crosses over the "bridge" between Mauna Kea and Mauna Loa, our anticipation climbed another notch, in spite of the roadside warnings of the hazards ahead (Figure 1). The latter volcano is also snow-capped but *sans* telescopes, for very good reason. Mauna Loa was the site of volcanic eruptions in the 1990s, the details of which were related to us by the Bochonkos, still excited about their previous experiences with lava, Pele's hair, and getting to the action by adventuresome means, children included! And now we could see the volcanic vents from the upper slope, clear signs that the "action" of a volcano is not all at the top of the peak! More obvious, too, were the telescopes, now more than just little bumps as we passed the 2000-m level, though they were lost to view over an intervening ridge as we reached the Visitor's Centre.

There we met author David Byrne (see the review of his book about Mauna Kea in the October 2006 *JRASC*), who entertained us with a concise history of the observatories and showed us the posters, calendars, and souvenirs in the gift shop. It seemed we were dawdling, but it was probably a good thing not to rush up to the full altitude without some acclimation at 2800 m. Leaving the Visitor's Center, we made a quick tour of the dormitory facilities next door, a temporary home for astronomers and technicians working at the telescopes. Some dormitory residents are on shift for three or four nights before going home to Waikoloa or Hilo; others are on longer sojourns for particular projects as visiting scientists. It was here that the extent of the organization supporting the observatories began to dawn on me! The dorm was set up to host breakfast at any time: cereal and condiments for toast were in well-designed shelves that encircled the pillars supporting the roof of the dining hall (why hadn't we packed peanut butter for our picnics?). The balcony outside the dining hall framed a vista that spread at least 145 degrees around the building, looking downslope and southward across the dormitory units toward Mauna Loa — perfect for viewing the rare eruptions in that direction.

The games room was well-equipped with adjoining rooms for conversation, relaxation with TV, or reflection in a private corner. The walls were full of photos of star fields and galaxies taken from one or another observatory (right up the hill, rather than on far-off Hawaii that I'd seen in a book or journal). These were interspersed with photos and paintings of the volcanoes, plants, and animals of the surrounding island. There was an office at the front door with a registration desk that takes logistics seriously from the look of the checklist and weather and safety information on the bulletin boards. Most thought-provoking for me: the large array of flags hanging in the front foyer of the building, one from every country that participates in the research and contributes to the funding and construction of the observatory complex and its use. Of course there were the familiar ones — Canada, Japan, France, the USA — and a host of others. Those bits of cloth really reinforced how much this incredible resource to global astronomy and public education and beauty is supported by a broad international collaboration. I sure hope that can continue and grow further. It seems the more I experience the world and make observations of my own about the motion of planets, Sun, Moon, and Milky Way, the more I realize that as a society, we actually make use of the exquisite level of information from basic astronomical observations made by the most powerful telescopes on Earth and in orbit! I applied once to join the Canadian space program as a want-to-be astronaut, maybe fearless in the face of adventure, and I'm enough of a researcher to know that someone, sometime in the future, somewhere in the world, can actually apply what earlier investigators learned through the scientific method. So here were my own personal tax dollars at work, a tiny part of the full cost of such support, making a difference to international science! What a neat feeling!

After an hour of acclimation and discussion, we drove up the switch-back road, now turned to gravel, toward the top. This road rose incredibly rapidly, another 1500 m in just under an hour (including photography stops at every turn as new vistas came into view, each one just that little bit better). The effects of the altitude weren't bad, although we found going downhill for a picture was much easier than walking back! And it was cooler, so another layer of clothes came into use. And then we turned at the fork in the road and stopped beside a perfect "set" of beautiful installations!

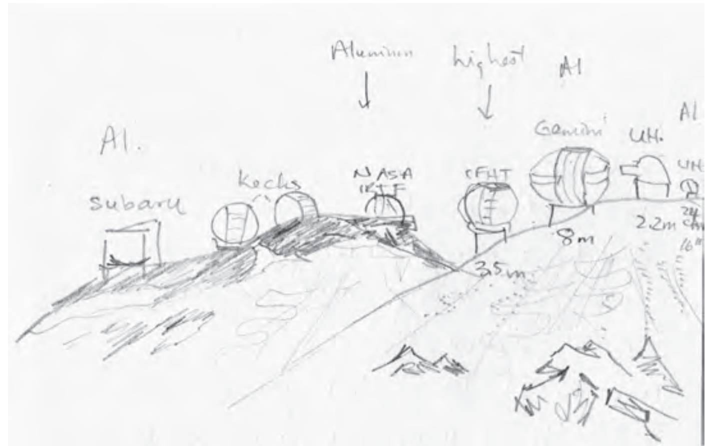

Figure 2 — The observatory line-up from the approach road.

These are the observatories. Each has a different texture of white or silver and is a unique shape, an architectural gem: rounded or oblong, tall or low, modern or "classic" — all decorating the ridge-line of the mountain. We were right next to the Caltech Submillimeter Telescope; it had the base opened up so the innards were visible right from the road. All around were more just like it! Now my naïveté was evident to all: I needed a tour guide to point out which was which. A camera, even wide-angle, was not going to capture my impressions of this hillside! One face of the snowy slope was sparkling in the sun, and on the other side a nearby lava-dome was sketched with braided tracings from snowboarders (another population with interest in mountain-top respect, even "worship"). There was a snowman at the roadside, and two snowboarders were shovelling snow onto the roof of their SUV so they could show where they'd been when they got home to Hilo, now 4000 m below.

Squinting through sunglasses, I paused to soak in the sight of the jewels decorating the peak, somehow on my own "analogue" terms — a sketch that helped settle observations of telescope design. Jay and Richard talked about the astronomical capabilities and limitations of each instrument, their history, and their future applications. I got confused at one point and was surprised to see two more domes farther up the hill, looking smaller in the distance. My sketch (Figure 2) was compressed at the right and "wrapped" in two parts from my vantage point at the roadside. Finally, photography was in order, and I probably added another 100 to those Jay had taken while I was sketching, lost in awe of these international dreams, now come to fruition. These are beautiful buildings in an amazing location.

We next went to the CFHT, the last observatory on one ridge line. The "two smaller telescopes" weren't small at all! They were huge! Details of the building materials and design were much more evident close up. I was enjoying this immensely, although I'd only recently developed a fascination with telescope design during a visit to Mount Wilson, during the Solar Eclipse Conference in August. That experience was the first time I'd connected the history of discoveries in optics and physics with the construction of a telescope. I admit this somewhat reluctantly — my previous dispassionate, technical interest in telescopes was brought to life by direct observation of their design! I've enjoyed learning about longitude and how Harris constructed accurate timepieces; these new observations will likely pull me further into biographies that connect past and present through science and invention.

We had booked a tour of the Subaru observatory and reached it right on the scheduled moment. This is a massive building, towering in the vertical about 8-10 stories, I'd estimate. We entered through a regular-sized door on one face of the building. It was sunny outside, and in the shelter of the building, out of the wind, quite warm, although ice was slipping off the wall overhead. The small foyer of the building however, was cool, and I was glad to don the hardhat, as it was a further layer to retain warmth! Our tour began — an intrepid group of eight, from an astronomer to interested citizens, so our questions covered a wide range, which really made the next hour or so into an animated discussion as we walked the various parts of the observatory, in and out of the elevator to visit each floor. Even the model of the Subaru telescope in the foyer was neat, and there was so much else to see and ponder. The mounting cell for the mirror floated over the floor where we stood, and it was huge! The underside of the building revealed how the whole telescope turned inside the building. There was a series of wheel housings on a track and a bar-code reader to position the whole assembly. The "basement" was an adventure all on its own, despite the seeming emptiness of the space. On the upper floors was more of the mirror superstructure and control system; in this observatory, the elevator rises up one side of the building, actually separated from the telescope: the whole structure is a building within a building. We walked around the catwalk, up about four stories, and took pictures of the Keck telescope from a great foreground vantage point. The yellow hardhats made us look like explorers as we toured the mechanism that would change a camera — these are very big cameras! The whole place is quite impressive, and I was particularly captivated by the assembly for washing the surface of the mirror (Figure 3). At this location, the whole side of the building was open exposing to us the design details that enabled cleaning an 8-metre mirror without removing it from the building. There was a crane system with a huge array of positioning devices; on a regular basis, it would carry the mirror over to a structure that looked like a brushless car wash. We explored dark nooks and crannies, peeking into the spaces that held the secondary mirrors and assorted odds and ends. The tour seemed to end too quickly, after a final flurry of questions. I was soaking up the ambience impressed at the end with the English and Japanese inscriptions made in felt pen on the side of the camera housings, by various astronomers who'd used the telescope. It brought a very human side to the technically amazing installation and showed how scientists are apt to personalize a particularly meaningful moment of collaboration, perhaps to record the meeting of minds in active exploration and discovery.

Figure 3 — The mirror support mechanism at Subaru, designed to support the 8-m glass during its travels from the telescope to the washing and realuminizing tank.

Next we went back to CFHT and met up with Bill Cruise, a colleague that Richard had worked with during his earlier professional work there. Bill is a telescope systems engineer, more familiar with fixing things than observing. Bill introduced us to Sarah Gajadhar, an electronics engineer who maintains the camera and telescope. She was overseeing repairs (on a more or less continuous basis) to the Megacam camera system, which apparently is amazingly good (read that as excellent), considering it is "old" in comparison to the newer systems on the mountain peak. We were able to see the inside of the CFHT, this one on an equatorial mount, more familiar to me than the alt-azimuthal mount in the Subaru observatory. We could admire the bottom of the mirror housing, the long arm of the telescope sealed in a cylinder, and that beautiful U-shaped, dark bronze-grey metal mounting. It looks like Taurus' horns right there inside the dome and has amazing contrast compared to the rounded, painted surface of the scope. This instrument has the same design [a Naismith focus — Ed.], essentially, as the instrument housed at the University of Manitoba's Glenlea observatory, which was "received" after a DAO refit in the 1970s. I recognized the similarity, partly as we'd seen the Glenlea pier poured (at the same time as the adjacent RASC pier).

Inside the CFHT, one feels that the "classical telescope" is alive and well: the dome mechanism has doors that open, one up and one down, in the armature of the fixed "leaves" of the dome. There was something missing when the dome was rotated while we stood inside or walked on the catwalk around the outside. It was quiet! All that tonnage moving smoothly — an interesting experience, feeling that relative motion while standing still! We got a close-up tour of the camera system, with huge plate filters that have to work reliably at low temperature. It seemed like a true labour of love to care painstakingly for the intricate metal mechanisms, cold (out of circumstance and necessity), gloves off, and breath visible. No wonder the kitchen-lounge was warm, tucked just inside the door to the catwalk! We unpacked our picnic and talked to Bill of his travels (by motorcycle!) and long-time dedicated service at CFHT.

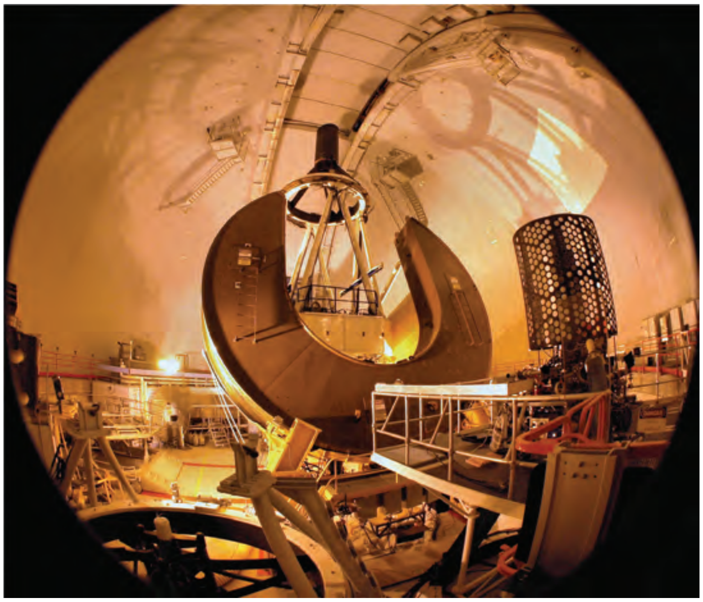

Figure 4 — The Canada-France-Hawaii Telescope from the north axis. MegaCam is the bird-cage structure to the right.

Earlier in our trip to Hawaii, we'd had the pleasure of visiting with Bernt Grundseth, who lives in Waikoloa on the west side of the island. He and Richard had worked together, and he had recently retired from active service to CFHT. It was fascinating to think of the careers that are possible in such a beautiful location and with such amazing opportunities for observation and discovery in the heavens! Inside CFHT we met Mary Beth Laychak, who was supervising the regular schedule of observations and data collection by the telescope that night. She was reviewing the previous night's observations, cataloguing them in the control room of the telescope, and setting up to collect observations for the oncoming night. Her university degree had opened up a huge door into a future as a professional "photographer" on a vast scale! And she was having the time of her life, putting her skills toward a collective goal on an international level! How much more can we ask from life?

After CFHT, we ventured back into the sunshine toward the Keck telescopes. These are a pair of uniquely designed instruments that work together as an interferometer. A video in a cold lobby showed the design and construction of the telescope. Imagine having to build those mirrors in one location (not in Hawaii, either), and then having to ship them to the island, and get them up that hill! We went into an observation area where the base of one of the telescopes was visible from within a fairly small, glassed-in room. The framing of the octagonal lens segments is a deep blue and has a most ingenious and beautiful design — like the armature of a very large gemstone in a very delicate jewellery setting. And the mirror was rotating, so the segments and armature moved past us; we could see various parts and assemble them mentally into a conceptual whole. Again, it was impressive that such a massive structure could move so quietly and glide past us so smoothly, seeking a position with exquisite exactness. By now it was late afternoon, and we were content to watch until the building closed for the day. It was cold again, and maybe the altitude was getting to me a little.

We headed back toward CFHT, and parked the car to wait for sunset. There were quite a few snowboarders enjoying the hillside. They drive up, discuss plans for the next descent, and then start off down the slope. Skating on the edge of the hillside, using their edges for control, they weave back and forth, all the way down to the roadway, 450 or so metres below. By the time they descend, exhilarated, the designated driver has taken a vehicle down to pick them up, and they return to the top of the hill for the next turn. The light was beautiful. We watched as the Sun neared the horizon, and picked out the seacoast and Mauna Loa. The sky colour changed from crystal-clear blue, deeper and deeper, tinged first delicately and then dramatically with gold, then pink, rose, purple, and indigo. This transition took quite a while and allowed a few naps, a snack, a walkabout for a few photos (wait for the Christmas card from the Andersons), and a second visit to CFHT. There was a procession around the catwalk at the CFHT, everyone marvelling at the deepening glow and the darkening sky, picking out the brightest stars. Sirius was high up and the Big Dipper was oddly tilted and so comfortingly recognized. There was also a lovely view of the shadow of Mauna Kea cast into the rose-coloured horizon, triangular and broad, just below the near-Full Moon, rising in the east. This was the night before the total lunar eclipse, so we were fascinated with the alignment — a metaphor of the cosmos cast on a sea of clouds! I recalled seeing a film on the 1991 total solar eclipse and how the Moon's shadow was so beautifully visible as a cone receding away from the CFHT. This shadow was also impressive, but not so clearly delimited from the sky; it was lovely to see the sharp outline of the volcano, rising toward the darkening sky!

Figure 5 — Sunset and the rising shadow of Mauna Kea. The Moon is one day before Full and a lunar eclipse.

Figure 6 — Gemini opens to begin another night of discovery. The observatory opens along the side to allow a flow of cool air into the dome.

The absolutely most magical moment was now just starting! We'd marvelled at the colours in the sky and the reflections changing colour on the snowy surface of the landscape. Shadows were deepening around us, and the observatory buildings were coming alive! The CFHT dome was rotating again, and now the doors were opening. The adjacent Gemini observatory had vertical doors that were fully open; its mirror was first rotated and then lowered into position for the night's observations. There was a liquid-silver look to this massive round mirror pointed low in the sky to the northeast. What a truly beautiful sight in the deepening darkness: it was brilliantly shiny and illuminated, even in the dark! A jewel, yes, but also alive! And as I looked about, all the other observatories were also opened, turning, doors moving; secrets were being revealed to observers, readying for a night of activity! I was holding my breath, totally entranced with the process of awakening on that high mountain top! There in the midst of people, conversations, observatories, and equipment, was a very private, perfect moment...

Soon it was dark, and the observatory staff now had work to do, and we would be in the way. So we collected our clothing, lenses, final photos, and glances at the peak, and headed back down to the Visitor Centre. Hot chocolate was very welcome, as was the slightly denser atmosphere. We shed some jackets and listened to the public-education sessions starting up in the entry-way. Four or five amateur-sized telescopes had been wheeled out for public viewing. I don't know if any of us actually looked through a telescope: I think we were all enjoying a quiet moment while our memories collected. We got back in the car and headed downhill to Hilo, having shared a marvellous adventure.

This is not the telling of an astronomer's experience of Mauna Kea. Readers of *JRASC* will know much more about the observatories, especially CFHT. This is just the story of my day on top of a mountain, learning about my own interaction as a human being with the observatories and their embodiment of implied dreams and discovery. This was more than a trip from Hilo to look at observatories or at the stars in that blue blue-blackening sky. The day had brought an international dream of discovery to life and was looking waayyy up to that dream from one little me. Thanks for indulging my reflections and for supporting inventions to reflect the heavens on us all!

Judy Anderson usually watches her husband head out into the dark skies by himself, but the lure of Hawaiian volcanoes was too much this time. When she's not chasing eclipses with Jay, she is a research professor, anatomist, and head of Biological Sciences at the University of Manitoba.

In the Shadow of Aristarchus and the Lunar Eclipse of 2008 February 20

by Martin Beech, Campion College, University of Regina (beechm@uregina.ca)

For all his fame and renown, Aristarchus of Samos is a rather mysterious figure within the history of astronomy. He was born towards the beginning of the 3rd century BC on the Greek island of Samos, and died *c.* 230 BC. For his contributions to astronomy, Aristarchus is accredited with the invention of the hollowed-out bowl-shaped *scaphe* sundial and he is remembered for his suggestion that the Earth might actually move around the Sun, with the sphere of the stars being fixed, or unmoved. Aristarchus also outlined a method by which, when the Moon is at either 1st- or 3rd-quarter illumination, the distance of the Sun from the Earth can be determined in units of the Earth-Moon separation. The relative distance he derived, however, was an underestimation of the true value by a factor of about twenty, but this is probably because he guessed rather than attempted to measure the angle required to complete the analysis. In contrast, in the one surviving text by Aristarchus, *On the sizes and distances of the Sun and Moon,* that has come down to us through history, he outlines the correct reasons for the phases of the Moon and he also describes a potentially accurate method by which the distance to the Moon can be determined in units of the Earth's radius $R_\oplus$. In the latter case, the method he outlines is partly based upon the measurement of the cross-section size of the Earth's shadow at the Moon's orbit during the time of a total lunar eclipse. Aristarchus assumed the shadow width to be twice that of the Moon's angular diameter — an angle corresponding, therefore, to 1 degree on the sky. This is not a particularly good estimate (although it is close to being correct). Claudius Ptolemy, working several hundred years after the death of Aristarchus, *c.* AD 100, in Book V of his *Magna Syntaxis,* gives a more reasonable estimate of 13/5 times the Moon's diameter, corresponding to an angle of 1.3 degrees for the width of the Earth's shadow. In the work of Aristarchus, we indeed find both the great strength and the overpowering weakness of classical Greek astronomy. It wasn't the thinking or the methodology that was in any way wrong; it was the poor means they at their disposal with which to measure very small angles on the sky with any degree of precision.

I have seen many eclipses, both lunar and solar, over the years and was not immediately excited by the February 20 eclipse prediction when I first read about it in the fall of 2007. By great and good chance, however, I was reminded of Aristarchus' study concerning the lunar distance while reading through James Evans' wonderful book *The History and Practice of Ancient Astronomy* (Evans 1998). Here, it immediately struck me, was a chance to re-live a small part of astronomical history. Having previously measured, a number of years ago now, the Earth's radius according to the methods of Eratosthenes (Beech 2005), it was time to delve into the deeper realm of the incorruptible heavens.

The observing conditions at Regina, in spite of all expectation, were perfect for the total lunar eclipse on 2008 February 20. The days before had been blustery and overcast, but on the night of the eclipse the skies opened up to reveal a glorious star-studded, moonlit vista, and a cold, crisp observing session began (Figure 1).

Figure 1 — A 3.5-hour exposure, starting at 19:30 CST, of the lunar eclipse unfolding. The picture was taken with a fish-eye lens on a Nikon camera body using standard 35-mm colour print film. A close examination of the image reveals trails for Sirius and Mars.

Figure 2 shows the geometry that I am going to apply in this analysis. The centre of the Earth is at position O, and the Moon's orbit (assumed circular, of course) is shown as the dashed track. Aristarchus noted that, during a solar eclipse, the Moon would (typically) just cover the Sun's disk and this, he argued, indicated that the Sun and Moon must have nearly the same angular diameter on the sky. Archimedes of Syracuse (827 – 212 BC), in his *Sand Reckoner,* further tells us that Aristarchus discovered that the Sun has an apparent angular size of 1/720th part of the zodiacal circle, which is an angle of 0.5 degrees — a remarkably good angle determination in this case. The solar eclipse condition is shown on the right-hand side of the diagram, and this allows us, as it did Aristarchus beforehand, to take angle $\varphi = 0.5°$. Constructing lines parallel to the full shadow rays associated with the solar eclipse condition, and extending them so that they are tangential to the Earth allows us to construct the Earth's full shadow zone (the Earth's umbra), which reaches a point at P on the far left of the diagram. To close the analysis, we require an estimate of the angular width of the Earth's shadow at the Moon's orbital distance from the lunar eclipse observations. This observation will provide us with an estimate of the angle α. If we take the Moon's orbital radius to be $D_☾$ then, without going through all the trigonometric details, we have

$$D_☾ / R_\oplus = [2 - (2 + \varphi) / (1 + \varphi/ \alpha)] /\varphi \quad (1)$$

where we have used the small angle approximation with φ and α being expressed in radians. Clearly, equation (1) and the use of radians was not the approach taken by Aristarchus, who would have used a more geometrical method of analysis, but we will allow ourselves some degree of modern convenience. We already have one number at our disposal: φ = 0.5° = 0.0087 radians. To estimate α, we need to look at the Moon during the partial-eclipse phase. Figure 3 illustrates the method used to determine the radius of the Earth's shadow at the Moon's orbit.

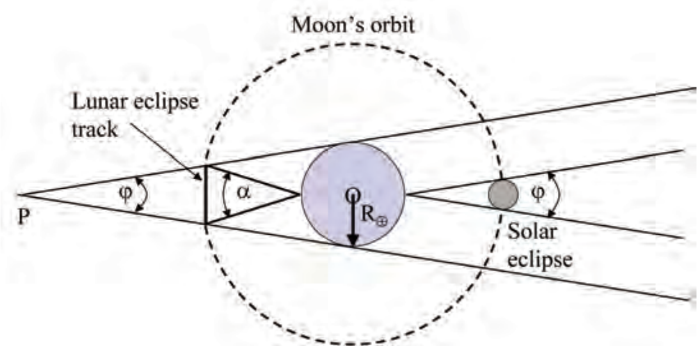

Figure 2 — The geometry used to determine the angular width α of Earth's shadow at the Moon's orbital radius. The angle φ is the angular diameter of the Sun and Moon, taken in this analysis to be 0.5 degree.

The analysis illustrated in Figure 3 builds upon the well known, indeed classical, geometrical result that a unique circle can always be constructed to pass through any three coplanar points, provided that the points do not all lie on the same line (this result is also expressed through the theorem, which states there is a unique circumscribed circle to every triangle — Smith 2000). As shown in Figure 3, the centre of the Earth's shadow is located at the interception point c of the perpendiculars constructed at the mid points m of segments vL. The point v is located by constructing a perpendicular at the mid-point of the line LL that is constructed to cross the Moon's limb at the intercept points of the Earth's shadow. Once the centre point of the Earth's shadow c has been determined, then the radius of

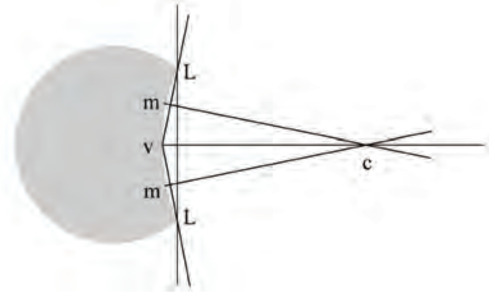

Figure 3 — Method for the determination of the Earth's shadow radius at the Moon's orbit. The line LL crosses the Moon's limb at the same location as Earth's shadow. The perpendicular constructed at the mid-point of LL is extended to give point v. The perpendiculars at m are then constructed on lines vL, and extended to meet at the centre point for the Earth's shadow at c. The image scale is provided by assuming that the Moon has an angular diameter of 0.5 degrees.

the Earth's shadow at the Moon's orbit is given by the distance cv (and cL). The angular width of the Earth's shadow α can then be determined from the diagram, given the known angular size of the Moon (φ= 0.5°).

Three lunar-eclipse images were analyzed (via the method described in Figure 3) in order to estimate the radius of the Earth's shadow at the Moon's orbit — the distance cv (see Figure 4). The results are presented in Table 1. Accordingly, I estimate that α = 1.34° = 0.0234 radians.

Time (2008 Feb. 20) CST	Shadow width	Shadow width
	(degrees)	(radians)
20:10	1.32	0.023
22:25	1.38	0.024
22:50	1.32	0.023

Table 1 — Values derived for the angular diameter of the Earth's shadow at the Moon's orbit. The calculation assumes that the Moon has an angular diameter of 0.5 degrees.

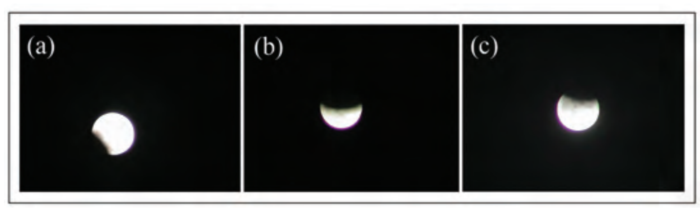

Figure 4 — The three "raw" partial-eclipse images analyzed in order to estimate the radius of the Earth's shadow at the Moon's orbit. Each image was greatly enlarged in turn and analyzed according to the construction described in Figure 3. All images were taken from Regina, Saskatchewan, at the times indicated in column 1 of Table 1, with a Sony 8 Handycam operating in single-frame-capture mode.

From equation (1) with $\varphi = 0.0087$ radians and $\alpha = 0.0234$ radians, my estimate for the Moon's orbital radius in units of Earth's radius comes out to be $D_{\leftmoon} / R_{\oplus} = 61.58$. From the details given by Ptolemy it appears that Aristarchus didn't actually attempt to measure the diameter of the Earth's shadow at the Moon's orbit, rather he assumed that it was twice as large as the Moon, corresponding to $\alpha = 1° = 0.0175$ radians. This combination of numbers results in $D_{\leftmoon} / R_{\oplus} = 75.67$. The great Hipparchus of Rhodes, working about a century after Aristarchus, estimated the Earth's shadow diameter at the Moon's orbit to be 8/3 times larger than that of the Moon (Kopal 1970), corresponding to $\alpha = 1.33° = 0.0232$ radians. With this value of α in equation (1) it is found that $D_{\leftmoon} / R_{\oplus} = 61.97$. From Ptolemy's estimate for the shadow width of $\alpha = 1.30° = 0.0227$ radians, we have $D_{\leftmoon} / R_{\oplus} = 62.97$. Using the *Observers Handbook,* we find that the Moon's mean orbital distance is 3.844×10^5 km and that the Earth's mean radius is 6371 km, giving $D_{\leftmoon} / R_{\oplus} = 60.34$ [indicating that $\alpha = 1.37(8)° = 0.0240(5)$ radians]. Not only did the ancient astronomers, Hipparchus and Ptolemy in particular, procure good estimates to the distance of the Moon, but, to my great surprise (being a mostly desk-bound writer and computer-screen reader), so did I. My estimate of the relative distance to the Moon is about 2% too high. Combining this with an earlier estimate of 6294 km for the Earth's radius (Beech 2005), the derived measure for the orbital radius of the Moon is ~387,600 km.

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Martin Beech teaches astronomy at the University of Regina, and, when not delving into the world of ancient astronomy, is thinking about the Solar System, specifically the Solar System of the future. He has just completed a book on planetary terraforming, which will be published by Springer later this year.

Daytime Observations of Venus with the Unaided Eye

by David M.F. Chapman, Halifax Centre (dave.chapman@ns.sympatico.ca)

In 1985, I first became interested in Venus. The Inferior Conjunction of 1985 April 3 was an opportunity to view Venus as a Morning Star and an Evening Star on the same day, owing to its large angular separation from the Sun on that occasion. Those observations — and the eight-year cycle associated with them — were the subject of an essay I wrote and submitted to the RASC as an entry for the Simon Newcomb writing award. The essay was published as a *JRASC* article (Chapman 1986). Soon I was contacted by Father Lucian Kemble (1922-1999), a well-known RASC member who had a similar fascination. At the General Assembly of the RASC in Edmonton in 1985, he gave an oral presentation entitled "Daytime Observations of Venus at Inferior Conjunction," which was also published in the *JRASC* (Kemble and Chapman 2000). He described an unaided visual observation of Venus in the daytime sky in 1948, and telescopic observations of Venus near Inferior Conjunction in 1977 and 1985.

I had never observed Venus during the day until recently; I confess that I had not even tried. Nevertheless, on October 5, just before Thanksgiving weekend, Dan Falk of Toronto gave me a "heads up" of a possible daytime sighting by inviting me to an "event" on *Facebook* (Dan is a science journalist and a RASC member). The "event" was named "I'm going to look for Venus in the middle of the day today." Dan's message was that the waning crescent Moon would be in the general vicinity of Venus, and could be used as a guide to find Venus in the

Blair MacDonald of the RASC Halifax Centre photographed the waning crescent Moon and Venus together in the daytime sky on Sunday, 2007 October 7.

daytime sky. As it turns out, Venus is not that hard to see in the daytime — if you know exactly where to look!

Last year, Thanksgiving weekend turned out to be a glorious three days of cool, dry, and sunny weather — at least in Halifax — and the sky was particularly transparent. In principle, one should be able to see Venus almost any day as long as the sky is clear enough. But how to find it? At night, one's sensitive peripheral vision aids detection of objects outside of the central field of view, but the bright daytime sky disables this faculty, as was pointed out by Roy Bishop during an email exchange in the middle of the ensuing observations. To see Venus in the daytime, one has to look directly at it; accordingly, a pointing device is needed.

This is where the Moon comes in. That weekend, the waning crescent Moon slowly passed by Venus over an interval of four days, and the Moon itself was easy to find in the daytime sky, being larger and brighter. From the Moon, one could find the way to Venus knowing their relative positions. (I use a program called Voyager III on the Mac, but there are several others, including Dave Lane's *Earth Centered Universe,* for PC/Windows.) Once the approximate location of Venus was known, a little scanning with the eye brought it into view. Once found, it appeared as a tiny but brilliant pinprick of light, yet if one's vision was averted even a little, Venus was lost.

I first found Venus on the Friday, about twenty degrees from the Moon in the direction of the Sun and a little below the connecting line. (Stretch out your hand and splay the fingers apart. The maximum angle between your thumb and little finger is about twenty degrees.) Using the Halifax Centre email list server, I alerted some local astronomy friends to the event and they also found it. Mary Lou Whitehorne in Bayswater described Venus as brilliant (literally). Gilles Arsenault and John McPhee (in the Annapolis Valley) also found Venus easily. I confess that I used binoculars to find it first, but others did not need this aid.

On Saturday, the Moon was closer to Venus — the distance between the first and second fingers making a peace sign (or V-for-victory, if you prefer). More viewers were conscripted, including my wife, Chris. Sherman Williams of Avonport used the view to compare the visual acuity of his left and right eyes. Roy Bishop (also in Avonport) saw Venus, and reports also came in from Curt Nason in New Brunswick and Terry Trees in Pennsylvania.

On Sunday, the Moon was even closer, although now the Moon was between Venus and the Sun, a distance of two closed fingers from Venus. That day, I found Venus without really trying. The temperature had taken a sharp drop, and those who know about such things (National Observing Chair Paul Gray) were attributing the improved sky transparency to a mass of cold, dry, Arctic air. More reports came in from Maritime observers Paul Gray, Keith Lowe, Mike Gatto, Paul Evans, Tony McGrath, Larry Bogan, and Blair MacDonald, who took the amazing photograph accompanying this article. (Steve Irvine of Wiarton, Ontario, also posted an Internet link to an astrophoto he took of Venus during the day on 2007 September 21: `www.steveirvine.com/astro/venus21ix07.html`)

It is interesting that all of the successful reports that weekend came from the east, none from the rest of Canada, even though an alert was broadcast. Are we keeners? Blessed with perfect sky conditions? Ironically, neither instigator Dan Falk (smoggy air in Toronto), nor noted unaided-eye observer Dave Turner (on duty in rainy Victoria) saw Venus. Better luck next time!

I also wonder why many of us had not tried this before. Surely, this must have been possible all along. What made this time so special? Perhaps it is due to the connectivity of the Internet, the social networking that is so easy and rapid these days.

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Visual Impressions of the Planet Mercury

by Carl Roussell, Hamilton Centre (newton15cm@yahoo.com)

Introduction

Mercury has been a prime observing target of mine for the last several years. Being a visual astronomer, I use drawings to record what I see through the telescope. As my observing and drawing skills improved, appreciation for the work done before the advent of imaging has led me to adopt this approach as much as possible. Several of the streaks, patches, and light areas observed agree to some extent with accepted albedo features for the planet.

A comparison of the images taken by the *Messenger* spacecraft during the first Mercury flyby earlier this year and professional and amateur studies, resulted in some surprising similarities. Several of the albedo features could be described not only as light or dark areas on the visible disk, but as variation in either regolith intensity or geological units. Therefore, with enough practice and perseverance, one can observe these albedo markings and the largest high-contrast geological structures using rather modest backyard equipment. Comparisons with the *Messenger* images increases the understanding and excitement experienced when seeing those "little smudges."

I have made observations of Mercury using two six-inch telescopes (one Newtonian reflector and one refractor), a magnification range of 200× to 300×, and a selection of coloured filters (W21 orange, W23A light red, W25 red) in an effort to record any definite or suspected albedo markings on the visible disk of the planet as accurately as possible. Drawings were done in grey scale because filters used for daytime observing alter the hue, and therefore do not represent the true colour of the planet.

Albedo Features

An albedo feature is a region of a planet that is decidedly lighter or darker than the surrounding areas. These features do not always relate to actual physical structures on a planet, and may be better thought of as geographical areas. Mercury has many such markings. The IAU has adopted a map prepared by Dolfus, Smith, and Murray illustrating the positions and relative intensity for each feature. This map can be found in the online book, *Atlas of Mercury* on the NASA Web site (`http://history.nasa.gov/SP-423/sp423.htm`). The latitude and longitude values given for each feature below are from the United States Geological Survey's *Gazetteer of Planetary Nomenclature,* also available online (`http://planetarynames.wr.usgs.gov/jsp/SystemSearch2.jsp?System=Mercury`).

I have been an avid Mercury observer since April 2003, when I first noted Solitudo Criophori as a dark shading along the south terminator. Since then, many of the albedo features listed below have been observed repeatedly over several apparitions, a few have been seen only rarely, and a few (marked with an asterisk) have yet to be spotted.

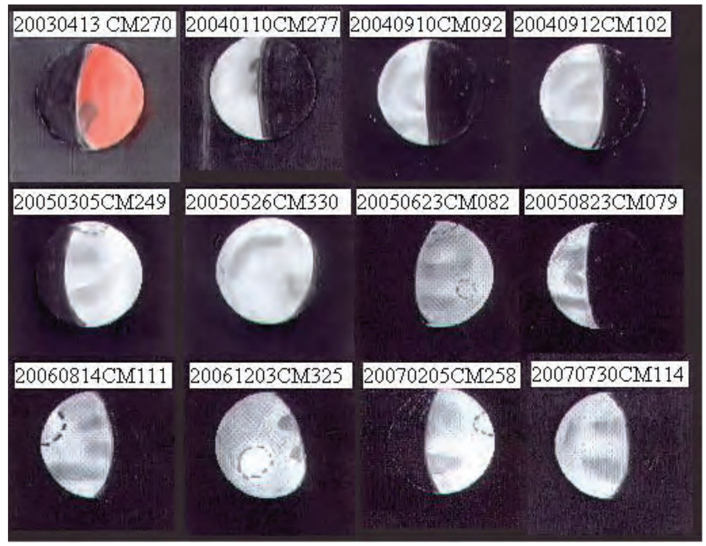


Figure 1 — A collection of images of Mercury drawn over a four-year period. The caption with each image gives the date and the longitude of the central meridian.

Apollonia: lat +45, long 315; a rarely seen light patch northwest of S. Aphrodites and S. Phoenicis.

Aurora: lat +45, long 90; a rarely observed light marking seen as a rather bright patch northwest of S. Lycaonis.

Australia: lat -72.5, long 0.0; a rarely seen brightening of the south area of the planet.

Borea*: lat 75, long 0.0; this feature has never been seen with enough confidence to chart. Borea is located northeast of S. Admetei.

Caduceata: lat +45, long 135; a rarely seen brightening of north polar region. It lies northwest of S. Admetei. From *Messenger* images, this region of Mercury seems to be a light-coloured plain. Observation 20050623.

Cyllene: lat -41, long 270; Rarely seen brightening of south polar region west of S. Persephones.

Heliocaminus: lat 40, long 170; Rarely seen elongated light streak west of S. Neptuni. This coincides with western portion of Caloris Basin. From the *Messenger* Flyby 1 images, this area seems to have a rather dark regolith with a dark-haloed crater roughly central to the position of this albedo feature. Observation 20050823.

Hesperis: lat -45, long 355; Rarely seen light patch southwest of Pieria.

Liguria: lat +45, long 225; Rarely seen light streak west of S. Phoenicis. This area coincides with the central portion of Caloris Basin. Spacecraft images have shown the presence of a large bright-rayed crater central to the location of this albedo feature, which may add to the general lightness of this feature visually. Observation 20070205.

Pentas*: lat +5, long 310; Another feature that has never been seen with enough certainty to chart. Located north of Pieria.

Phaethontias: lat 0.0, long 167; Most often seen as a nondescript area, though on the rare occasion it did appear to have a slightly lighter intensity than normal. Bounded by S. Neptuni and S. Lycaonis to the north, and S. Hellii, S. Maiae, S. Iovis, and S. Martis to the south. Several observations were necessary to see the full extent of this feature. Appears to be roughly coincidental to the position of three bright-rayed craters where the rays intersect one in an east-west orientation, and lighter-coloured regolith to the north. Observation 20040910.

Pieria: lat 0.0, 270; Frequently seen when this aspect of the planet visible as a very bright large spot or patch. This albedo feature coincides with the ejecta blanket of a radar-bright crater. Observation 20040110.

Pleias Gallia: lat +25, long 130; A nondescript area between S. Neptuni and S. Horarum. Only the presence of these dark features allowed the position of Pleias Gallia to be determined. Observation 20040910.

Sinus Argiphontae*: lat -10, long 335; This feature was never recorded. It is located northwest of Pieria.

Solitudo Admetei: lat +55, long 90; occasionally seen as a dark patch or streak. Most often, it is presented as a northwest extension of S. Neptuni. Observation 20040910.

Solitudo Alarum: lat -15, long 290; Occasionally observed dark streak. Observation 20040110.

Solitudo Aphrodites: lat 25, long 290; One of the darkest markings on Mercury, seen over many apparitions. At times, this would be the only marking visible for an observation. This is thought to be the multi-ring "Skinkas Basin." Observation 20040110.

Solitudo Atlantis: lat -35, long 210; Seldom-seen dark albedo feature southeast of S. Criophori. Roughly coincidental with the position of a dark plain imaged by *Messenger*. Observation 20050305.

Solitudo Criophori: lat 0.0, long 230; One of the most readily observed and darkest albedo features. From images, this area seems to be a plain with a very dark regolith. Observations 20030413 and 20050305.

Solitudo Helii: lat -10, long 180; Rarely made sighting of the dark extension of the S. Martis/S. Iovis/S. Maiae band of dark features. Its location is defined by the notch on the north side of the band south mid-disk. The location of this albedo feature roughly agrees with a dark plain imaged by *Messenger*. Observation 20040910.

Solitudo Hermae Trismegisti*: lat -45, long 45; Never-observed dark patch southeast of S. Martis.

Solitudo Horarum: lat +25, long 115; Occasionally seen dark patch that along with S. Lycaonis forms a crescent shape opening eastwards. Observation 20040912.

Solitudo Iovis: lat 0.0, long 0.0; Easily seen dark feature congruent with S. Maiae and S. Martis. A few of the observations of this area seemed to show some small dark patches within a slightly lighter band. Since these observations occurred over different apparitions, I am confident this each of these markings were sighted as separate features. Observation 20040912.

Solitudo Lycaonis: lat 0.0, long 107; Frequently seen as an arc extending eastwards; congruent with S. Horarum. Observation 20040912.

Solitudo Maiae: lat -15, long 155; Easily seen dark feature congruent with S. Iovis and S. Martis. Same notes as with S. Iovis. This too seems to be a dark plain. Observation 20040912.

Solitudo Martis: lat -35, long 100; Easily seen dark feature congruent with S. Iovis and S. Maiae, and sometimes S. Helli. Observation 20040912.

Solitudo Neptuni: lat +30, long 150; Frequently observed dark band, at times it appeared arced. From *Mariner* images, this region is known to be a smooth plain. Observation 20040910.

Solitudo Persephones*: lat -41, long 255; Never-observed dark feature south of S. Criophori. From spacecraft images, this seems to be a plain region with a distinctly darker regolith.

Solitudo Phoenicis: lat +25, long 225; Frequently observed dark feature, having at times a patched or streaked appearance. Several observations were necessary to find its full extent. From the *Messenger* images, this area seems to be a dark plain with a well-defined eastern boundary with Caloris Basin, and a poorly defined western limit. Observation 20050305.

Solitudo Promethei*: lat -45, long 142; Never-observed dim feature south of S. Maiae and S. Iovis.

Tricerna: lat 0.0, long 36; Very rarely seen dim crescent. Observation 20050526.

Summary

A few generalizations that can be made about the visual appearance of Mercury in smaller telescopes.

1) Appearance - The dark features are usually the first to be recognized. Next, the brightest areas may be on the "I found it" list. Lastly, many of the low-contrast features, either

dimmer or lighter in nature, can be very difficult to identify, but are well worth the effort to find.

2) Detail - Smaller features will often be seen as connected with little or no detail to differentiate between them. Only repeated observations over several apparitions, and trusting your eyes, will let the finer detail become apparent.

3) Associations - As a general guideline, dark features seem to be associated with plains, bright areas associated with rugged topography, and bright spots with rayed craters.

4) At times you will see nothing other than the phase, so do not get discouraged. It will take repeated observations over several apparitions to see what Mercury has to show.

Messenger has two more flybys of Mercury before entering orbit for a yearlong study of the planet in 2011. By the end of this period, several of the suggestions made regarding the nature of the albedo features will no doubt need modification. Even though it appears that not all albedo markings have a physical base for their appearance, trying to find those that do, and attempting a description of their nature, adds to the feeling of exploration and discovery when observing Mercury. I hope you will take some time to get to know this tiny world.

Carl Roussell has been a member of Hamilton Centre since 2005, of ALPO since 2003, and he is an avid planetary observer. His daughter Arwen says he is "mad with Mercury!"

A Moment With…

Dr. Vicky Hipkin

by Phil Mozel, Toronto and Mississauga Centres (phil.mozel@sympatico.ca)

As I write this, I look out the window and see, beside my driveway, the mid-February snow I have back-breakingly piled up in mountainous heaps over the last two weeks. The scene is decidedly polar in aspect, which, if nothing else, puts me in the proper frame of mind to write about Dr. Vicky Hipkin.

Dr. Hipkin hails from the decidedly non-polar Edinburgh, Scotland. She received her M.Sc. in Remote Sensing and Image Processing from the University of Edinburgh and, being interested in extreme environments where unusual things may happen, obtained a Ph.D. from the University of Leeds by studying Antarctic atmospheric boundary-layer dynamics. As a graduate student with the British Antarctic Survey, she looked at atmospheric stratification during the polar night and saw effects that are difficult to explain (such as the ten-degree difference in temperature that can develop over a distance as short as that between one's head and feet). This effect will be more pronounced in cold environments where the air is even thinner — say, on Mars.

Availing herself of the opportunities offered by Canada, including the wide-open spaces and natural places, Dr. Hipkin answered a call from Dr. Jim Drummond at the University of Toronto for a researcher to work on Mars mission concepts. Dr. Hipkin eventually worked on *MARVEL*, the **MAR**s **V**olcanic **E**mission and **L**ife Scout. *MARVEL* would be an orbiter designed, in part, to seek out the chemical traces of life, such as microbe-produced gas in Mars' atmosphere as well as signs of active volcanism. As part of this mission, Dr. Hipkin became co-investigator for MICA, the Mars Imager for Clouds and Aerosols, a multi-band camera tailored to imaging clouds and dust using the light of Martian sunrises and sunsets. MICA was to support the goals of *MARVEL* through the "study of Mars dust and cloud latitudinal, seasonal, and vertical variability and microphysical processes" and, through studying clouds, help us better understand the Martian water cycle.

Dr. Vicky Hipkin

MARVEL placed among the four finalists vying for a NASA ticket to Mars, with *Phoenix* being the ultimate selection. Nonetheless, Dr. Hipkin found the *MARVEL* work very exciting and wonderful training for the work she was eventually to carry out herself on *Phoenix*. As program scientist for planetary exploration with the Canadian Space Agency, she is involved in MET, the Canadian meteorological station that is part of this polar lander. Dr Hipkin is one of seven Canadian co-investigators on the *Phoenix* mission. With other *Phoenix* team members, including scientists from York University, she hopes, finally, to be able to use its data to develop an improved picture of the water cycle on Mars, although she admits, this will be challenging with information from only one landing site.

With full confidence in the mission engineers and not feeling any real tension as *Phoenix* approaches Mars, Dr. Hipkin does admit that the situation is becoming more exciting and real as the days pass. However, she acknowledges that the *Phoenix* team needs to remain focused on how to plan and respond to the measurements that will be flowing daily from the spacecraft, following the landing on May 25.

Dr. Hipkin is also a member of NASA's Mars Exploration Program Analysis Group, part of a syndicate looking at science objectives for what is probably the most exciting robotic undertaking on Mars: a sample return mission. While we do have samples of the surface (in the form of meteorites blown off Mars during impacts and collected on Earth), interpretation is difficult, as they are changed by their journey through space and we don't know exactly where they are from. By placing the samples in their proper stratigraphic context, rocks both older and younger than the returned specimen can be assessed across the planet. A returned sample can be a key to unlock the timing of major events in Mars history, including climate changes. Detailed laboratory analysis of samples on Earth can give new information on conditions and processes on Mars, including how habitable it has been at different times in its history. Canada is involved in planning for this project through the Canadian Space Agency's participation in the International Mars Architecture for Return of Samples (iMARS) task force, a committee of the International Mars Exploration Working Group.

While unable to actually visit Mars in person, Dr. Hipkin has done the next best thing by participating in the Haughton-Mars Project on Devon Island. Part of her efforts at the Canadian Space Agency has been working with team members to develop the use of extreme environments on Earth to understand scientifically and operationally how to explore other planets. On Devon Island, she had the opportunity to join scientists from McGill University who are studying ice-wedge polygons — geometrical figures formed in soil that heave due to repeated cycles of freezing and thawing. These polygons are also characteristic of the *Phoenix* landing site but the Martian variety is smaller and may have a different formation process. What is that process? Perhaps *Phoenix* will shed some light on the subject as it seeks, and is hopefully able to sample, shallow, sub-surface ice.

The main goal in sending robots to Mars, other than to blaze a path for humans, is to look for life. Dr. Hipkin suggests that proving its existence will be tricky as attested by the difficulty of deciphering the circumstances of the first life on Earth. On the positive side, we've discovered that terrestrial microbes can live in rocks at great depths and that those trapped in ice for many years may be revived. This increases the likelihood of life on Mars — but also raises the ethical issue of visiting a planet with current or nascent life. Dr Hipkin has a role in this debate as a member of NASA's Planetary Protection subcommittee. To ensure that any life the Mars exploration program detects in future is not life we have brought with us, and to prevent "forward contamination," international agreements hold nations to standards of cleanliness for spacecraft intended to reach the surface, as is the case with *Phoenix* and its ice-seeking arm. Dr. Hipkin points out that while planetary protection is already a practical concern for missions today, the ethical and philosophical issues of finding life extend far beyond the scientific community.

As a female scientist, Dr Hipkin has been delighted to find herself among several young women on the *Phoenix* team. In fact, it was Isabelle Tremblay, an engineer from the Canadian Space Agency working with MET, who designed the mission logo showing the mythical *Phoenix* rising in front of Mars. Dr. Hipkin suggests that the reason there are so many young women involved is because planetary science is a relatively new discipline. With the growth of women in science and engineering blossoming during the space age, many are finding their way into this field, partly because it is an exciting, growing area, but also perhaps because it is seen as less dominated by male tradition.

Phoenix has gotten much closer to Mars even in the time it has taken to write this column and will probably be on the surface by the time you read this. I'm sure I join all *Journal* readers in hoping that Dr. Hipkin and her colleagues are receiving all the data they can handle from a healthy lander in the Martian arctic.

This column is dedicated to my father, who was first to show me the stars.

Philip 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.

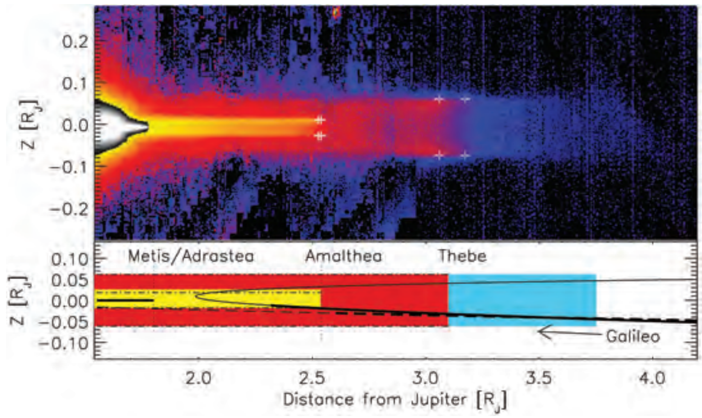
Changes in the Dark for Jupiter's Rings

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

Jupiter's rings were discovered by the *Voyager* spacecraft in 1979. They are nowhere near as big and bright as Saturn's rings, which is why they went undiscovered for so long. They are shepherded by tiny satellites that generally bound their radial extent and their thickness, with one conspicuous exception: the "Thebe extension." This is a faint extension of the ring bounded by Thebe, and according to classical ring theory, it simply shouldn't be there. But it turns out that some dust is in even odder orbits. Douglas Hamilton of the University of Maryland and Harald Krüger of the Max Planck Institute for Solar System Research in Germany have found dust on highly inclined orbits and a sorting of ring particles by size, so that there is an excess of very small particles inside Amalthea's orbit. They are able to explain all these oddities by showing that the dust particles become charged when they enter Jupiter's shadow and discharge when the leave it (see the May 1 issue of *Nature*). Jupiter's strong magnetic field can then push the charged grains into very strange orbits.

The *Galileo* spacecraft, which orbited Jupiter from 1995 to 2003, had a dust detector on board. It passed through the Thebe and Amalthea rings in 2002 and 2003, finding dust particles that were inclined up to 20 degrees from Jupiter's equatorial plane! The dust in the visible rings is spread over only about 1 degree from the equator, so the high inclination was very surprising to Hamilton and Krüger, who consequently spent a lot of time investigating whether this was an instrumental artifact. They also found a decrease in the overall number of particles inside Thebe's orbit, which was puzzling, given the smooth increase in the brightness of the ring. Moreover, the smallest dust grains were much less abundant near Thebe than near Amalthea. Normally, the dust grains should be well mixed, with roughly the same distribution of sizes everywhere. These weird new properties, along with the Thebe extension, prompted Hamilton and Krüger to see if a single coherent explanation could be found for all of them.

Under normal conditions, rings are dominated by gravity — Jupiter's and the shepherd moons'. If the dust is not charged, it feels no electromagnetic force. But around Jupiter there is a fair bit of plasma, much of which comes from gas spewed out of Io. The dust grains can pick up this plasma, and can also become charged as ultraviolet photons from the Sun kick out electrons. On the sunlit side of Jupiter there is a different overall balance than on the night side, so there is an overall force applied to the grains as they move between the night and day sides. The details of this "shadow resonance" were worked out by Mihály Horányi (now at the University of Colorado) and Joe Burns of Cornell University back in 1991. But images available to them at the time were too poor to critically test the model.



Jupiter's diffuse rings, showing the positions of the moons Metis, Adrastea, Amalthea, and Thebe. The upper panel shows the rings as seen by *Galileo* in 1995. The lower panel is a cartoon presentation of the thickness and radial extent of the rings. The thin yellow rectangle is the Amalthea ring, the thicker red box is the Thebe ring, and the blue rectangle is the Thebe extension. Image courtesy of Nature, Harald Krüger, and Doug Hamilton.

Hamilton and Krüger realized that the shadow resonance could pump dust particles outward from Thebe, explaining both the Thebe extension and the newly discovered gap. But could it sort the dust and put it on highly inclined orbits? To answer that, they ran computer simulations of the effect of gravity, radiation, and electromagnetic forces on the grains. A key parameter in their simulation was the plasma density, which has not been measured, so they had to test a variety of densities. They concluded that a density of about ½ electron per cubic centimetre produced rings with the observed properties, so this becomes a strong prediction of their result. If the electron density is substantially smaller or larger than this, then their explanation cannot work.

One could reasonably ask why Amalthea doesn't have an extension like Thebe's. It turns out that the electromagnetic force near Amalthea is significantly weaker than the force near Thebe, so the dust grains can't be moved as much, and moreover they re-collide with the moons much more rapidly.

So the next time you look at Jupiter, imagine its rings and how they are shaped by shadow!

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.*

Deep-Sky Contemplations

Centaurs and other Hoofed Monsters

by Warren Finlay (warren.finlay@interbahn.com)and Doug Hube (jdhube@telus.net) Edmonton Centre

ω Centauri [RA = $13^h\ 27.3^m$, DEC = -47° 31′] is the most massive globular cluster in our galaxy. Lying at a distance of 5 kPc, ω Centauri is thought to be the remnant of an accreted dwarf galaxy. Also labelled as NGC 5129, it contains several million stars that formed during distinct intervals in the first few billion years of our Universe, possibly due to separate accretion events during interactions with interstellar clouds.

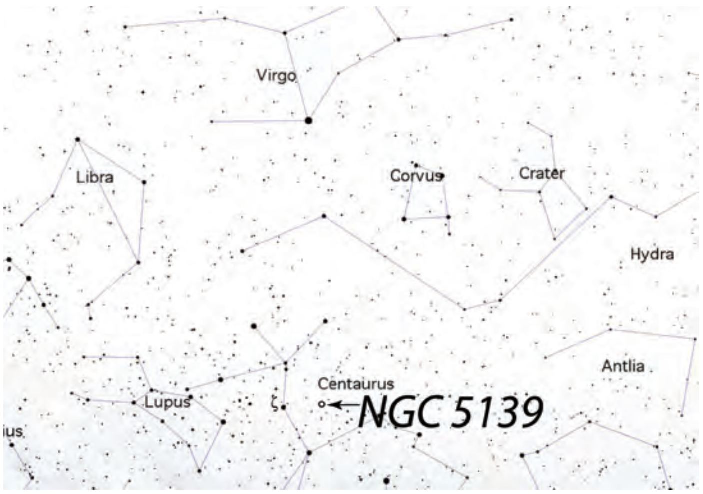


Figure 1 — Position of NGC 5139 in the night sky.

While ω Centauri may have long ago been labelled a galaxy, it is now arguably the most beautiful globular cluster in our sky. Unfortunately, ω Centauri rises above the geometrical horizon only for those observers south of 41° 29′. Since this is just beyond the most southern latitude in Canada (41° 43′ at Pelee Island, in Lake Erie), you might conclude that you will never see this object from Canadian soil. However, refraction bends light near the horizon by about 30′, so that it is theoretically possible to see this object from latitudes south of about 42°. In fact, if the horizon is cloud free, ω Centauri does barely peek above the horizon in Canada, as described by Dan Taylor in the April 2001 issue of this *Journal*.

While technically possible to see this splendid object from Canada, its sparkling beauty is best appreciated from more southern latitudes where it rises high in the sky. Indeed, it was with this very goal in mind that I (WF) set out for a night of observing during a trip to Tucson, Arizona. With my trusty travel scope in the back seat of my rental car, I headed south of the lights of Tucson, driving a short distance up the road to Whipple Observatory. I pulled off at what appeared to be a promising flat spot, and drove far enough into the desert scrub that I wouldn't be bothered by people or other cars' headlights. After feasting my eyes (both aided and unaided) on ω Centauri, as well as bagging a number of other objects that are difficult to observe from my normal northern observing latitudes, I sat back and appreciated the sky, feeling quite pleased with what had been a promising start to my night of observing.

My pleasure was soon dampened, however, by loud rustling noises in the nearby scrub and cacti. The rustling seemed to be coming slowly towards my location. Being a mere 30 km from the Mexican border, and not being familiar with desert fauna (or illegal immigrants), I had no clue what could be making the

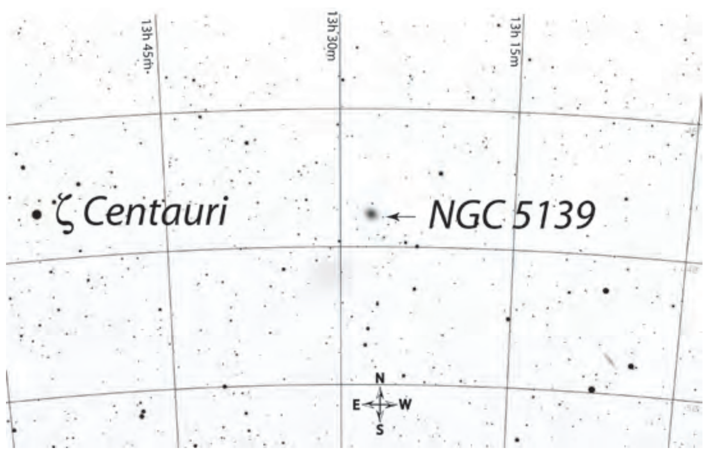


Figure 2 — Finder chart for NGC 5139.

noise. To avoid destroying my night vision, I attempted to find the source of the offending noise with my dim red flashlight, but to no avail. As the rustling became louder, my nerves got the better of me and I reluctantly hauled out my white light. There on the other side of a few cacti were two big eyes staring at me. It must be a cow, I decided, so I lobbed a few rocks, hoping to scare it off. Whatever belonged to the beady eyes was not deterred by my rock throwing. Being somewhat annoyed that my observing was being disturbed, I hopped in the car, turned on my headlights, and edged toward the eyes. In the beams emerged the massive bulk of a large bull!

Standing behind the safety of the car, I had the brilliant idea that a few well placed rock throws would rid me of this beast and allow me to return to observing. After the third direct hit, the bull started pawing the ground and began snorting. Not wanting to have to explain to the rental car agency that the dents in their car were the result of an off-road run-in with a bull, I threw the car in reverse and retreated. The bull seemed to think this was a good move as the rustling noises withdrew and finally stopped. Putting the car between me and where the bull had been, I went back to observing, although my deportment was admittedly less than serene. An hour or so later, the rustling started in earnest again, right in the middle of a difficult star hop that I was reluctant to halt. However, fear bested me and I tore my eyes from my star charts, and moved the car, putting it between me and the rustling noise.

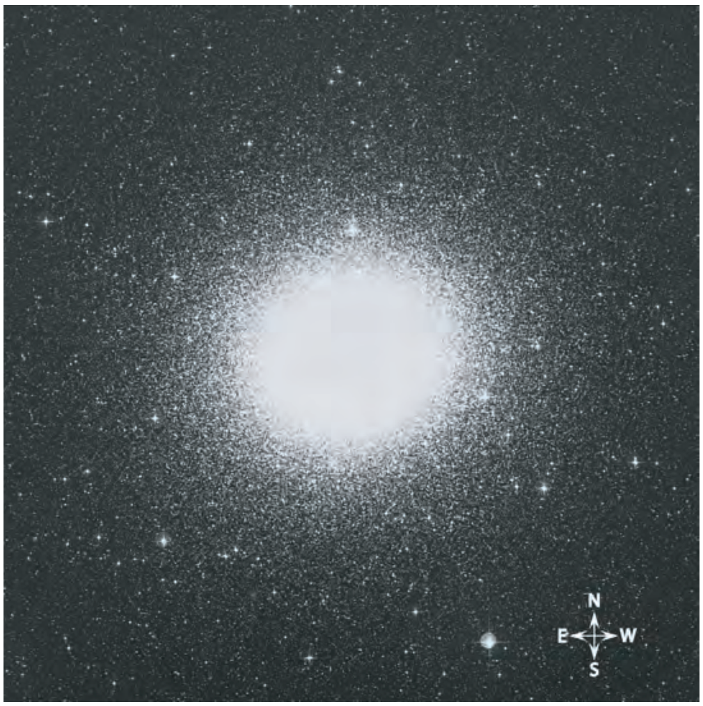


Figure 3 — 50′x 50′ POSS image centred on NGC 5139.

Starting my star hop over again, I had nearly found my object when there was a thunder of hooves that made me stand up and peer into the dark beyond the far side of the car, transfixed by what sounded to my frightened ears like an entire herd of bulls. Flying out of the scrub came a single bull, presumably the same one as before, who thundered to a halt just short of the car on the side opposite me. I spontaneously erupted into a stream of shouting, partly out of surprise and partly out of annoyance that my observing was being disturbed. I followed this with a torrent of rocks that caused the bull to start backing up. Thinking I was winning this contest, I shouted even louder and threw more rocks, although I couldn't now see where to throw as the bull began to move out of range. The rustling moved off into the distance and I eventually went back to observing, although never quite recovering my composure enough to truly appreciate several more deep-sky objects that I observed. Knowing that the bull was out there somewhere, and that I had a plane to catch the next morning, I took one final farewell peek at ω Centauri, packed up my gear, and began the long trek home to lands where this wonder of the sky remains unobservable, but where bulls are readily seen.


Figure 4 — Image of NGC 5139 courtesy Kevin Hobb (RASC Hamilton) obtained with a Tele Vue 101 and Canon Digital Rebel: stack of 13 x 120 s, ISO 800, Paramount ME, STV/Pronto Autoguide.

Next time you go south at this time of year, have a look at the crown jewel of Centaurus, but take care that celestial Centaurs are the only hoofed beasts you find!

Acknowledgements. Figure 3 is a Digital Sky Survey image produced at the Space Science Institute under U.S. Government grant NAG W-2166.

Warren Finlay enjoys visual astronomy at night (especially when the night time fauna keeps to itself), but is a professor of engineering by day. Doug Hube is a professional astronomer actively retired from the University of Alberta, and Associate Editor of this Journal.

Under Southern Skies

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

I'm back in the frozen wastes of southern Ontario again, after a month in New Zealand and Australia. The astronomical highlight of my trip was four perfect nights spent at the "Deepest South Texas Star Safari," held at Warrumbungle Mountain Motel near Coonabarabran, New South Wales. Coona is the astronomy capitol of Australia, located only a few kilometres from Siding Spring Observatory. You know you're getting close when you start seeing giant scale models of the planets along the roadside.

Picture a small 14-unit motel in the lush Australian countryside, far from civilization. A bend in the river encloses the motel, and a large field behind it is covered with closely trimmed grass. On that field are some of the largest Obsession Dobsonians to be found in Australia, 18-inch and 25-inch apertures (a couple of each), plus a pair of Fujinon 25×150 binoculars, and assorted other optical goodies, all manned by a bunch of Australia's top amateur astronomers: John Bambury, Tony Buckley, Gary Kopff, Lachlan MacDonald, and Andrew Murrell. As dusk falls, the occasional wallaby wanders through the field. Once the sky is fully dark, the southern Milky Way arcs overhead, and a myriad of southern deep-sky wonders beckons.

2008 March 02-03

My first task is to get myself oriented with my star charts, as described in the last issue, using my eyes and 10×50 binoculars. In the southeast, alpha and beta Centauri point upwards towards Crux, the Southern Cross, with the brilliant Carina Milky Way above it. The Large Magellanic Cloud is high over the south celestial pole, with the Small Magellanic Cloud down towards the southwest. These two satellites of our galaxy appear like faint puffs of cloud against the dark sky, but my binoculars soon reveal them to be rich star fields rivalled only by the Milky Way itself. Nestled below the Southern Cross is the inky dark nebula, the Coal Sack, and alongside it I make my first southern discovery, NGC 4755, the Jewel Box open cluster.

Soon I join my friend, John Bambury, fellow moderator of the Talking Telescopes Yahoo Group, who is at the controls of an 18-inch f/4.5 Obsession Dobsonian equipped with Argo Navis setting circles and a ServoCat GoTo system. We embark on a tour of what John calls "eye candy": the highlights of the southern sky. First up is the Tarantula Nebula, NGC 2070, in Dorado. In fact, this is a nebula not in our own galaxy, but in the Large Magellanic Cloud, large and bright enough to rival the Orion Nebula, even though much farther away. John has a soft spot for star clusters, both open and globular, and that is what we spend most of the evening on. Like most southern astronomers, he insists that 47 Tucanae (NGC 104) is a much better globular than its more famous rival, omega Centauri (NGC 5139), and both of them put our best northern globular, M13 in Hercules, to shame. I tend to agree with him; omega Centauri's rather even distribution of stars makes it look like what we now suspect it to be, a dwarf galaxy stripped of its gas and dust by an encounter with our Milky Way, while "47 Tuc" is a true globular with a brilliant concentration of stars at its core, fading away to nothingness in its outer reaches.

Figure 1 — eta Carina from the 4000-m heights of Bolivia, by Jay Anderson

Another highlight is my first good look at NGC 5128, known as Centaurus A or the Hamburger Galaxy. This famous object is two galaxies in collision, resulting in strong radio emission, with a strong dark band across its centre, where the dust lane of one galaxy is silhouetted against the core of the other galaxy, hence its resemblance to a giant hamburger. Then I spend a long time examining one of the most intriguing objects in our galactic neighbourhood, the eta Carinae Nebula, NGC 3372. At its centre is the star that gives it its name, probably the best candidate for a supernova in our part of the

Continued on page 112...

Pen & Pixel

John Mirtle captured this image of the PacMan Nebula (NGC 281) in Cassiopeia from Mount Kobau in August 2005. The image is taken through a Takahashi FSQ-106N using an SBIG ST-8XE camera and a Hutech Type 2 filter. Exposures were 2x10 m in R and G, and 2x12 m in B. Several prominent dark Bok globules can be seen superimposed on the background nebula.

March's lunar eclipse attracted astrophotographers across North America. This image was taken by the Winnipeg Centre's Steve Altstadt under clear skies and -25 °C temperatures. Steve used a Hutech-modified Canon D40, an f/5 Takahashi FSQ-106ED on an AstroPhysics mount, and an exposure of 1.6 s at ASA100 for this picture.

A brilliant "Capellid" meteor streaks into view as dawn breaks: the image is one still from a sequence of a few hundred that Alister Ling, Edmonton Centre later assembled into a short time-lapse movie.

See Bruce McCurdy's column on P. 116 for more on the Orionids.

"This image — 'Full Moon over Canoe Rock' — was taken on 2007 August 27 at Valdes Island, British Columbia, while I was waiting for the total eclipse on the morning of August 28." explains John McDonald of the Victoria Centre. Several exposures were taken as the Moon rose and this image is a montage of one that captured the Moon and rock at its best, and another that caught the bird over the rock moments later. Exposure was 1/500 sec. at f/5.6 and ISO 800 using a Canon 300-mm lens on a Rebel XT camera.

…Continued from page 109

galaxy, the so-called "homunculus" looking like a tiny golden brain. Immediately adjacent to this is the dark Keyhole Nebula, and surrounding all of this are vast steamers of dust and gas.

Finally, I ask John if I can try for the Horsehead Nebula (*JRASC* December 2007, 256). The terrible Canadian winter of 2007-2008 has prevented my searching it out at home, so I have brought my Hydrogen-beta filter with me. With it I can see the faint background glow of the diffuse nebula IC 434, and then the Horsehead appears with averted vision as a shadow across the faint nebulosity...success!

2008 March 03-04

Tonight we concentrate on southern galaxies. Most memorable for me is the Fornax cluster of galaxies. In the 18-inch it looks just like the *Hubble* Deep Field: a huge scattering of many sizes and shapes of galaxies. Later on we check out some of the south's double stars, Acrux (a triple) and alpha Centauri (our nearest stellar neighbours), both blindingly bright after all those faint galaxies! Finally we observe some old friends from up north. First, my all-time favourite galaxy pair, NGC 4038 and 4039 in Corvus. Instead of looking like the faint vee I see in my 11-inch at home, each of the galaxies takes on a distinct size and shape. M104 in Virgo is as beautiful as always. The real surprise is M83 in Hydra. Seen high overhead, instead of through the horizon murk at home, its spiral arms show it to be much larger than the bare nucleus, which is usually all I can make out.

2008 March 04-05

Much of tonight is devoted to a tour of the showpieces of the Large Magellanic Cloud, organized by Lance Humphreys, attending from Pahoa, Hawaii. We view field after field in the 18-inch with a Tele Vue 13-mm Ethos eyepiece, each view containing several different deep-sky objects!

I turn in a bit early in order to get up at 4:30 a.m. to see the northern "summer" Milky Way joined up with the southern "winter" Milky Way, both high overhead. This is one of the most glorious sights I've ever experienced in a lifetime of astronomy! Poor little M13 looks so puny compared with 47 Tuc and omega Centauri, both bright naked-eye objects.

2008 March 05-06

Tomorrow will be the first half of a long drive down to Melbourne to visit our son David, so I turn in fairly early, though not before reviewing the highlights of the southern skies, plus visiting a few old friends in Monoceros.

Geoff Gaherty is currently celebrating his 50th anniversary as an amateur astronomer. 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. Though technically retired as a computer consultant, he's now getting paid to do astronomy, providing content and technical support for Starry Night Software. *And now he's made us all jealous.*

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Gizmos

An Inner Tube for Your Mount

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

No one will argue that the German equatorial mount is one of the great inventions of astronomy. It eliminates latitude and makes it possible to track the stars by rotating on a single axis with just a simple clock mechanism. It made astrophotography possible. You wheel in the declination and right ascension, engage the clock drive, and open the shutter. What could be simpler? The only wire in the place was connected to a light bulb, and you left that off.

Actually it wasn't that simple, but at least it was what the German equatorial mount was designed for.

Today wires have taken over the observatory, and wires are not what the German equatorial mount was designed for. To the mount, there are a power feed and a couple of serial cables, but to the telescope, there is a power wire for the focuser, power for the camera, power for the dew heater, USB for the camera, control for the camera, USB for the guide camera, and to top it all off, coolant hoses for the chip, all draped in such a way that they never snag, never hang up, and never pull loose when the mount does a meridian flip.

Good luck.

Most solutions seem to involve nylon zip ties or Velcro straps. The zip ties do a tidy job and contain everything tightly, but they make a cable that is about as flexible as a broom handle, and to add a wire you need to cut them all off and start again. The Velcro straps are better but still produce a tight cable that hangs from only one of its components at each end, and that component, at the worst possible moment, inevitably comes unplugged.

A better answer is wrapped around your bicycle wheel. That inner tube is actually a light, flexible sleeve with a curve built into it that exactly matches the arc of all those wires draped beneath your scope.

Leave the tube on your bike, a new one doesn't cost much. Hang it beside the sweep of wires below your scope and mark it for length. Add about 1" at each end and cut. Roll the ends over the 1", and use an eyelet punch to place an eyelet at each end.

Feed the wires through the tube and arrange them neatly. Run a shoelace through each eyelet into the tube, go around the wires and back out through the eyelet. Tie off the ends to something solid at the mount and at the scope, pulling them up just tight enough to provide some slack in the wires where they come out.

The inner tube in use.

Wires are added or removed easily. The shoelace ties add full strain relief and the final result, once you get over the fact that you are using an inner tube, actually looks good.

Couldn't be easier, except that there might be the odd person reading this that doesn't own an eyelet punch. Take it to a shoemaker, or you can actually do without the eyelets. Just make holes with a paper punch.

Don and Elizabeth Van Akker belong to the Victoria RASC Centre. They observe from Salt Spring Island, where there are a lot of bicycles.

Alligators, Officers, and Other Hazards

by Guy Nason, Toronto Centre (asteroids@toronto.rasc.ca)

So bye bye Miss American Pie
Drove my Chevy to the levee, but the levee was dry.
Them Good Ol' Boys were drinking Whisky and Rye, singing...
This'll be the day that I die,
This'll be the day that I die.

From American Pie
©1971 Don McLean

I wondered if there were any alligators down there.

My good buddy Dave Bennett and I had just driven to a levee in his Chevy (it wasn't really a Chevy, but Nissan doesn't rhyme with levee) and were standing out in the dark, trying to get our bearings under a strange-to-us Florida sky. An hour earlier we had checked into a motel in Homestead, south of Miami, to spend a week enjoying the long-awaited 1986 apparition of Comet Halley. Telescopes, eyepieces, tripods, and mounts were at the ready, when suddenly we heard a very sharp *Crack!* that sounded like it came from down by the floodway at our feet. Someone or something in the dark had snapped a twig. That's when I wondered if there were any alligators down there.

I must have wondered out loud because, *Zot!* with lightning speed, Dave dove into the Chev - er, Nissan, *thunk-thunk*, slammed the doors shut and *Click-Click-Click-Click!* locked them all!!

I slowly and calmly ambled over to the car in my coolest Clint Eastwood gunfighter swagger. I tapped on Dave's window. He recklessly cracked it open a full two millimetres.

"Dave," I drawled. "I don't think alligators can open car doors. So...if it's not too much trouble...UNLOCK THE FRICKIN' DOORS AND LET ME IN!!!!"

One fine spring evening seven years later, my son Jeff, who was 13 years old at the time, and I had just set up to observe an occultation by the asteroid (216) Kleopatra from a conservation area east of Toronto. All was in order: scope up and running, target star in the eyepiece, short-wave radio time signal beeping away, and tape recorder at the ready. About 15 minutes before I was to take my position at the eyepiece, a beat-up old Plymouth Fury rattled up the drive and stopped right in front of us. Two Good Ol' Boy wannabes, dressed in gum boots, jeans, lumberjack shirts, ratty denim jackets, and John Deere baseball caps, tumbled out and headed straight for the telescope.

"Wow! All this stuff must have set you back a bundle!" said Red Neck #1.

I turned to Jeff and whispered, "Get in the van and lock the doors. If there's trouble, lean on the horn and keep leaning on the horn until help comes."

Seeing my concern, RN #2 spoke up. "Hey, it's OK. We're undercover police just checking to see if there are any poachers in here jumping the start of fishing season."

I exploded! "You off-springs of unwed female canines!" (Or words to that effect.) "Don't ever do that! You scared the bejeezez out of my son and me! You come at us looking like that, asking what my equipment is worth? And you're cops?? You call that serving and protecting?? Instead of inquiring as to the monetary value of my possessions, you should have identified yourselves immediately and defused the obvious threat you appear to be." (Or words to that effect.)

Having been shown the error of their ways, they apologized in a contrite fashion and vowed they'd never do that again. All was forgiven. I explained why we were there, what we were doing, and offered to show them a planet or two if they'd wait until I had completed my occultation observation. They readily agreed, promptly forgot all about poachers and spent an enjoyable hour or more touring the splendours of the spring sky. Oh, yes. The occultation was a miss.

Another time, Dave and I, having survived the Attack of the Phantom Alligators, were once again setting up under a moonless sky, this time on a rocky knoll beside a country road north of Orillia, Ontario, when an Ontario Provincial Police cruiser drove by, u-turned, came back to us, and stopped. As the officer stepped out of the car, Dave called out, in his cheeriest, most welcoming voice, "Hi! Wanna see Saturn's rings?"

Instantly reassured that we were mostly harmless, he said he'd love to take a short break and take a look. Well, it turned into a very long break as the constable, Dave, and I cheerfully toured the autumn sky for an hour or so. He seemed very impressed and thanked us profusely when he eventually and reluctantly took his leave. Dave and I then settled down to a long and safe night of quiet exploration.

So what does all this have to do with chasing occultations? In a word: safety. There are many ways that an enjoyable night of data-gathering can be turned into tragedy. Wild animals, hostile people, vehicle mishaps, and other dangers are waiting in the dark to ruin your night. In the interest of minimizing such calamities, I humbly offer some advice. Much of this is just common sense, of course. The trick is remembering to use that not-so-common talent in stressful times.

Alligators aren't normally considered a likely hazard in Canada, but we have one or two dangerous beasts of our own to contend with. Bears, for instance. When in bear country, always be alert. Black bears are not normally aggressive, but you never know. Through no fault of your own you could find yourself in deep trouble if, under the obscurity of darkness, you find yourself caught between a mother and her cubs. Those of you in Alberta, B.C., and 'way up north need to think about grizzlies and polar bears, which are even more dangerous. What to do?

The main thing is to avoid surprises. Steady, gentle noise is good. Your short-wave radio time source should alert bears that you are there so they won't be surprised or threatened by your presence. If you don't use an s/w radio for timing purposes, then play music or listen to a ball game on your car. Stay close to your vehicle and keep the doors unlocked (right, Dave?). You might consider keeping a can of anti-bear pepper spray handy, although I wouldn't put all my faith in the stuff. However, it might buy you a few extra seconds to get to your vehicle. My favourite bear-country advice was given to me by an Algonquin Park ranger: "Never go into the bush with someone you can't outrun." ("Hey, Grandma! Wanna go for a drive and see Saturn?")

Skunks are a greater worry, perhaps. Although I'm unaware of anyone actually being killed by a skunk, I know one or two who wish they had been. Best skunk defence: make like a statue. Stay perfectly still and let the cute little fella satisfy his curiosity on his own time. I once had one investigate my telescope and me in a most unhurried way. He/she sniffled right up to my foot, and then stretched up my leg, apparently in search of grubs embedded in my knee. Finding none, the critter then waddled over to my telescope and investigated its legs, too. All the while I wondered what effect tomato juice would have on my mirror if it came to that. Fortunately, it didn't come to that. My visitor, bored with this human and his toys, slowly departed for greener, more grub-infested hunting grounds. Remember: no sudden movement. No sudden noise. And where a dog might be useful in protecting you from bears, it most assuredly will not be an asset when it comes to skunks! So whether or not you bring Rover along depends on your expected *bête du nuit*...and common sense.

When it comes to personal safety, I'm usually more concerned about humans than other critters. For this reason I never trespass on private property, unless I have obtained permission to do so by the property owner. I prefer to seek out gateless public parks, conservation areas, or easily accessible wildlife refuges. Provincial and national parks usually have staffed gatehouses. In those instances, a brief explanation and a courteous request for entry almost always gets me into a safe area without having to pay a fee.

Some occultationists like to search out the nearest police station to their intended site, introduce themselves to the authorities and explain their intentions. I've never done this, but I can certainly see good reasons for doing so. My concern is that I might catch some over-zealous Deputy Bubba on a bad day, who might decide to be officious just for the hell of it and deny me the use of any park or roadside right-of-way. However, if he's not alerted to my presence in the first place, he is unlikely to interfere.

Twice, while doing occultations, I was accosted by hostile authorities. Once was in Pennsylvania, where I was swarmed by a squadron of four cruisers and eight State Police officers. When it quickly became apparent that I was a Good Guy, they stood down, chatted for a bit, and then hustled off, Keystone Kops-like, in search of Bad Guys. The other time I was on the western edge of Canadian Forces Base Borden near Barrie, Ontario, when two MPs in a Jeep rushed up, apparently thinking that my Newtonian telescope was some kind of rocket launcher. That was a bit hairy, until I satisfied them that I was no threat to Her Majesty's tank. In these cases, calm courtesy carried the, um, night, and all was well that ended well. Perhaps advising these fine people of my intentions beforehand would have been a good idea, after all. By the way, both of these adventures happened prior to 9/11. I'm much more careful now when in the USA or near military installations.

Civilian interference could be a problem, but I cannot comment on that scenario, since, in 20 years of mobile observing, I have never been threatened by members of the public while on station. My only advice here is to rely on those old standbys, courtesy and common sense.

Don't neglect basic highway safety. Make sure your vehicle is in good running order, that the tank is full, and your tires are properly inflated and appropriate to the season. Carry

Here is a list of possible occultations over populated parts of Canada for the next two months. For more information on events in your area, visit the IOTA Web site, `www.asteroidoccultation.com/`. It is very important that you advise me or another IOTA member if you plan to observe and time an event so we can avoid duplicating chords.

DATE(UT) 2008	ASTEROID #	Name	STAR MAG	Δ-MAG	MAX DUR	PATH
Jun. 7	790	Pretoria	12.2	0.8	12.9	QC
Jun. 14	124	Alkeste	11.3	0.7	8.4	nON - nAB
Jun. 16	345	Tercidina	11.1	1.3	9.7	sNS - nAB
Jun. 16	4526	Konko	10.2	5.6	1.2	QC - eON
Jun. 22	283	Emma	11.0	2.0	13.8	nON
Jul. 1	387	Aquitania	10.3	1.7	7.0	eQC - NB
Jul. 4	479	Caprera	11.6	2.2	7.1	cON
Jul. 14	1149	Volga	11.6	3.4	8.6	sSK - nBC
Jul. 21	6670	Wallach	9.1	4.6	1.2	cON
Jul. 27	423	Diotima	11.4	1.2	32.0	nNL - NS
Jul. 27	640	Brambilla	11.5	2.2	7.3	nON - sBC

safety flares or reflective triangles and a good set of booster cables. Never set up on the shoulder of a roadway. At the very least, get well off the road, up onto the right-of-way (but not on private property) where there is no danger of being struck by an errant vehicle. Use public parkland whenever possible.

With all this in mind, and remembering to dress according to the weather (JRASC December 2006), I'm sure you'll enjoy your travels in Occultation-land. Just remember to watch out for alligators!

Guy Nason currrently lives in Toronto. He joined the Astronomical Society of Canada in 1985 and has served on Toronto Centre Council continuously since 1986 (currently Coordinator of Observational Activities and Past President). He joined the International Occultation Timing Association (IOTA) in 1990, and successfully observed several lunar grazing occultations, total lunar occultations, and — so far — ten asteroidal occultations. He owns and operates Gneiss Hill Observatory at his cottage, 80 km northwest of Kingston, Ontario.

Orbital Oddities

Meteor Meanderings

by Bruce McCurdy, Edmonton Centre (bmccurdy@telusplanet.net)

I'm looking at the big sky
I'm looking at the big sky now
You've never understood me
You never even tried

— Kate Bush, "The Big Sky"

Can't say as I blame "you"; I don't even understand myself much of the time, no matter how hard I try. But I do know I'm happy pretty much any time I'm looking at the Big Sky.

As the calendar turned to 2007, my New Year's resolution was to do more of that. I was starting to feel bogged down with too many astronomy-related commitments at the expense of my own observing, and found my enthusiasm for the whole scene flagging. I decided that the ratio of personal observing sessions to committee meetings would have to change significantly, reasoning that it was essential for me to stoke my passion for the sky to bring focus to the various other duties I have accumulated over the years. I chose meteor observing, long a favourite pastime of mine, as the conduit.

I needed a project to focus my efforts over the intermediate term in a manner that would keep me coming back for more. The *Observer's Handbook* annually features a list of a dozen "major" nighttime meteor showers (Zenith Hourly Rate ≥ 10), which, with a couple of challenging exceptions, are all moderately-to-very accessible to a northern boy like me. So, I pondered, why not try for all 12?

Of course, there is no way the meteor calendar can fall where no showers are compromised by moonlight. In 2007 there were 13 Full Moons, with the first and last of those occurring during a shower peak. I decided to make that a part of the challenge — to observe under a variety of conditions and take whatever the sky offered me. I have never been a "dark sky chauvinist," so why should meteors be any different? That said, I was determined to observe from a dark *site* as much as possible, even if it wasn't always as dark as I would like.

I'm delighted to report that my project was very successful. From the Wolf-Moon Quadrantids to the Long-Night-Moon Ursids, I observed members from all 12 of those major showers, and identified meteors from an additional 20 minor radiants in the process. In all I recorded 20 sessions at 10 different locations around northern Alberta, logging almost 40 hours "Teff" (effective observing time) and over 500 meteors. Given that the typical observing location was an hour's drive or more from home and the mean time of observation was ~2:00 a.m. local time, I feel obliged to give myself points for persistence, if not downright stubbornness.

For sheer counting numbers, I was unlucky, being clouded out for the peak nights of the Perseids, Orionids, Leonids, and Geminids; thus my overall counts were not as impressive as other years when I have seen 400+ meteors on a single night. Isaac Newton may have seen a little further by standing on the shoulders of giants, but I was standing on the shoulders of the peaks and didn't see quite as far, or as often, as I would have liked.

I have come to appreciate that observing the shoulders is an important contribution to the process. The Global Meteor Observing Forum (MeteorObs) connects an intercontinental network of observers, and I like to contribute to the joint effort. Some showers persist at sub-peak rates for days or weeks and coverage isn't constant. For example, while I was skunked by bad weather during the Perseid peak, there was plenty of coverage around the globe that night; whereas my one successful Perseid session two nights earlier occurred during a two-hour window when I was the only observer who reported to International Meteor Organization, nicely filling in a gap in the global data.

I have long compared meteor observing to fishing. One merely needs to sit under an open sky, cast one's eyes in its direction, and wait. There is something about the simplicity of the method that appeals to my inner Luddite. Certainly it's more rewarding and interesting when the fish are jumping, the cotton is high, and the sky is alive with meteors. But even when one gets few bites, it's still an opportunity to reconnect with the Big Sky, and to have a quiet debate with nature by stopping to consider its myriad points (of light). It all comes to state of mind, and even on the slowest nights I choose to enjoy the process. Besides, I never know when I might land the Big One.

While no field-of-view-limiting optical instruments are required, technology has its uses. A talking watch (available at CNIB) and microcassette recorder allow me to observe continuously, while a Sky Quality Meter double-checks my limiting-magnitude estimates. These devices allow me to enumerate each meteor and, after some effort to transcribe and report the results, contribute to science in a meaningful way. My location in northern Alberta typically defines one extreme of the observing network, and I am particularly well-placed to observe northern radiants.

It is an odd fact that geometry strongly favours meteor observers in the northern hemisphere. The 12 major showers listed in the *Observer's Handbook* have an average declination of *+30°*! This is so far from the expected mean of zero that one wonders if physical factors are somehow at play. Better still, in most cases the Sun is well below the celestial equator; 8 of the 12 "majors" occur within a three-month interval between October 8 and January 4 when dark skies are the norm in these parts.

In only two cases is the radiant at a lower declination than the Sun. Both occur near the edges of perpetual twilight: the very challenging eta Aquarids of early May (described last issue) and the weak but worthwhile South delta Aquarids (SDAs) of late July. This past year I got exactly one of each Aquarid near its peak night, barely sustaining my annual objective each time. But there's more to the sky than meteors! The SDAs were accompanied by no fewer than six negative-magnitude satellite sightings and a spectacular late-season display of noctilucent clouds.

The northern bias is hardly limited to the major showers. Of the 56 "established showers" listed by IAU, no fewer than 41 have a radiant north of the equator. Thus I am well-positioned to observe activity from minor radiants as well, and in 2007 these provided some of the more interesting activity.

The highlight of the observing year was the Aurigid outburst of September 1. The visibility zone for the minutes-long eruption was a very narrow strip of pre-dawn terminator along western North America, so experienced meteor observers were at a premium. There was no compromising on the time — this was one peak that had no shoulders whatsoever — so my observing buddy, Alister Ling, and I had to be flexible in space instead. We ultimately drove over 700 km to achieve partially clear skies, with aurora in the holes! Under relatively poor conditions the modelers' (spectacular) predictions came true before my eyes, as I observed 9 Aurigids in the appointed hour, including 8 within 15 minutes, just at the peak. This rare cluster of meteors sourced from a long-period comet (C/1911 N1 Kiess) were impressive specimens indeed, with an average magnitude of minus (!) 0.6. See Alister Ling's outstanding image on page 111 that captured a magnitude-2 "Capellid," as well as the challenging sky conditions.

Subsequent pursuits of "enhanced activity" advisories for the Draconids and alpha Lyncids produced indifferent results except for the thrill of the chase. I lucked into a couple of other minor bursts, most notably an unexpected display of the little-known lambda Orionids that occurred while I was out watching for late Leonids. I observed whatever came my way, be they lions or lambdas.

It was interesting to compare the characteristics of the various showers. The high-velocity Perseids and Leonids left plenty of fading trains. The post-peak Geminids featured lots of negative-magnitude meteors but few trains; meanwhile the low-yield, relatively dim sigma Hydrids had me exclaiming about their subtle beauty during virtually every one of a dozen examples spotted during Geminid week. In contrast to the Aurigids and their 15-minute peak, the Taurid showers proved to be extremely long-lived; I saw my first North Taurids on October 7 and my last on November 19. At no point during several sessions in the intervening six weeks were the Taurids truly plentiful, evidence that the meteoroid stream is extremely mature and diffuse due to the frequent passes of its parent: very-short-period Comet 2P/Encke.

One evening in mid-November, Alister and I pursued the Taurids in a two-hour drive near Whitecourt, Alberta, finding a dark spot well away from yard lights, very near a railway crossing. The bucolic night air was filled with the sounds and smells of a nearby herd of cattle. The bleating bovines maintained a running commentary all night, and were quickly dubbed the Taurus Chorus. We turned our eyes to the skies in hopes of spotting their visual counterparts. Appropriately enough, the handful of Taurids we saw were none too bright! But we both saw the brightest flash of my meteor year, an early Leonid of magnitude -5 ripping the fabric of the sky, which needed a good 30 seconds to complete its usual seamless repair job. This came just minutes after a rare sighting of an Andromedid, an ultra-slow, deeply orange, -1 sparkler that sputtered and went out near Rigel. As I began to record my comments, a locomotive tooted its warning blasts, then erupted into my line of sight to temporarily rob me of my night vision. Over a hundred cars crashed by as I yelled my description of the gorgeous Andromedid. Meteor trains are supposed to be long and bright, but this one was loud!

Busy nights or slow, I looked at the Big Sky. In late October, Comet Holmes erupted into prominence, and throughout the year's busy final quarter, I included "the Second Great Comet of 2007" in my field of view as much as possible. It was fun to compare the exaggerated retrograde loop of an object so far from the ecliptic with that of Mars zigzagging through a fine northern opposition high in the Winter Hexagon. Beyond those Solar System neighbours lay stars both constant and variable, the best and brightest of the deep-sky objects, and the many clouds, clots, and clusters of the fabulous edge-on galaxy we call the Milky Way. Closer to home were artificial satellites, aurorae, local weather, and my own breath of life crystallizing in the crisp pre-dawn air. Such depth of field can be a soul-altering experience.

Often as not I would be alone in the pursuit. Occasionally Alister would join me for a dash in whatever direction he predicted clearing skies (always correctly; I highly recommend having a skilled meteorologist as an observing buddy!). Other times I would be on the outskirts of a group at the Northern Prairie Starfest or during club observing night at the Beaver Hills Dark Sky Preserve. On one such occasion I settled into my cozy sleeping bag for an hour's meteor count at the end of a night of telescopic observing. While my nearest neighbours were observing galaxy clusters, the largest observable structures in the Universe, I was monitoring for interplanetary sand grains. Hmmm, I pondered, what are ~50 orders of magnitude between friends?

All the while my ears would be monitoring too. Often I would tune my car radio to an "empty" FM band, where occasional bursts of some distant broadcast would be the signature of a meteor, its ionization train a temporary reflector forward-scattering a snippet of newscast, commercial, or any manner of song. While it's always fun to play "Name That Tune," the content of the sound packet is immaterial; to paraphrase Marshall McLuhan, the meteor *is* the message.

Other nights, when I already had enough static in my life, I would leave the radio off and just listen to nature. At times, profound silence was king. Coyotes, crickets, and cows all had their say in 2007, but birds ruled the night. I thrilled to the *hoohoohoo-hooo-hoooo* of the Great Horned Owl on the hunt, the remarkable "drumming" of the (not-so-) Common Snipe making his rounds, or the beautifully complex call-and-response of the Red-winged Blackbird in the rising dawn. One morning, the avian chorus rose from a single chirp to a cacophony of over two dozen aurally distinct species.

In some respects meteor observing and birding have plenty in common. The peak nights of the great showers are similar to the great migrations or perhaps the Christmas Bird Count. The sighting of a single Aquarid or Andromedid can be as thrilling as that unexpected observation of a rare bird. Just a few nights after my Aurigid experience, I compared notes with a birder who told me of an adventure where he drove many miles out of his way and nearly got lost in the dark while confirming a report of five Whooping Cranes somewhere in the flats of Saskatchewan. Most of his story was about inconvenience and confusion, but when he described the sight of the male Whooping Cranes doing their mating display in the setting sunlight, his eyes shone. I rhetorically asked if it was worth the effort, and his reply rang a loud bell: "It was a *life* experience!"

As 2007 came to a close, I was very fortunate to spot a couple of Ursids in the harsh light of the Long-Night Moon, and thus bring my Great Meteor Project to a successful conclusion (not that I'm planning to stop). On this one occasion I cheated and used binoculars to sweep up the third naked-eye comet of the year. Comet 8P/Tuttle was brightening to prominence, and, with 17P/Holmes, provided an unprecedented showing of two bright periodic comets, just a couple tens of degrees apart. Better yet, Tuttle is the parent comet of the Ursids, and the opportunity to see both cause and effect in the same sky was a rare and fitting ending to a remarkable observing year.

2007 summary: Bruce McCurdy, IMO code MCCBR
20 sessions, Teff = 38.78 hr
5 QUA, 18 LYR, 1 ETA, 2 SDA, 2 CAP, 36 PER, 3 KCY, 9 AUR, 1 66A, 1 SUM, 6 SPE, 1 LYN, 15 NTA, 12 STA, 3 TAU, 6 DAU, 2 GIA, 1 EUR, 2 OCA, 6 ORI, 34 LEO, 2 AND, 4 IAU, 11 LOR, 2 AMO, 128 GEM, 12 HYD, 15 COM, 5 MON, 7 DLM, 1 ALY, 7 URS, 26 ANT, 149 SPO
= 535 meteors, average magnitude = +2.0, brightest = -5

Bruce McCurdy has been interested in dynamic astronomy, both observational and theoretical, for over two decades. A Contributing Editor to JRASC *since 2000, this is Bruce's 40th column about the mechanics of the Solar System.*

The Undiscovered Country — The Skies at Low Power

by Gerry Smerchanski, Winnipeg Centre (smerch@mts.net)

"If all you have is a hammer, everything looks like a nail."
— Bernard Baruch

Our telescopes enable us to observe objects that we cannot see and reveal captivating detail in naked-eye objects that otherwise would get little more than a passing glance. And yet our telescopes have limitations, directing our attention to objects for which they are most suited and causing us to ignore others. Baruch's quote above implies that we will try to use our instruments in inappropriate ways, but astronomers, being a bit more deferential than most, will tend instead to concentrate on the objects for which the instrument is most suited. Of course, this stance usually only results *after* we do as Baruch claims and try to use our telescope to observe everything found in the sky, from aurora to Sedna. After an initial growing curve, many of us will start to acquire a variety of observing instruments to cover the range of objects that lie within optical reach. One realm that often gets ignored is that of the large extended objects that are best viewed at very low magnification. This article will evaluate the characteristics and types of instruments that are needed to explore the low-magnification Universe.

Many observers, once they get past their first department-store telescope, decide to "go big," reasoning that they would be wasting time and money to move slowly and progressively up the aperture scale. A few decades ago, the "ideal" telescope was a six-inch Newtonian on an equatorial mount. Then came the eight-inch Schmidt Cassegrain, displacing the Newtonian from its leading position. Today, "popular" means at least a 9- to 12-inch Schmidt Cassegrain, or even larger Dobsonian, sometimes accompanied by a 100-mm high-end refractor to take care of shortfalls in the larger instruments. But even during the era when a six-inch Newtonian was the "ideal" instrument for amateur astronomy, there was a magnification gap between observations with the unaided eye and the minimum magnification of the telescope — typically around 30×.

New Instruments and a New Perspective

Exploration of the low-power wide-angle realm requires a change of thinking as well as a change of equipment. Most of us have used binoculars to peruse some of the Messier list and a few have even succeeded in using binoculars for Messier marathons. Other observers are quite content to "cruise along the Milky Way" in search of pleasing vistas, aware, at least, that the best views of the Pleiades or the double cluster in Perseus are found in low-powered instruments (LPIs). At this point, many of us give up our LPIs to pursue more traditional observing — after all, don't most of the Messier objects look better at higher magnifications than typical LPIs can provide? Hardcore binocular observers imagine what the Great Orion Nebula would look like if it were only a tenth as far away!

One approach to rekindle interest in low-power astronomy is to retrace the history of astronomical observing, seeking out objects neglected in the traditional lists and catalogues — catalogues that are intended for telescopic viewing. Fortunately, we have pioneers who have charted this realm, and their catalogues and lists can serve as our guide. We will exchange our Messier and NGC lists in favour of those created by Philibert J. Melotte (1880-1961), Per Collinder (1890-1975), Jurgen Stock (1923-2004), Beverly Lynds, and Stewart Sharpless. The study of the objects and interests of these observers will open up a new perspective on our skies.

Figure 1 — Some of the binoculars examined. Front row left to right: Bushnell Explorer 7×50, Meade 9×63 roof prisms, no-name 10×50, William Optics 7×35 ED. Back row: Meade 11×80, Antares 11×80, Omcon 15×80, Nova 20×90 triplet objectives. Olivon 20/40×100 on optional tripod.

Tools for the Journey

What and how many instruments do we need to cover this gap between the unaided eye and the lowest power of our "optimal" single scope? These days, with a plethora of 60- to

80-mm f/6 and slower rich-field telescopes on the market, the choice for low-powered viewing is wider than it has ever been. We also have a veritable explosion of affordable large-objective binoculars that can be found in powers that fill the 0-30× gap. There seem to be many ways of approaching this quest, and no one way will be suitable for all observers. There is one rather useful division between the two: if you are concerned with maximizing the visual experience, binoculars have several advantages. But if your emphasis tends towards photography or drawing, then small telescopes should be your starting point. I'll emphasize visual observing here and leave low-powered rich-field telescopes for the next installment.

Many articles about binoculars have claimed that, while there is no one perfect instrument, the highest magnification hand-held binocular should be at the top of the list. This usually means that something around 10×50 is near the ideal. Ten-power magnification (10×) is about as much as the average person can hold steadily, while 50-mm objectives pass an optimal amount of light. At 10×, objectives much larger than 50 mm result in exit-pupil diameters too large for some eyes, resulting in so-called "wasted aperture." Pupils can dilate to 5 mm when dark-adapted (slightly more for younger eyes), so there is a limit on efficient objective size for a given magnification (more on this below).

A crucial and unjustified assumption underlies the claim that 10×50s represent the best compromise in binoculars. This assumption is that we are restricted (due to cost, or convenience, or convention) to only one pair. But binoculars can be purchased at comfortably low prices, so why not buy more than one? Happily, a fleet of decent binoculars with magnifications spanning most of the gap between eye and telescope can be purchased for less than the cost of a premium eyepiece.

One of the greater goals of low-power viewing is to maximize the true field of view. If we follow the route of pathfinders, such as Melotte, Collinder, and Stock, we must first recognize that many of their catalogue objects have large angular diameters. To see these objects in their environment, we should then seek out LPIs that give us the greatest true field of view. So while 7×50 binoculars and other wide-field low-power binoculars are frequently passed over in favour of 10×50s, we should seriously consider them an option, as they allow an optimal framing of objects larger than the usual telescope targets. Then, we need not worry about the 7-mm and larger exit pupil that might be more than our aging 5-mm pupils can appreciate, and instead value 7×50 binoculars for their expansive field of view (FOV) — a compromise noted by Al Nagler regarding the benefits of his small Tele Vue refractors. Sometimes, "wasted aperture" is a good tradeoff in exchange for a larger FOV. Some obvious examples of this are Melotte 20 (the Alpha Persei cluster), Collinder 70 (Orion), and Melotte 111 (Coma Berenices star cluster). These objects, and some others, are all but impossible to encompass in a telescope FOV.

With binoculars it is a loose but general rule that the field of view will increase as the magnification decreases; so that a 10× binocular usually has a smaller field of view than a 7× does. FOV is determined by focal length and the apparent field of view of the eyepiece (determined by optical design of the eyepiece). Focal length and eyepiece apparent field of view are seldom disclosed in binocular specifications, but usually the FOV is stated outright. Still it's a pity that such specifications are so difficult to find for binoculars. Having said that, it is possible to find wide-angle 10× binoculars with FOV equal to or greater than the FOV of 7× optics, but the edge of the FOV in the wide-angle versions usually is not as sharp as the same FOV in the 7× "normal" eyepieces.

Binoculars with a large FOV have limitations, though. You may want a large field and higher magnification. Open star clusters fall in this category, as do the star clouds found in Sagittarius and Scutum. Many large nebulae and supernova remnants also benefit from low-power high-contrast views, where a little extra magnification helps to increase the contrast between target and background. After experimenting with many binoculars, I was surprised to see the large gain in image impact by moving up to 15× or 20×. With increased magnification come dimmer images unless there is a similar increase in objective diameter. These days there are plenty of choices in the 11×80 and 15×70 to 20×80 categories, and most of them enhance the observing experience, while gathering enough light to overcome the penalty of higher magnification. In this test, I evaluated five different binoculars in this range. All gave me a rewarding view at a price less than a premium eyepiece. There are also the very large binoculars with objectives of 100 mm or more. Many have interchangeable eyepieces and angled prisms, allowing for more comfortable viewing. Most are also expensive and therefore do not support the theme of this investigation, but some have become tantalizingly affordable and thus bear examination.

One of the objectives of this column is to provide a historical perspective on the technological progress of astronomical equipment. Fortunately, many old binoculars are still in circulation and the quality of the previous generation is encouragingly close to current offerings, making the choice of cheaper used units attractive. But what is being given up? The William Optics 7×35 EDs have a new design that uses low-dispersion glass. They are fairly large and hefty, and have some of the largest eye lenses (at 27 mm) found on any binocular. They also have individual-focus eyepieces, which, for astronomical use, are precise and hold focus well. Compared to my venerable Bushnell Explorer 7×50s — which already provide sharp (on axis), bright, and high-contrast images — the newer William Optics deliver an even brighter image that is sharp farther out to the edge. The latter have better coatings, which reduces flare and reflection on bright targets such as the Moon. William Optics have an incredibly good pair optically, that only suffer from objective dust caps that do not stay in place and rubber armour that prevents binocular mounts with large flanges from reaching the threaded hole. Small-flange mounts work fine.

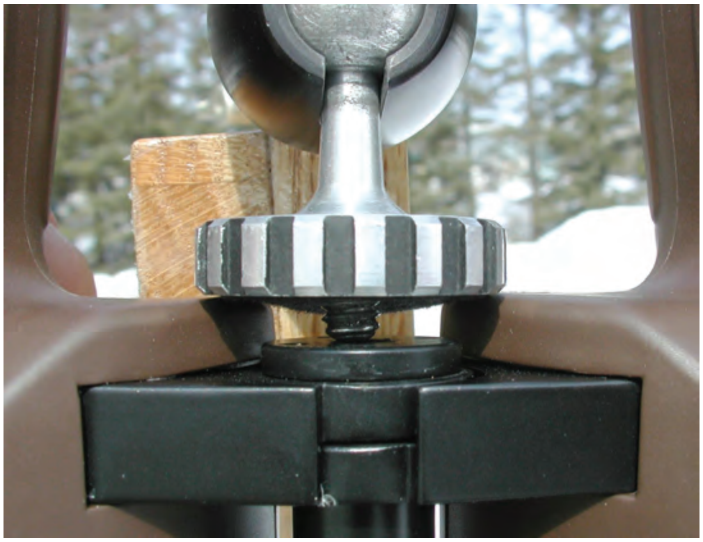


Figure 2 — Large flanges on some binocular mounts won't work with the William Optics armour-covered 7×35 EDs.

Except for cosmetic differences, the new Antares 11×80s look quite similar to the older Meade 11×80s, with similar performance. The older Meades were slightly sharper on-axis but both are very good. Modern coatings give the Antares slightly *less* flare but otherwise there is little difference between these two. As proof of the progress in value, the cost of these new Antares is *less* than the used cost for the Meades of eight years ago. Progress indeed, but these might not be for everyone. The Antares represent a great deal, but you might want to make sure that your eyes can take in a 7.3-mm exit pupil to maximum advantage. Otherwise, a smaller and lighter pair of say, 12×70s, with a similar 4.5 degree FOV, might be more suitable.

Figure 3 — On the left, the Meade 11×80, rubber-coated; right, Antares 11×80. They're similar in looks and performance.

I also tested a very good pair of the ubiquitous 15×70 binoculars that are sold under many different brand names. Employing wide FOV eyepieces, these cover about 4.5 degrees on the sky and are lighter than the 80-mm models mentioned above. If your eyes are older, or you just want a lighter, almost hand-holdable pair, the 15×70s represent a very attractive choice. My experience reveals a noticeable variation in quality between suppliers, so be prepared to give the instruments close inspection before buying. They can now be purchased for less than $100.

The Olivon 20/40×100s represent a new group of reasonably priced "twin refractor" binoculars that can take us up in magnification to the lower boundary of telescopes. This pair comes with two set of eyepieces of 20× and 40×. Binoculars in this range used to cost several thousand dollars but these can be had for around $1000 or less. The Olivons are well built, with interchangeable eyepieces and slide-out dew caps, and are almost as versatile as telescopes for magnification changes. Their only shortcomings are that they take proprietary eyepieces and are not interchangeable with either the standard .956-inch, or the 1.25-inch eyepieces. Given the limited focal travel of these instruments, it is not surprising that they were not designed to accommodate the wider range of focal points found in telescope eyepieces. Still these flagships of the LPI fleet are quite impressive. They deliver sharper edge-of-field star images than the other larger binoculars, and with their built-in 45° prisms, are made for comfortable viewing at most angles, though views near the zenith still require some uncomfortable contortions. The 20× eyepieces are comfortable and give sharp, high-contrast views. The 40× eyepieces allow this LPI to reach the threshold of telescope magnification, with high-powered views that only sacrifice performance at the edge of the field.

Figure 4 — The slick, robust, and heavy Olivon 20/40×100 are also sold under other brand names.

I compared a slightly older pair of 20×90 triplet-objective Nova binoculars with the 20/40×100 Olivons. The Olivons, which use individual focusing, were much easier to adjust and more willing to hold focus compared to the centre-focus Novas. With their 45° angle viewing, the Olivons were much more comfortable. They were also slightly sharper on the edge of the FOV. The 20× did give somewhat better views of smaller objects than the 11× and 15× LPIs used up to this point, but the gain was not as drastic as going from 7× to 15×. The Olivons also have the 40× eyepieces, which give that extra reach. At 40× and with 100-mm objectives, the entire Messier catalogue is within reach, giving compelling views of most. At this point the realm of telescopes has been reached.

So what we need for low-power observing can be approached in at least two ways. The economical approach would be to have a pair with a wide FOV — here represented by the 7×50s. They are light, inexpensive, and hand hold-able. Used pairs work fine, as low power is less demanding of optical execution. For better views of smaller, dimmer objects, 15×70s up to 20×80s can suffice. The price of the ubiquitous 15×70s makes them the binocular of choice for the budget-minded. This still leaves a bit of a gap between these and the lower end of the telescopes, but it is one that many can live with. No object will be unobservable in that gap; it is only that some objects will be viewed at a less-than-optimal FOV and power.

Figure 5 — Economical instruments, including used Nikon 7×50 too old to have a model name, and the ubiquitous 15×70 (these are "Galileo" brand). This combo is more versatile than one 10×50.

The cost-is-no-object approach would be to treat yourself to a pair of high-quality 7×50s such as the William Optics ED versions, complement those with some 11× to 15× binoculars with 70- or 80-mm objectives, and then top off with a pair of large 100-mm-plus objectives with interchangeable eyepieces to bridge the remaining gap. Like a Swiss Army knife, you'll always have the optimal tool for the target.

Figure 6 — A deluxe trio, including the William Optics 7×50 ED, Antares 11×80, and the Olivon 20/40×100.

Today the opportunity to travel either of these routes is more viable than ever. Combine these choices with a reoriented view of star clouds and large-area open clusters, and the three-dimensional aspect of our Galaxy will start to take shape in your mind. With these LPIs, you will be well equipped to reorient an ingrained view of the sky and see the heavens from a more complete perspective.

Note: Due to space limitations, more information is gathered in these evaluations than can be included here. Email author for more details on items discussed.

Acknowledgment: I thank John Hleck of Sideline Enterprises for graciously providing many of the binoculars used in this study.

Across the RASC

Don’t Disturb the Bears

by Mike Stephens, Winnipeg Centre

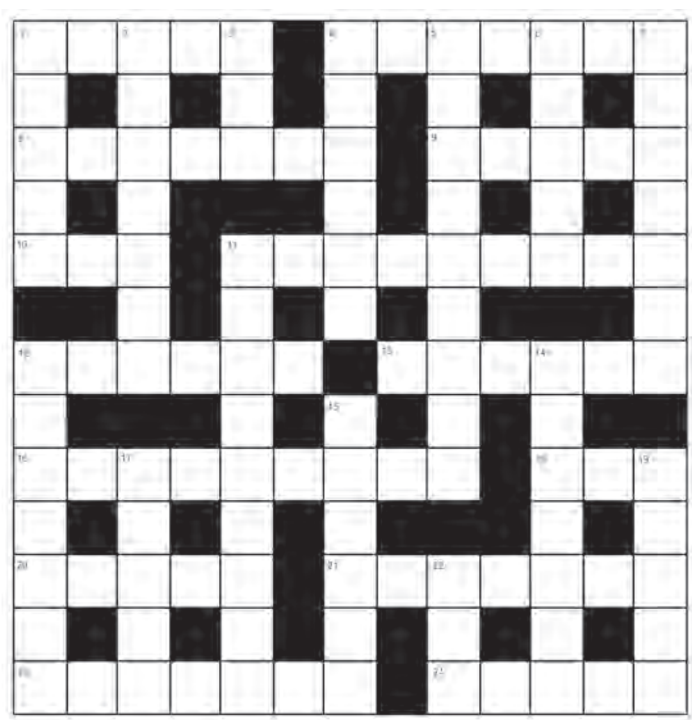
A beautiful total lunar eclipse was to occur on 2004 October 27 with the umbral phase lasting from 21:23 to 22:44 CDT in Winnipeg. The Winnipeg Centre agreed that this would be a great public event and began to scout out observing locations. The Assiniboine Park Zoo runs a family event called “Boo at the Zoo” every year in the two weeks leading up to Halloween, and the Centre approached the zoo about hosting the public observing session. The response from the zoo was unusual, to say the least. Concerned that the event would add even more to the large crowds expected for “Boo at the Zoo,” they asked if we could reschedule the eclipse event until after Halloween! The Centre was unable to accommodate the request.

Postscript: It rained all evening in Winnipeg on 2004 October 27.

The next total lunar eclipse that will occur during “Boo at the Zoo” will be on 2050 October 29!

Astrocyptic

by Curt Nason



ACROSS

1. Calendar man would tag up around the bases (5)
4. Brilliant comet bent around the net (7)
8. Eyepieces have little copper in solar arrangement (7)
9. Girl upset about eastern star (5)
10. Little Ferris wheels around the nuclear plant (1,1,1)
11. Jeers the urban railroads, impressions left as Armstrong rose from the Moon (9)
12. Look after short refractor left on earth crosser (6)
13. Right ascension gears in extinct bird or the swordfish (6)
16. Commercial robotic GEM will oddly turn a map around zero (9)
18. Shortened scope displayed first in Mallincam and Khan (3)
20. Gregorian type who started a handbook (5)
21. “Understand, Mr. Nagler?” asked hippy in explaining modern imaging (7)
23. Hesper’s exploded into planets (7)
24. He writes of variables seen in upper Cygnus Loop (5)

DOWN

1. Annoying image of Jupiter’s in Hydra (5)
2. Cleverly put lion in orbit beyond Neptune (7)
3. A sun god at the altar (3)
4. He wrote 20% of the book on the chessboard (6)
5. Her many years are gone from the north cottages (9)
6. Eastern gale blew around the nebula (5)
7. Bend steel into orbit around Saturn (7)
11. Photon detector needed to reboot LEM anew (9)
12. Conjunction and quadrature warp space to Eliot (7)
14. Current device makes me tamer (7)
15. Youth group keeps the star centred for a shot (6)
17. Arrive at a star within region before Achernar (5)
19. Editor put Lane and Ling in key parts of the book (5)
22. Gas has s/p conversion in space between electron levels (3)

Quick Picks for Observing

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

June 2008	**Event**
Sunday, June 8 2:00 UT	Mars. 1.1° N of Moon, Occultation*
Sunday, June 15 22:42 UT	Double shadow transit* on Jupiter
Tuesday, June 17 5:00 UT	Antares 10.2° N of Moon, Occultation
Saturday, June 21 0:00 UT	Summer Solstice: The Sun is at its most northerly declination and appears to have come to a standstill. Declination: latitude
Monday, June 23 2:40 UT	Double shadow transit* on Jupiter
Monday, June 23 9 UT	Neptune 0.8° S of Moon Occultation* N. America except Alaska S. Greenland

July 2008	**Event**
Tuesday, July 1 4 UT	Mars 0.7° N of Regulus Regulus is in the constellation Leo and on the Brightest Star list in the *Observer's Handbook* p. 256. Though Mars is faint, it should have a slight tinge of red/orange.
Sunday, July 6 12 UT	Regulus 1.6° N of Moon Daytime event
Friday, July 11 6 UT	Mars 0.7° S of Saturn
Saturday, July 12 5 UT	Mercury 1.9° S of M35 - Objects needed to earn your **ETU and Messier Certificate** see `www.rasc.ca/observing` for more information on these Observing Certificate programs
Thursday, July 17 12 UT	Jupiter 3° N of Moon Daytime Event
Monday, July 28 20 UT Peak time	S. δ-Aquarid meteor shower (July 12 - Aug 19) see p. 234 in the *Observer's Handbook* or `www.imo.net/calendar/2008#sda`

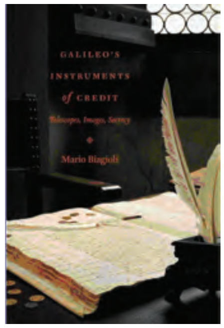
August 2008	**Event**
Saturday, Aug. 2 15 UT	Venus 2° N of Moon Daytime Event
Tuesday, Aug. 5 9:04 UT	Double shadow transit* on Jupiter
Tuesday, Aug. 12 11 UT Peak time	Perseid Meteor Shower (July 17-Aug 27)
Saturday, Aug. 16 0:00 UT	Mercury 0.7° S of Saturn - Objects needed to earn your **ETU Certificate** see `www.rasc.ca/observing` for more information on this Observing Certificate Program
Saturday, Aug. 16 21:16 UT	Full Moon-partial Lunar Eclipse See p. 124 in the *Observer's Handbook*
Saturday, Aug. 23 5 UT	Mercury 1.3° S of Venus - Objects needed to earn your **ETU Certificate,** see `www.rasc.ca/observing` for more information on this Observing Certificate Program
Thursday, Aug. 28	Zodiacal Light visible in Northern latitudes. Look east before morning twilight for next two weeks. **Zodiacal Light** - the glow of sunlight off interplanetary dust, see p. 248 in the *Observer's Handbook*

***What is a Transit Shadow?** A transit shadow is when a moon or planetary body crosses in front of another planet or object, casting a shadow on the background object.

***What is an Occultation?** The passage of a celestial body across a line between the observer and another celestial body. This generally results in a brightness drop. There are several types of occultation — see the following pages in the *Observer's Handbook:*
Lunar and lunar grazing, pp. 158, 160, 166;
Planetary, p. 228
Asteroid: For more detailed information on all occultations see: `www.lunar-occultations.com/iota/iotandx.htm`

Reviews
Critiques

Galileo's Instruments of Credit: Telescopes, Images, Secrecy, by Mario Biagioli, pages 302 + xi, 16 cm × 24 cm, University of Chicago Press, 2006. Price $35.00 US hardcover (ISBN 0-226-04561-7).



When I first started reading *Galileo's Instruments of Credit,* I found its approach and thesis so annoying that I put it down for three months. My first impression was that the author was truly stretching to find something unique to say on the early appearance and impact of the telescope and Galileo's motivations. Given next year's 400th anniversary of the publication of Galileo's *Siderius Nuncius* — arguably the most important book in the history of science (I am avoiding saying the 400th anniversary of the "invention" of the telescope, since there is reasonable evidence that it was more than 30 years earlier) — there has been a rash of books coming to press to take advantage of the anniversary. The International Year of Astronomy in 2009 also seeks to recognize the same event. Galileo's pivotal observations and his realization of their significance is, for the scientifically minded, the critical anniversary, one that truly launched the scientific revolution and lofted Galileo's career to the point that even the Church had to deal with him in unique fashion.

On ending my reading hiatus, I turned first to the book's Epilogue subtitled "Unintended Differences." There I found a concise summary of the book's main themes: economies of credit, instruments, visibility, and print, where the author observes "...these patterns relate to unstable scenarios of knowledge production where unforeseeable things happen, information is limited, the actors' tactics are steadily scrambled, and the deferred nature of knowledge claims is evidenced." With such reassurance, I delved back into the book, this time with a much better impression. The primary themes make perfect sense when one tries to piece together the rapidly evolving knowledge of the telescope in 1609-1611 to the publication, only months later, of the revolutionary discoveries of Jupiter and its moons, the phases of Venus, and the "imperfections" of the Sun and Moon.

The problem I initially had reading the Introduction ("From Brass Instruments to Textual Supplements") and first chapter ("Financing the Aura: Distance and the Construction of Scientific Authority") was that Biagioli has adopted definitions and an understanding of specific words in documents written by the various protagonists, including Galileo, the Medicis, Christoph Scheiner, Kepler, *etc.,* that may not have been the meanings understood in that earlier period. Biagioli is Italian, and I believe he also understands Latin, but despite that, determining the specific and evolving meanings of words over time is never easy, and even linguists would be cautious drawing wide-ranging conclusions without very careful research into the changing meaning of the key terms. Biagioli, an historian of science at Harvard, has been developing his thesis for several years, having published related papers: "Rights or Rewards? Changing Contexts and Definitions of Scientific Authorship" in *Journal of College and University Law,* 27 (2000), pp. 83-108, and "Replication or Monopoly? The Economies of Invention and Discovery in Galileo's Observations of 1610" in *Science in Context,* 13 (2000), pp. 547-590. Despite the author's expertise, I still found his conclusions in the early chapters not entirely convincing. The other factor of which I was skeptical was that his early arguments are largely founded on economic issues and motivations. I do not recall anyone assessing Galileo's motives previously in such terms, *i.e.* was he seeking to take financial advantage of his research? Certainly Galileo was very eager to receive the patronage of the Medicis for the stature it gave, but beyond that I am not so certain, and not convinced by Biagioli.

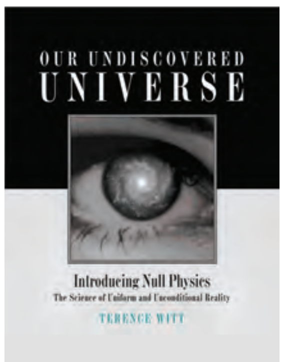
Once I got past the first chapter, Biagioli's discussion of Galileo's discoveries and how they were received is interesting and well presented. One thing for which I cannot fault Biagioli is the level of his scholarship and thoroughness of his research. On thinking about why I had initially found the work annoying, I realized that I was reading all the footnotes as I went. The problem is that on some pages, 80% of the page is devoted to footnotes, and it is challenging to read both the text and the extensive footnotes while keeping the thread of the main discussion flowing in one's mind. That is a fundamental error by the book's editors; the footnotes should have appeared as chapter endnotes. One might suggest that having so much information in the footnotes reflects the author's suspicion that he is out on a limb and therefore feels he must justify his thesis point by point. However, after reading each chapter, I went back to read through the footnotes. To my surprise they have their own story and, given the details therein, provide another perspective that will help the diligent reader assess the primary thesis.

The true strength of *Galileo's Instruments of Credit* is Biagioli's discussion of the *Siderius Nuncius* and its precursors. Many monographs have discussed this important little book, but, for historians of science and astronomy, I would equate Biagioli's contribution to be equal to Albert van Helden's critical work, *The Invention of the Telescope* (1977). *Galileo's*

Instruments of Credit is thorough, engaging, and has new insights. Like me, you may not agree with the author's thesis, but it will stimulate you to reassess how you view Galileo and his contemporaries. Biagioli has delved into many archival sources from *c.* 1609-1615 to trace the dissemination of Galileo's findings and how they were accepted, misrepresented, and also how various people from the nobility, to clergy, to scientists across Europe, interpreted the discoveries. As with modern science, the background and prejudices of Galileo's contemporaries had more than a little impact on how the science was accepted.

Randall C. Brooks

Randall Brooks' passion is the history of astronomical and other scientific instruments. He has been privileged to see Galileo's lenses first hand.



Our Undiscovered Universe: Introducing Null Physics, by Terence Witt, pages 457 + xx, 20 cm × 26.5 cm, Aridian Publishing Corporation, Melbourne, 2007. Price $59.00 US hardcover (ISBN-13 978-0-9785931-3-1).

Humility is not Witt's *forte*. Right in Chapter 1 of *Our Undiscovered Universe* we learn that the "Search for truth begins now." Perhaps the reader can be forgiven for not wanting to go further. Yet the book has merit. It begins with succinct but critical reviews of the Standard Cosmology, the Quasi-Steady Cosmology of Hoyle, Burbidge, and Narlikar, the Plasma Cosmology of Eric Lerner *(The Big Bang Never Happened),* and the Machian Cosmology of Halton Arp.

Some of Witt's criticism is completely correct. For instance, he faults the Standard Cosmology for violating energy conservation, an observation that is even emphasized by one of the cosmology's founders. In *Principles of Physical Cosmology,* P.J.E. Peebles concedes that energy is conserved globally only in the matter-dominated era. In earlier, radiation-dominated times, energy is determined by photons whose wavelength increases linearly with the size of the Universe. Here the volume energy density of the Universe decreases as its size to the inverse fourth power, and cannot balance the volume that increases only as the cube of the size. In the present accelerating Universe, the cosmological constant provides a mysterious repulsive force whose origins are in the local equations of Einstein, not in any overall balance of energy.

Sometimes Witt's enthusiasm simply overwhelms the reader. For instance, he appreciates that the negative gravitational energy of the Universe as a whole may make it possible to create matter without expenditure of any net energy. After all, Hoyle and Burbidge (and Feynman) have shown that if the radius of the Universe is taken to be the Hubble radius and density is taken as the critical density, then the gravitational energy $-GMM/R$ balances the inertial energy Mc^2 to within a factor of two. Thus, it is surprising to read Witt's assertion: "the negative gravitational potential of the universe's matter does not even come close to balancing its total energy content." It would have been so helpful if Witt had written what he meant, namely the Universe's baryonic matter. For Witt, as for several other skeptics, neither dark matter nor dark energy is acceptable.

Similarly Witt seems to believe that he is the first to labour the distinction between a photon (or a graviton) having no mass and the particle having an "infinitely small mass." Here we see a distinction between the photon and graviton. In his famed text on electromagnetism, J.D. Jackson shows that the Proca equation enables one to go smoothly from a photon of infinitely small mass to zero mass. The same is not true of the graviton. Van Dam and Veltman have shown that a massive field cannot approach general relativity in the limit of zero mass. Even with a small, non-zero mass, the bending of light around the Sun is only three-quarters that observed (and predicted by general relativity). Surprisingly, most physicists take this irregularity as an argument against a massive graviton, not as a suggestion that general relativity may not be a complete theory.

Occasionally Witt just gets his facts wrong. In discussing the small violation of Charge-Parity (CP) symmetry, Witt correctly notes that the violation observed by Cronin and Fitch 40 years ago in kaon physics is too small to account for the preponderance of matter over anti-matter in the Universe. But Witt does not describe the experiment correctly. Fitch and Cronin used neutral kaons, not charged ones. Neutral kaons were not just an experimental convenience. Quantum mechanics only allows a neutral K-beam to have two constituents that mix with each other.

Witt is rightfully concerned about the "quantized" red shifts of receding galaxies as first observed by William Tifft. Standard cosmology cannot explain why such red shifts should be quantized in units of $\Delta z = 1.2 \times 10^{-4}$. Witt's model of lumetic decay of ordinary photons can neatly accommodate the observations. Alas, ordinary physics may be able to do the job as well. In 2004 Leif Holmlid showed how the quantized red shifts could result from Raman scattering of light from intergalactic Rydberg matter. Whose interpretation is right? Perhaps Witt could suggest a test.

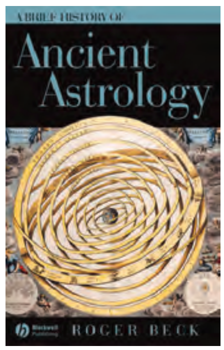
Our Undiscovered Universe is a handsomely produced book. The figures, many in full colour, are exquisite. The footnotes are very helpful. Witt cites specific pages in many standard texts, rather than just giving a chapter or a section. A minor quibble: the footnotes are not in order, and some refer to text that may have been in earlier drafts and dropped during final printing.

Witt does not, in my view, succeed in his lofty goal of deriving the evolution of the Universe from first principles. Nonetheless, his book is a significant contribution to a topic that is still far from settled.

David F. Bartlett

David F. Bartlett is a physics professor (emeritus) at the University of Colorado in Boulder. He shares Witt's disdain for dark matter and dark energy, but differs in his proposed alternative.

A Brief History of Ancient Astrology, by Roger Beck, pages 159 + xii, 14 cm × 22 cm, Blackwell Publishing, 2007. Price $23.99 paperback (ISBN-13: 978-1-4051-1074-7).



Why, you might wonder, is a professional astronomer reviewing a book on *astrology* in a reputable journal like this one? Let me count the reasons: (1) The author is my colleague, University of Toronto Professor Emeritus Roger Beck, a classicist who is an acknowledged expert on ancient astronomy and astrology. I believe that one of the functions of the *JRASC* should be to review astronomy-related books by Canadian authors; (2) For better or worse (mostly the latter), astrology is with us today, and it behooves us to know something about its origin and nature. Fortunately, astrology has not changed much since Ptolemy wrote his *Tetrabiblos* textbook, two millennia ago; (3) Astronomy and astrology share some common roots, so, by learning about ancient astrology, we are learning about the origins of our own science; (4) The astrological concepts that you will read about in this book are familiar to skywatchers today — the zodiac; the Sun, Moon, and planets; and the geometry of the celestial sphere; (5) The book is brief and, despite the potentially technical and dry subject matter, is a delight to read; the prose is clear, interesting, and elegantly written; (6) Perhaps most important: the book enriches our understanding of Greek and Roman culture and philosophy. For most Canadians, those represent an important part of our cultural heritage.

It was tempting to review *A Brief History of Ancient Astrology* by summarizing it, but the content is so rich that a summary would not do it full justice. Needless to say, it begins with an introduction, explaining the cultural and intellectual role of astrology in classical civilization, and how mathematical astronomy and astrology were linked as a "single predictive enterprise." The book continues with the historical basis of astrology and astronomy, beginning over 3000 years ago, flourishing in Babylon *c.* 500-300 BC, and expanding through Egypt to the Greek world of the Middle East, and thence to Rome. The goal of astrology was to relate the aspects of celestial bodies at birth (or conception) with outcomes, either for individuals or groups. That required a mechanism for knowing the configuration of the sky at any time in the past, which in turn required observations and/or a computational model. Shards of ancient pottery reveal a veritable "Observer's Handbook" of observational records and tables. They and surviving horoscopes, on papyri, provide research material upon which scholars' knowledge is based.

The next chapters introduce the nuts and bolts of astrology: how to construct a simple horoscope, ancient style (or, for those who desire, how to replicate it with standard sky software). That involves four basic concepts familiar to every knowledgeable skywatcher: the signs (or the constellations) of the zodiac; the Sun, Moon, and naked-eye planets; the fixed "centres" on the sky, including the ascendant (east), mid-heaven (upper meridian), descendant (west), and lower mid-heaven; and, perhaps most important, the *aspects* or relationships within or between objects in those groups. Next comes a key chapter on the theory and practice of preparing and interpreting horoscopes. It is clearly illustrated with some actual horoscopes and handbooks, retrieved from ancient sources.

What was the sociopolitical impact of astrology? Did astrologers actually claim to foretell important events in the lives of individuals — especially those in power? And how did the state react to astrologers' predictions? Fortunately there were sufficient ambiguities built into the horoscopic process, so that astrologers could weasel out of specific predictions. Indeed, much of astrology worked in reverse: astrologers sought to explain the observed outcomes in terms of the natal horoscope. But Augustus (AD 11) issued an edict against prophesy, and astrologers were, from time to time, banished from the cities.

The brief concluding chapter asks "why bother with ancient astrology in the 21st century?" The answers are subtle, complex, but powerful, and are based on astrology's rich symbolism, which was so deeply embedded in classical culture. It was a medium for telling stories about our world, and about the human condition. "Stars may or may not *cause,* but they surely do signify."

For those who wish to delve further, the book includes several pages of notes and references, and a good index.

Some might predict that the book is dying, or already dead. Not so! I am delighted to see, in my local bookstore, several series of brief, reasonably priced, authoritatively written introductions, like this one, to major branches of knowledge. They include Icon Books "Introducing" series, and especially Oxford's "Very Short Introductions." A *Brief History of Ancient Astrology* is a model of the same kind. I recommend it highly, for those who want to go beyond the basic, vanilla-flavoured prose on the Internet.

John R. Percy

John R. Percy is Professor Emeritus of astronomy and astrophysics, and of science education, at the University of Toronto. He has served as National President of the RASC, and as Editor of the Observer's Handbook.

Society News

by James Edgar, National Secretary (jamesedgar@sasktel.net)

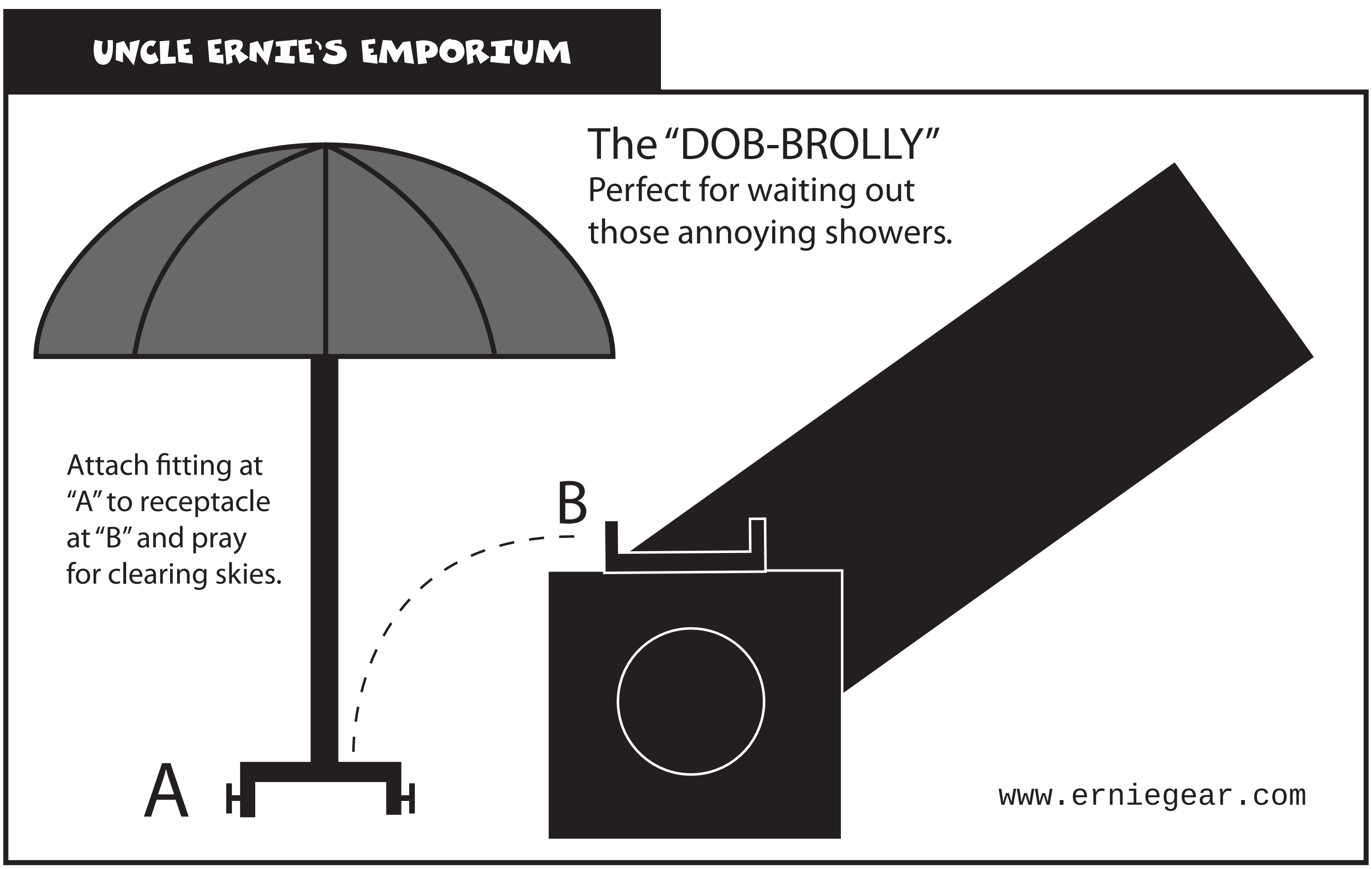
Events often come up and bite you hard in the soft underbelly! We were dismayed last April 7 to learn of Scott Young's resignation as RASC President. All of us on the Executive respect Scott's decision, and trust that he has a clear path to the future. His happy smile and calm demeanour will be missed in all our deliberations.

By the time you read this, we will be well on our way into a disclosure to the Canada Revenue Agency (CRA). We discovered, mostly by accident, that we had several practices at odds with the Income Tax Act. These practices had been ongoing for several years. All the necessary steps have been taken to stop any improper actions, and we are on the way to full "recovery."

At the end of June, at the General Assembly, National Council will have a great opportunity to carry forward the Board Pilot Committee experiment for another year. It *is* an experiment, but all involved realize that one year is just not enough — we need more time to carry through on some of the current initiatives, such as IYA2009, By-Law reform, financial stability, and to follow through on some of the items related to our affairs with the CRA.

In February, I wrote about the newest addition to the RASC — Sunshine Coast Centre (SCC). At the time, their By-Laws were in a state of revision, but now they have officially received the approval of the Executive Committee, so Welcome Aboard, Sunshine Coast Centre! We're looking forward to meeting some of you at the GA in Toronto. Bring some of your famous clear skies! To celebrate joining the RASC, the Sunshine Coast Centre held a Gala Night on April 25 at the Sechelt Legion Hall. Dr. Jaymie Matthews delivered a presentation and the new SCC banner was unfurled during the opening ceremonies.

Finally, I put to rest the old myth that a new telescope brings clouds — the day mine arrived in early April, the clouds parted and I made first light that same evening. Saturn was magnificent in the cool, clear night sky — a little too cool, but, hey, it was Saskatchewan, after all!



New Brunswick Centre - Centre Projects Grant Report
by Paul Gray and Don Kelly

Kudos to The National RASC for helping our New Brunswick Centre acquire a Coronado solar telescope. For a number of years, we had recognized the potential that this instrument held with public observing sessions, school visitations, and our Centre membership. We received our grant at the 2007 General Assembly in Calgary and placed the order on the same day. It arrived ten days later in New Brunswick and began service at our Mid-July Dam Star Party and Centre Bar-B-Que held at Mactaquac Provincial Park, and later at the Astro-Atlantik star party held at Mt. Carleton in August. It proved to be a popular observing activity with hundreds of children and adults. From Astro-Atlantik, the Coronado scope visited a Fredericton church, where more than a hundred parishioners viewed solar prominences during a community fun day. From there, it joined 500 students and parents for an Astronomy Day event at Hartland High School in the Saint John River Valley. It became a "prominent" observing station over the course of the day, and was operated efficiently by RASC member Daymon Baker.

Since Hartland, our solar scope provided a portion of the program agenda at meetings of several units of our Centre. It has passed from member to member on a first-come, first-served basis. Members are exploring the photography potential for our new solar scope and several are achieving admirable results.

In addition to the PST, we purchased an extra Cmax 12-mm eyepiece and an EQ1 mount and tripod. The total cost was $1132.02, and the portion paid by National Office was $566.01.

Thank you, national RASC, for supporting astronomy in New Brunswick.

Sunshine Coast Centre Launch

A packed house at the Sechelt Legion on April 25 celebrated the "launch" of The Royal Astronomical Society of Canada - Sunshine Coast Centre with members of The Sunshine Coast Astronomy Club. The local club will now be known as an RASC Centre, and is the 29th Centre of the Royal Astronomical Society of Canada!!

UBC's Dr. Jaymie Matthews gave a sparkling presentation entitled "The Search for Terra Nova," and Sechelt Mayor Cam Reid unfurled the new Sunshine Coast Centre Banner. Membership Chair Gary Little signed up seven new members and President Bill Clark drew a gasp from the assembly when he announced that the Sunshine Coast Centre had received a five-figure donation to go to the Observatory Fund.

The evening with Dr. Matthews was a great success, with members working hard to make sure everyone enjoyed it. There were also visitors from RASC Vancouver who made the trip to join in the celebration, and a congratulatory letter from B.C. Premier Gordon Campbell was read.

Learn more about the RASC - Sunshine Coast Centre at `www.coastastronomy.ca`.

The Last Astronomer Pirate

(as sung at the Calgary GA)

To the music of "*The Last Saskatchewan Pirate*" by The Arrogant Worms
Lyrics by the 2007 RASC-Edmonton Centre Council (with apologies to the Worms)

I was an astronomer, and tried to do it right,
I had a nice observing site far from city lights
But time went by and though I tried, the dark sky wasn't there
Developers came and built next door and told me they don't care.

I went to every agency, the answer always no.
"Dark skies now?" they'd always laugh, "we LOVE this orange glow!"
The government said that they would look into the problem soon,
But promises won't bring dark skies during the new Moon.
Then I thought, I give a damn that the stars are gone!
I'm gonna be a PIRATE in the city of Edmonton!

Refrain:

And it's a heave-ho, hi-ho, comin' down the lanes
Breakin' bulbs and streetlamps, extinguishing the flames
And it's a ho-hey, hi-hey EPCOR dim your lights
When ya see the mad astronomers on the city streets at night

Well, you'd think the auto dealers would know that I'm at large
But just the other day I found an over-lighted Dodge
I snuck up to the car lot; they didn't see me come,
I smashed their lights and put them out and called "so long scum"!
A bridge outside of Blackfoot spans a mighty river
Drivers cross in so much fear their stomachs are a'quiver
Cause they know that MIGHTY BRUCE is hiding in the bush
He'll jump the bridge and smash their lights and kick 'em in the tush!

Refrain:

Well, Ranger Bob he chased me, he's always such a dope
He'd hide along the tree line cause he didn't own a scope
But changes were a'coming and the Ranger came to see
That dark skies were terrific; he declared a DSP!
A swingin' Dobs, and Cassegrains and pleasant company
I never pay my power bill and screw the MDT (SCREW IT!!)
From St. Albert down to Bonnie Doon, you really have no hope
If you wanna reach the TWOSE deck, boy, you better bring a scope!

Refrain:

Dark skies are appealing (but) you just don't find them here,
I've heard that down in Calgary, there's a band of buccaneers
They roam the Bow from Cochrane down to Fish Creek Park
And you're gonna lose your white light if you pass them in the dark!
Well, summer is a'comin' and the days are gettin' long
My Pirate days are over once the twilight lingers on
I'll be back this autumn but now I have to go
I hear there's lots of dark sky down in New Mexico!

Refrain (x2)

Great Images

Glittering Galactic Fossils

The Great Globular Cluster in Hercules, M13, is one of the grand sights of the sky. It contains hundreds of thousands of stars, is about 25,000 light-years away, and its age approaches that of the Universe itself. A favourite target for amateur astronomers' telescopes, M13 was also a target for a radio message sent its way in 1974 by the radio telescope of the Arecibo Observatory. We may get a reply in about 50,000 years!

— Photo by Serge Théberge from *Observer's Calendar,* June 2008

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

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

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This Issue's Winning Astrophoto!

Stuart Heggie is our June winner for the "Own the Back Cover" photo contest. This image, of M33, the Triangulum Galaxy, was acquired at Flesherton, Ontario on 2007 November 10, using ST-10XME and CFW8a cameras and an Astro-Physics AP155 EDF refractor on an AP900GTO mount. Exposures were 4×5 min Luminance, 5×5 min RGB.