Orbit

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Roger Hill, Editor

Not much of a lunar eclipse, was it? Well...not from around here, anyway, which was really a shame because I was really looking forward to it. This was the last of something called a "Tetrad", where four total lunar eclipses occur in a row, 6 lunar months apart.. The others were on April 15, 2014, October 8, 2014, April 4, 2015 and September 28, 2015.

We were clouded out for the first one, the Moon set during totality for the second, the Moon set before totality for the third and then there was September's. It was all set up to be the best of them all. A lovely early Fall Sunday evening, the entire eclipse from first penumbral contact to the last visible from southern Ontario, this was going to be an eclipse to savour.

So, despite the Clear Sky Chart indicating that there'd be 30% cloud cover, I got everything ready on Sunday afternoon. I had invited a number of friends over to view the event, but they decided to pass given the probability of cloud. I hoped that 30% cloud cover meant that 70% of the sky would be clear.

I opened up my observatory for the first time in a few months, only to find out that wasps had set up a nest in the roof. They weren't happy when the nest was moved! I left them alone when they calmed down, and I cleaned up a mouse nest. I put my 6" RC on top of my 12" SCT, and got it all nicely balanced. I put a white light solar filter on the 'scope and a focal reducer in the optical train (resulting in 937mm of focal length. The focal reducer is one produced by Rock Mallin (of Mallincam fame) for his line of Ritchey-Chretien telescopes, and while the Sun and the Moon will fit on the chip of my Canon T1i, using the focal reducer means that if the lunar rate tracking is slightly off, I don't have to keep adjusting the mount to re-centre.

This normally is much more important for my EQ5, though. The LX200GPS has a "lunar rate".

I used the solar filter to properly focus the telescope, and there were a couple of nice sunspots that made the job a little easier (top, Page 3) The clouds rolled in and out and I hoped that this would remain the case for a further 12 hours, meaning I could get some pictures in the "sucker holes" between the clouds. At 8pm I went outside and I wasn't happy with what I saw. The clouds were fairly thick, but the Moon was visible. I took the solar filter off, pointed the scope at the Moon, and took a picture (middle, page 3). I set the camera to take a picture every minute, put my 15x70 binoculars on a tripod and got a comfy lawn chair ready. The clouds got worse, though and I went inside and checked the RASC list. It looked like all of southern Ontario was in the same boat, so there was no advantage to be had by driving anywhere less than 500km away.

I left the telescope and camera running, and checked every 10 minutes or so, but the skies remained obstinately overcast.

Since I had to get up at 4:25am to get to work, and with it being completely socked in, at 10:20pm I decided to close up the observatory. This took a bit longer than usual, since I didn't want to disturb the wasps. When I initially moved the roof, I could hear some movement, so I tied some rope to the roof, and pulled it shut from outside.

When I checked the photos that had been taken automatically, there was one that showed a hit of the Moon through the clouds. It ended up being a 10 second exposure, and does show the shadow of the Earth (bottom, Page 3).

And so ends my eighth year of editing Orbit. I've now done 78 issues (illness prevented two being produced). One of these months, I'll get around to producing an index to them all. I'd like to carry on doing this for another three years, so I can do the 50th Anniversary issue, as well as doing over 100. I'll have to check wit h~Eric Golding...he has a copy of every issue! It would be great to get all the paper copies scanned in.

Roger

A check of good focus using the Sun and a Baader solar film filter made by Kendrick. 1/2000 of a second at f/6.3, ISO 200.

Last picture of the Moon before the penumbral phase started.1/30th of a second at f/6.3, ISO 1600.

Only picture of the Moon during the eclipse. It was taken shortly after the Moon started entering the umbra. The shading to the right is, therefore, the darkest part of the penumbra,

Measure the moon's size and distance during a lunar eclipse

By Ethan Siegel

The moon represents perhaps the first great paradox of the night sky in all of human history. While its angular size is easy to measure with the unaided eye from any location on Earth, ranging from 29.38 arc-minutes (0.4897°) to 33.53 arc-minutes (0.5588°) as it orbits our world in an ellipse, that doesn't tell us its physical size. From its angular size alone, the moon could just as easily be close and small as it could be distant and enormous.

But we know a few other things, even relying only on naked-eye observations. We know its phases are caused by its geometric configuration with the sun and Earth. We know that the sun must be farther away (and hence, larger) than the moon from the phenomenon of solar eclipses, where the moon passes in front of the sun, blocking its disk as seen from Earth. And we know it undergoes lunar eclipses, where the sun's light is blocked from the moon by Earth.

Lunar eclipses provided the first evidence that Earth was round; the shape of the portion of the shadow that falls on the moon during its partial phase is an arc of a circle. In fact, once we measured the radius of Earth (first accomplished in the 3rd century B.C.E.), now known to be 6,371 km, all it takes is one assumption—that the physical size of Earth's shadow as it falls on the moon is approximately the physical size of Earth—and we can use lunar eclipses to measure both the size of and the distance to the moon!

Simply by knowing Earth's physical size and measuring the ratios of the angular size of its shadow and the angular size of the moon, we can determine the moon's physical size relative to Earth. During a lunar eclipse, Earth's shadow is about 3.5 times larger than the moon, with some slight variations dependent on the moon's point in its orbit. Simply divide Earth's radius by your measurement to figure out the moon's radius!

Even with this primitive method, it's straightforward to get a measurement for the moon's radius that's accurate to within 15% of the actual value: 1,738 km. Now that you've determined its physical size and its angular size, geometry alone enables you to determine how far away it is from Earth. A lunar eclipse is coming up on September 28th, and this supermoon eclipse will last for hours. Use the partial phases to measure the size of and distance to the moon, and see how close you can get!

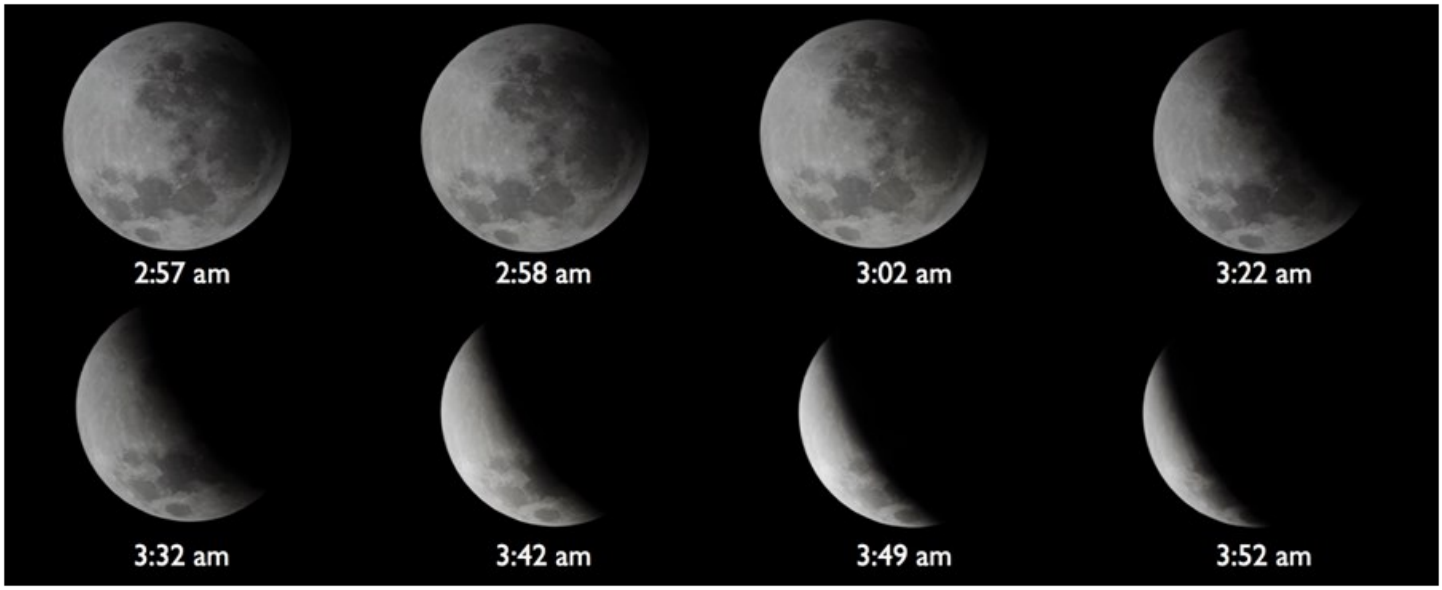
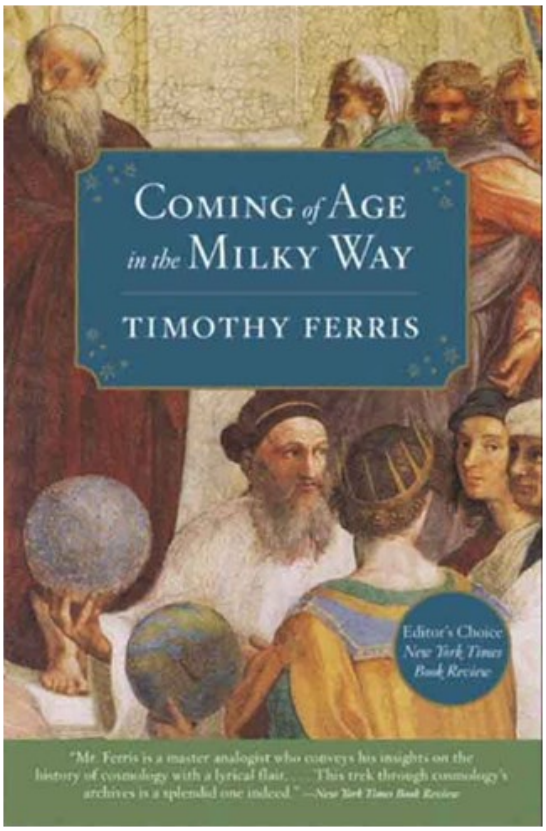


Image credit: Daniel Munizaga (NOAO South/CTIO EPO), using the Cerro Tololo Inter-American Observatory, of an eight-image sequence of the partial phase of a total lunar eclipse.

Librarian's Report for October 2015 by Chris Talpas



Our understanding of the size and nature of the Universe has changed immensely since ancient times and this month's book aims to trace that development. "Coming of Age in the Milky Way" by Timothy Ferris provides a detailed history of how our understanding of Space, Time and the Creation of the Universe has evolved over time.

At 512 pages [13.5 x 20.3 x 2.9 cm] and written over a period of 12 years, it is not a book that you are going to finish in a day or two. However this scientific history book is very well written and presents the information in an interesting and very accessible manner keeping mathematical equations and jargon to a minimum. Ferris tells us not only about the theories but we also learn about the people behind the discoveries with many interesting and enjoyable anecdotes.

As one reviewer noted: "Science writing, if it is to appeal to us unwashed masses, must achieve two very difficult things: it must render difficult concepts comprehensible to the laymen and it must be exciting enough to hold the reader's interest. Coming of Age ... succeeds brilliantly on both grounds."

I personally found it to be a great read, learning about many things and having lots of fun along the way.

The book is divided into 3 major sections covering Space, Time, and Creation and the content of each section will be briefly discussed below:

Part I Space: Beginning in the ancient past, Ferris traces the steady expansion of the size of the cosmos from ancient Sumerian, Chinese and Korean astronomers who believed as they climbed the steps of their observatories that they were getting visibly closer to the stars, to our current understanding where the universe extends beyond 13 billion light years in every direction we look. The better these early astronomers became acquainted with the periodic motions of the heavens, the more complicated they became with things like retrograde motion and precession. The early Greeks like Eudoxus envisioned the heavens as a series of concentric spheres [27 in the case of Eudoxus] centered on the Earth, spinning at different rates and inclinations to account for the apparent motions of the stars and planets. Aristotle attempted to improve upon this model with his 55 crystalline spheres. Ptolemy abandoned the aesthetic beauty of the sphere in order to make further improvements but his became more of a mathematical model rather than a faithful reproduction of the heavens. Ferris introduces us to Aristarchus who conceived of a heliocentric model of the heavens 1700 years before Copernicus.

After the dark ages and the rebirth of the age of discovery Ferris details the personalities and works of great thinkers such as Copernicus, Tycho, Kepler, Galileo and Newton. In the chapter "A Plumb Line to the Sun", Ferris discusses how efforts were made to accurately determine the size of the Astronomical Unit; the relative size of the solar system to the Earth's orbit was well established by Kepler but the absolute size eluded scientists until they accurately determined the distance to Venus during one of its rare solar transits. The further expansion of the size of the cosmos is covered including Kant's notion of a galaxy and Hubble's discovery that the spiral nebula are in fact galaxies in their own right.

Ferris provides the reader with a good introduction to Einstein and his theories of Special and General relativity and showing that the fabric of the cosmos is space-time. He goes into significant detail but never too deep and gently leads the reader down a good conceptual understanding of how gravity works and how space-time gets stretched and distorted. Part One concludes with a brief description of the expansion of the Universe. As noted earlier, what helps to set this book apart is that ample space is devoted to the personalities that advanced our knowledge and not just their discoveries.

Part II Time: Beginning with our ancestors concept of time being cyclical and infinite, Ferris traces the shift to a linear notion of time. He also traces the steady increase in the age of the cosmos from thousands of years based upon biblical accounts to the billions that we currently believe. We learn of the impact of steam driven excavation machines on revealing uniform strata throughout the world and many fossils that suggested different creatures lived at different times which sets the stage for his discussion of Darwin. We learn about the impact of the discovery of radioactivity on providing a driving force for keeping the earth's core molten and providing the means to radio-date ancient materials and rocks.

Ferris then describes how this discovery of nuclear physics then drives our understanding of the evolution of atoms and stars. Concepts like the Hertzsprung-Russell diagram are well explained along with how this understanding came about. The author describes the evolution of our understanding of how stars themselves evolve through nuclear fusion of progressively heavier elements with the largest stars ending their lives in supernova explosions. I have to say my own understanding of stellar evolution has been greatly enhanced from the clear explanations found in this book.

Part III Creation: Takes us into the strange world of Quantum Mechanics and the Standard Model with its Fermions and Bosons as well as Quarks and Leptons. While these terms may sound daunting, the author maintains an accessible style and never allows the reader to drown in waters too deep. In this section we are introduced to concepts of Symmetry and how the four fundamental forces of nature (gravity, electromagnetism, weak nuclear and strong nuclear) interact. Ferris takes us into the world of particle accelerators and shows how the very big and very small are together helping us to answer the question of how all this universe has come about. String Theory and its potential to unite the forces of nature are touched upon along with the problem that any observational tests of this theory are beyond our current technologies. The Big Bang and our quest to understand what occurred during those first fractions of a second are covered as is the concept of cosmic inflation -early in its history the universe expanded rapidly in an exponential fashion. Ferris even touches upon current theories of how the Universe's matter could simply pop into existence. He finishes with the possibility of other intelligences in the Universe asking these same questions.

While this books is certainly meaty, I found it to be as enjoyable as a fine steak (pardon the pun and apologies to the vegetarians out there).

This book is available at Indigo for $15.99 for the trade paperback An edition for a Kobo eReader is $11.99.

TINYMOS REVEALS WORLD'S FIRST PORTABLE CONSUMER ASTRONOMY CAMERA ASTRONOMY IMAGING IN THE HANDS OF EVERYDAY USER

Singapore, 21 September 2015 – TinyMOS, a Singapore-based startup, unveiled the Tiny1, the world's first portable consumer astronomy and travel camera, at TechCrunch Disrupt 2015.

Featuring advanced built-in imaging automation (such as presets for Milky Way and Northern Lights), combined with powerful hardware and software, Tiny1 packs performance and affordability within its pocket-sized body. Its sensors detects extremely dim lights, allowing the camera to capture images of the Milky Way and stellar bodies barely visible to our naked eyes at night, within a short exposure time of about 30 seconds. It is also capable of capturing time-lapse videos of the night skies at a resolution of 2.5K. The camera uses patent pending, state-of-the-art calibration techniques to automatically process the captured images, stacking the images to reduce noise in low light environments in half the time of traditional cameras. Not limited to just astronomy, Tiny1 also acts as a camera for day-to-day photography, performing as flawlessly as a mirror-less camera that provides unprecedented access to high quality images and videos to the everyday user.

For amateur astronomy enthusiasts, the Tiny1's Point-To-The-Stars feature combines up-to-date star charts with the camera's live preview to help the user locate the celestial objects they wish to capture. The bundled application will also provide regular updates on celestial events, such as Super Moons, meteor showers and more. Further software enhancement will allow for greater accuracy for telescopic applications.

"We hope to show people the wonders of the night skies, frequently forgotten by city dwellers," said TinyMOS founder Grey Tan. Grey Tan was inspired by an astronomy trip he went during his time at the National University of Singapore while pursuing his degree. "As someone who grew up in metropolitan Singapore; I was awestruck when I visited Malaysia on an astronomy trip with the school. The sky is so full of stars, I found it hard to locate Orion's Belt and I saw the Milky Way in person for the very first time." The eye opening experience inspired Grey to pursue astronomy imaging, and that was when he discovers the challenges of astronomy imaging. Technically demanding, time consuming and usually reserved for extremely savvy enthusiasts who deal with complex setups and high startup cost, even most novice stargazers often found themselves saddled with pounds of equipment costing thousands of dollars, such as DSLRs, telescopes and expensive lenses. This revelation eventually led him to start TinyMOS with his fellow co-founders.

The efforts by the team have not gone unnoticed. A demonstration of Tiny1 earlier this year has received (tremendous) praises from Dr. Bidushi Bhattacharya, a former rocket scientist who worked on the Hubble Space Telescope at NASA and at Jet Propulsion Labs. "I think that's really cool because you're providing access, like direct access to people.

Somebody could look at an object in the sky and they can actually capture (and share) their experience with somebody else," said Dr. Bhattacharya. A handheld "Hubble Telescope" according to Dr. Bidushi Bhattacharya; She describes TinyMOS's idea as "following in its (NASA's) footsteps, referring to the startup's innovative development of the Tiny1 camera, using imaging technologies initially spearheaded by NASA.

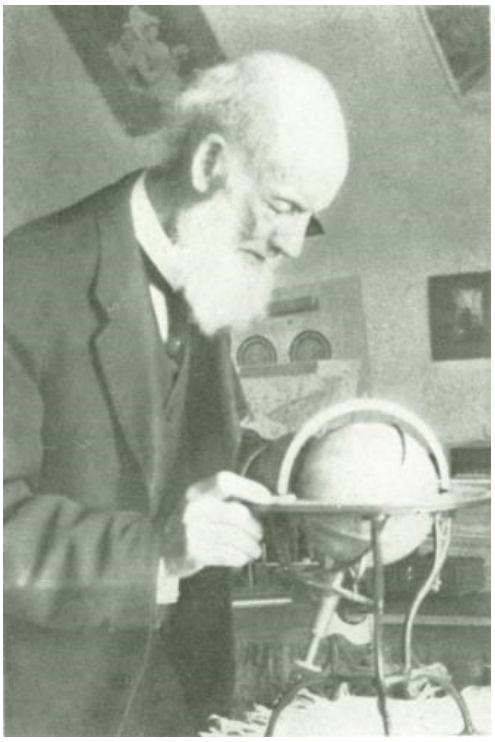
With the creation of Tiny1, Grey hopes to provide greater access to space imaging to the masses, with its powerful features yet simple interface, at affordable prices. "The Milky Way and other space phenomenon, such as the moon and auroras are literally just a click away," said Grey.

INDIEGOGO CAMPAIGN TinyMOS team is offering Tiny1 on Indiegogo this upcoming October, following a combined 18 months of engineering and product design work. The team is aiming to ship the first working cameras to Indiegogo supporters within 8 months, in time for "Milky Way season", one of the best times to observe the bright galactic center of the Milky Way.
For more information, please visit http://tinymos.com

The Origins & Evolution of the Royal Astronomical Society of Canada

Background

In the mid-nineteenth century, in the bustling Lake Ontario port city of Toronto, there were no professional astronomers. Many inhabitants of the city, however, were keenly interested in sciences and current developments in them. King's College, which grew into the University of Toronto, had been started in 1842. In 1849 it had 36 undergraduates attending, and had graduated a total of 55 students in the three faculties of arts, law and medicine. The Toronto Magnetic Observatory had been established in 1840. Its early directors and observers were officers and soldiers in garrison. Some of them, such as Captain J.F. Lefroy, contributed much to the cultural life of the city. Out of this body of interest came the Canadian Institute established in 1849 "to promote those pursuits which are calculated to refine and exalt a people."



Besides holding weekly meetings, the Canadian Institute accumulated an outstanding library. There many hours were spent in study by Andrew Elvins who had come to Canada from Cornwall in 1844. In 1860 he moved to Toronto, with a population then of 44,000, and became chief cutter in a well known clothing store on King Street. While the Canadian Institute held discussion meetings of all sciences, Elvins wished to concentrate on astronomy. For this purpose he gathered together a few like-minded friends.

Founding

On December 1, 1868 The Toronto Astronomical Club met for the first time, at the Elvins' home, "having for its object the aiding of each other in the pursuit of astronomical knowledge." The thousands of meteor sightings of the Leonid showers made in Toronto in November 1867 and 1868 had doubtless encouraged the project. In May, 1869 the word "Club" was changed to "Society." Written records were kept for the first year, until the secretary moved away. The last recorded "official" meeting was in early December of 1869, with only four members in attendance. After that, the Toronto Astronomical Society seems to have quietly dissipated; if it continued, it lead a shadowy informal existence, leaving few if any documentary traces of activity. Elvins attempted to keep interest alive through hosting meetings in his house, and eventually the Recreative Science Association (1879) was formed, which numbered former Toronto Astronomical Club members among its ranks. Astronomy was one of the objects of its meetings, but certainly not the most significant. An association—perhaps even an amalgamation—with the Natural History Society of Toronto followed.

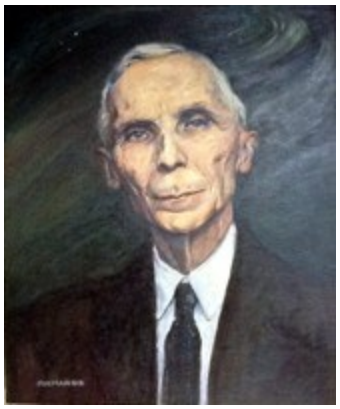
Incorporation

As the century wore on, Elvins the tailor, who lived till 1918, acquired more kindred spirits, some of them influential and prominent. A.F. Miller, a leading hospital administrator and colleague of Elvins, recorded that in the early 1880s "a small party of amateurs met occasionally, from house to house, to discuss scientific matters and papers under Mr. Elvins leadership." The 1882 transit of Venus played some role in bringing amateurs together (it is how Elvins and Miller met). In 1884 The Astronomical and Physical Society of Toronto was formed, which can be considered a reconstitution of The Toronto Astronomical Club of 1868-1869. On March 10, 1890, the organization was incorporated as The Astronomical and Physical Society of Toronto (incidentally, the year the British Astronomical Association was founded). Its first president was a government scientist, Charles Carpmael, director of the Meteorological Observatory, and president of the Royal Canadian Institute. From that time till developments in the 1970s it was the Canadian organization of astronomers, with a dual membership of professionals and amateurs.

Name Changes

In May, 1900, chiefly through the efforts of one of the important early members George E. Lumsden, another of Elvins' friends, and a provincial deputy minister, the name was changed to The Toronto Astronomical Society (tradition holds that Mrs. Lumsden's Victorian propriety was offended by the word "physical", as it could refer to the body!). In early 1903, the King of the Dominion, Edward VII of England, was petitioned through official channels to allow the Society to adopt the "Royal" style. On the 27th of February the Society was informed that "His Majesty the King has been graciously pleased to grant permission to the Toronto Astronomical Society to adopt the title of the Royal Astronomical Society of Canada" (the change was enacted in a provincial court on March 3, 1903). We have been known by that name ever since. For many years (1909-46) the Society had its offices and library in the Royal Canadian Institute buildings, and held meetings there as well as at the nearby Sandford Fleming Building on the campus of the University of Toronto.

Publications



Early in the 1890's, Dr. Clarence A. Chant of the University of Toronto became deeply interested in the Society. Dr. Chant's forte was not research, but he was an effective organizer and impresario of sorts for Canadian astronomy. Much of the direction he gave to the RASC until his death in 1956 still lingers. During its first fifteen years the Society published annually volumes containing its Transactions and Annual Report. In 1907 Dr. Chant started The Journal of the Royal Astronomical Society of Canada, and the Observer's Handbook, called then "The Canadian Astronomical Handbook." It is a remarkable fact that at the time of his death Dr. Chant had been the Editor of both the Journal and the Handbook for exactly 50 years. During this period he received generous assistance from many of the Society's members. At times the Journal was published monthly, but currently it is bi-monthly.

Expansion

The change of name in 1903 led immediately to the concept that the Society should not be limited to Toronto, but should become national in scope. The second Centre to be established was that of Ottawa in 1906, where the Dominion Observatory was being set up. In Ottawa W.F. King, Carlyle S. Beals, and Peter M. Millman along with equally notable collaborators made major contributions to professional astronomy, and the Society. The other early regional RASC node with a strong commitment to research and leading professional involvement was Victoria Centre, thanks to J.S. Plaskett, Andrew McKellar, R.M. Petrie, and colleagues.

Pro-Am Cooperation

Outstanding amateur members have made their mark on astronomy, and contributed to making the RASC more than just an astronomy club, among them David H. Levy, Paul Boltwood, and Damien Lemay, among many others.
As mentioned earlier, the close involvement of professionals in the Society and their provision of leadership changed with the rise of the Canadian Astronomical Society/Société Canadienne d'Astronomie (CASCA), during the long decade 1971-1983. CASCA is the voice of professional astronomy in Canada, and its Board of Directors forms the Canadian National Committee of the International Astronomical Union (IAU). Due to the changing nature of how cutting-edge astronomy was done nationally, and internationally in the 1970s, and the changing demands of securing big money for big science, the creation of a Canadian professional society was inevitable and necessary for the health of the discipline. Relations between RASC and CASCA remain cordial and cooperative, but the fact that professional involvement in the older Society has progressively and dramatically declined since 1971 has not been entirely to the good. Fortunately, some professionals are still members, and contribute significantly, such as James Hesser, John R. Percy, Douglas P. Hube, Doug Welch, Roberto Abraham, and Mike Reid, to name a few.

Epilogue

With 28 Centres from sea to sea across Canada, and well-over 4000 members, the Society has the potential to be significant within the scientific fabric of the country. Furthering science literacy isn't just noble, it's essential, for to quote Neil deGrasse Tyson: "I would teach how science works as much as I would teach what science knows. I would assert (given that essentially, everyone will learn to read) that science literacy is the most important kind of literacy they can take into the 21st century." With luck and discernment it is to be hoped that the Society can summon the vision to remain useful to our fellow citizens in the coming years.
—Helen Sawyer Hogg, Walter MacDonald, and R.A. Rosenfeld

Another Occultation of Aldebaran!

There's another occultation of Aldebaran this month, on October 2nd. The odd thing about this one is that it's a daytime event! If you can find the Moon in a pair of binoculars, and the sky is a nice deep blue as can happen at this time of year, then you may be able to see it!

Disappearance will be at 9:56:18 am on Friday morning, with re-appearance almost exactly an hour later at 10:55:47am. The image below shows the reappearance event from Milton, but the view will not be markedly different anywhere else in southern Ontario.

As with the one last month, the disappearance will be at the bright, sunlit, edge and the reappearance will be at the dark limb. Try to see Aldebaran half an hour before the event starts so that you can judge how easy, or difficult it will be to see the star pop out from behind the Moon.

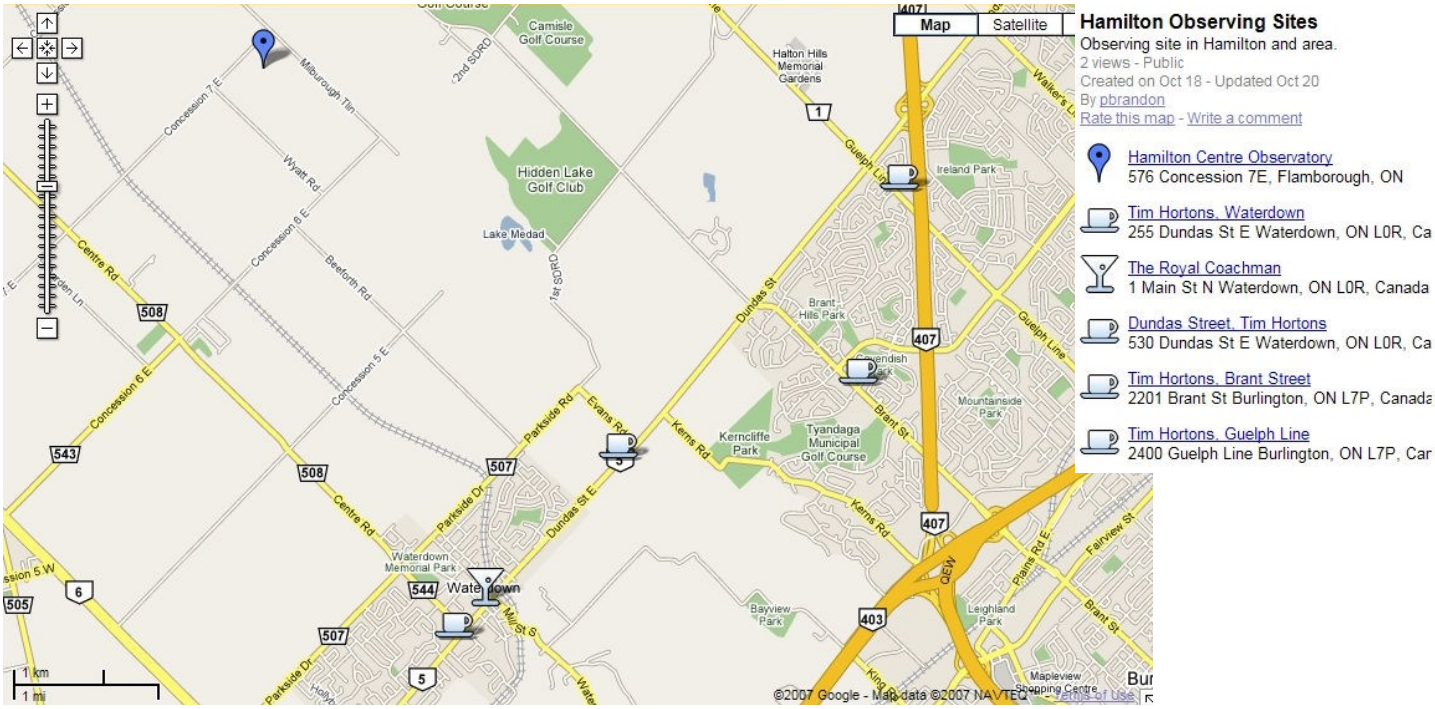
People with a polarizing filter may find it easier to see, as the filter might darken the skies just enough to make the event visible.

Enjoy! And remember, if you can see this one, then the daytime occultation of Venus on December 7th, will be easy!

Calendar of Events

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
September 27	**September 28**	**September 29**	**September 30**	**October 1** **General Meeting in Waterdown:** **Annual General Meeting**	**October 2** **Occultation of Aldebaran—see page 10**	**October 3**
October 4 **Last Quarter**	**October 5**	**October 6**	**October 7**	**October 8** **Board Meeting. Contact Gary Colwell for location.**	**October 9**	**October 10**
October 11	**October 12** Thanksgiving New Moon	**October 13**	**October 14**	**October 15**	**October 16** Moon 3° S of Saturn	**October 17** Mars 0.4° from Jupiter. Closest Approach
October 18	**October 19** **Lunar X—10pm EDT**	**October 20** First Quarter Straight Wall visible	**October 21**	**October 22**	**October 23**	**October 24** Venus 1.7° from Jupiter
October 25	**October 26** **Venus-Mars-Jupiter closest grouping in the morning**	**October 27** Full Moon—Hunters Moon	**October 28**	**October 29** **General Meeting in Waterdown:** **Annual General Meeting**	**October 30**	**October 31**

Mercury very low in very low in the E at the beginning of the month. **Venus** low in the E in morning twilight. **Mars** low in E in morning twilight.. **Jupiter** E in morning twilight.. **Saturn** very low in SW after sunset. Lost in twilight at the end of the month.



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I understand that Gary Colwell will not be continuing as President for the upcoming year.

Sometimes the pressures of a job can mean that other activities have to take a back seat for a while.

Thanks for all you hard work, Gary!