



Regulus



The Newsletter of the Royal Astronomical Society of Canada – Kingston Centre — 2007 December

Coming up...

RASC-KC Meetings

Stirling Hall Theatre "A", Baader Lane, Queen's University
Kingston, Ontario.

Friday 14 December 7:30-10pm

Friday 11 January 7:30-10pm

Meetings are co-sponsored by Queen's Physics and include astronomy lectures open to the public.

KAON Public Observing:

Queen's Observatory Ellis Hall, 4th floor from 7:30 pm to 9:30 pm

Saturday 08 December 7:30-9:30pm

Saturday 12 January 7:30-9:30pm

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Holleford Crater Tour Guide, and Commemorative Sign

On 25 November 2007, RASC-KC member Leo Enright led a field trip to the site of the Holleford Crater. Leo recounted the work of an investigative team from the federal department of mines and technical surveys, directed by Canadian astronomer Carlyle Smith Beals. Drilling for rock samples beginning in 1956, the team eventually discovered coesite at a depth of 810 feet, which confirmed it as a meteorite impact site. A similar discovery was made several years earlier at Berringer Crater in Arizona.

—More images on page 11

Kingston Centre of the Royal Astronomical Society of Canada

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**Annual Financial Report of the RASC -
Kingston Centre**

2007 November 01 by Kevin Kell
(2006-2007 Treasurer)

Observatory Equipment/maintenance 509
Misc 90
Total Expenses 8938

Surplus or Deficit on Operations -10

2006/2007 was not a bad year for the Centre. The systems and protocols for accounting, bookkeeping and auditing are falling nicely into place.

Income 2007

Membership Fees Regular	2294
Membership Fees Youth	0
Membership Fees Surcharge	518
Membership Fees Associate	15
Membership Fees Affiliate	0
Membership Fees Life	198
Donations	364
Fundraising/Grants	387
Educational Activities	1050
Interest	404
Sales of OH	40
Sales of Calendars	665
Sales of BOGs	20
Sales of Other	251
Subscription <i>S&T & Astronomy</i> 0	
Sales of Promo	33
Star Parties	1789
Annual Dinner	870
Misc	30
Total Income	8928

Expenses 2007

Library	275
Publications Newsletter	1049
Publications OH	50
Publications BOG	235
Publications Calendar	540
Publications Other	178
Events Meetings	90
Events Star Parties	1385
Events Annual Dinner	1490
Events AstroDay	343
RASC promo items	256
Equipment & Supplies	
Office Admin	230
Advertising	
General Expenses & Audit	621
Educational Activities	1279
Insurance	
Awards and Donations	318

Liquid Assets year start 20061001	21330
Surplus or Deficit on Operations	-10
Liquid Net Assets year end 20070930	21320
Capital Assets	20950
Total Assets	42270

Fund Allocation 20071001

FallNStars	\$927
General Operating	\$5,967
Observatory & Equipment	\$12,425
Reserve	\$500
Special Projects	\$1,500
Fund Total (per quicken)	\$21,319

Notes:

Our membership fees comprised \$3025/8928 or 34% of our income, as compared to 30% last year. Of the \$60 membership fee, the Centre retains \$27. We receive a life member grant of \$22 * 9 life members for \$198.

Interest returns were phenomenal at \$404 (\$10k of GICs)

Presented and accepted by the Board of Directors at the October 28th, 2007 meeting.

Audited by Susan Gagnon before the AGM and signed off as in order.

Presented on paper at the Annual General Meeting on Friday, November 9th, 2007, were available on the "Members Only" section of our web site, voted on and accepted by members present.

Capital Assets

These were updated and depreciated. Some items were written off (e.g. the Orbitor telescope).

Brief Notes on the Annual General Meeting,
by Kevin Kell

The RASC-Kingston Centre 2007 Annual General Meeting was held Friday November 9th, 2007 in Stirling Hall, Theatre D, on Queen's University Campus.

The required minutes from the 2006 AGM, President's, Secretary's and Treasurer's Reports were presented and accepted by the members attending.

The nominating committee presented its slate for the three positions open: President, Vice President, and Treasurer, with names presented for the positions of President and Treasurer only. A member was nominated from the floor for the Vice Presidency, and she accepted the nomination.

The following were acclaimed:

President: Kevin Kell

Vice President: Susan Gagnon

Treasurer: John Pilon

Congratulations!

The AGM adjourned after 30 minutes.

The Board of Directors for the RASC-KC for 2007/2008 are the three people above plus: Secretary Steve Hart (2006-2008), National Council Representative John Hurley (2006-2008), Librarian David Maguire (2006-2008), and Editor Joe Benderavage (2006-2008).

We will start work on the transition immediately. Thanks to those outgoing Board Directors Kim Hay and Norm Welbanks. Take some time off!

A Rudimentary Observation,
by Kirk Smith

Salutations and greetings! Kirk Smith here - recent 'graduate' of the OAFtN course.

After a rich, full day helping my brother move, I was on my way home on the 401 east of Bowmanville. On a beautiful evening, the sky was just starting to darken. Behind me in the west it was still quite light, and at zenith it was lavender fading progressively through hues of magenta to dark violet at the eastern horizon.

Then I realized that I was looking at a live demo of a photograph in *The Beginner's Observing Guide*, by fellow RASC-KC member Leo Enright.

There was a distinct line at about 20 degrees where the light magenta changed to dark violet all at once. Above the line the change in color was so gradual that it was barely perceptible. Below the line the color was uniform and noticeably darker than just above it. It took me a few minutes to realize what I was looking at, but then it was unmistakable - earth shadow...

Well, I said it wasn't an observation of extraordinary importance but it was the perfect end to my day. I've probably seen it dozens of times before but this was the first time I really appreciated it.

Thanks, Kirk out.

KAON November 10 2007, by Susan Gagnon

There were 187 visitors to the observing deck and despite the high light pollution levels due to construction there was a good variety of targets, with galaxies, globular clusters and open clusters. Of course the highlight of the evening was Comet Holmes. It did not disappoint!

The comet was a great way to sell the public on binoculars since with all scopes the eyepiece was filled with comet. The binocular view with the surrounding stars was appreciated by the crowd as a truly beautiful site.

We will attempt to keep a Centre set of binoculars with a tripod as standard equipment on the deck from now on.

In the warm room Dr. Martin Duncan presented a talk on "The New Solar System". The presentation was repeated later in the

Library donation, by Kevin Kell

Some years ago we started a section of the RASC-KC library devoted to videotapes of various astronomy programs. I'm not sure of the condition of this collection or how much it has been used, so I thought it would be a good time to try again, this time with DVDs.

I have made DVD Videos of the first season of "The Universe" and will be handing those off to the Librarian at the December meeting. As part of a new programming feature for the meetings, we'll watch the first 5 minutes of episode 1 to help people judge the value of signing out the collection or not. In future meetings we'll view 5 minutes of other programs as well.

"The Universe" (2007)

Season 1, Episode 1: Secrets of the Sun

Season 1, Episode 2: Mars: The Red Planet

Season 1, Episode 3: The End of the Earth

Season 1, Episode 4: Jupiter: The Giant Planet

Season 1, Episode 5: The Moon

Season 1, Episode 6: Spaceship Earth

Season 1, Episode 7: Inner Planets

Season 1, Episode 8: Saturn

Season 1, Episode 9: Alien Galaxies

Season 1, Episode 10: Life and Death of a Star

Season 1, Episode 11: The Outer Planets

Season 1, Episode 12: Most Dangerous Places in the Universe

Season 1, Episode 13: Search for E.T.

Season 1, Episode 14: Beyond the Big Bang

You can find out a little bit more about it at <http://www.imdb.com/title/tt1051155/>

RASC-KC Donation Report, by Kevin Kell

Our financial year ended on 2007 September 30 and I am happy to announce that we have received a total of \$364 in donations, all untargeted and going into the Observatory Fund.

Thanks to:

Gerry Cyr, Leo Enright, Susan Gagnon, Kim Hay, Ruth Hicks, Kevin Kell, David Maguire, Ernest Munroe, Joseph Pasek, Robert Powers, John Rossiter.

The fund totals \$12,425.

Call for Donations

Charitable donations in the range of \$25 or more will surely earn a tax receipt that may be claimed as an income tax deduction. You may specify any of a number of named funds; conversely, any untargeted donations will go to a special projects fund, or to the Observatory Fund. It also may be possible to accept observatory land as a donation to the Centre, which would preclude the necessity of leasing such land.

If you donate before the end of the calendar year, it will be possible to claim the donation as a deduction against 2007 income tax.

***Bons Mots on the 2007 Big Bang-quet*, by Kevin Kell**

The 2007 Annual Awards Banquet of the RASC Kingston Centre was held last night (Friday November 16th) at the Days Inn, Kingston. We had 16 people attending along with Dr. Brian Hunter, our guest speaker for the evening. The location was convenient, the service was great and the food was terrific.

Brian's talk, "Herstmonceux Castle and the Greenwich Connection," described his time at that castle in the UK, its history, and some of the telescopes located there. I loved the talk. Brian has a great delivery/presentation voice/style.

Awards Chairperson Kim Hay announced the newest name on the Messier plaque (Kim Hay) and on the Finest NGC plaque (Douglas Angle) and then presented the A.V. Douglas Award to its winner. The citation follows below:

2007 Award Winner: Walter MacDonald

[written by Hank Bartlett]

This astronomical verse is of a universe, where this A.V. Douglas winner roams,

It's all about observing achievements and observatory domes.

A variable observer this member is, and that does not mean indifferent,

It means the searching of the sky, for stars variably luminescent!

We now take this story to its root, and a young man with a dream,

To trek the sky from low to high and record what he has seen.

1980 he started this trek, and across the sky did navigate

Heavenly sights on available nights, with his new C8.

Just 4 years later on this spot an observatory he did build.

And there he looked and searched the sky until many log books he had filled.

For astronomical help and fellowship, other astronomers he did seek.

And through the years as Librarian, National Rep, and President he did speak.

What else, you ask, has this man done with his astronomical life?

Everything possible to avoid an astronomical wife!

Aperture fever, eclipse expeditions, the Ridiculous, and Ccads.

Building robodomes, and web sites, just to mention a few of these.

Technology has now changed the game, and he can observe while he does sleep.

And if anything out of the ordinary happens, "Merlin" lets out a peep.

But some observing takes a trained eye, no other way can it be done.

And leads to the discovery of SUPERNOVA 2007cf in MCG +02-39-21!

By now, many of you know the universe that in the first line was written.

It's "Walter's Universe," and it is no curse, that by the astronomy bug he was bitten.

Ladies and Gentlemen: 2007 A. Vibert Douglas Award winner Walter McDonald.

RASC GA 2008, by Susan Gagnon

If you have never been to a RASC General Assembly, consider 2008 the year to change all that! Whenever the GA is hosted by an Ontario or Quebec Centre it is a great opportunity for Kingston members to attend with minimal expense and time commitment. Traditionally, it only lasts 3 or 4 days unless it is held in conjunction with another organization like the AAVSO. This year the location is York University in Toronto and our hosts will be RASC Centres Hamilton, Mississauga and Toronto, as well as the Department of Physics and Astronomy at York. The dates are June 27 to July 1st. Check the National site for updates as the schedule firms up. The initial line-up looks unremarkable as it lacks much detail at this time, but there is frequent use of the word "workshop". This should be a great GA considering the number of Centres involved, and the pool of talent that is at their disposal.

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Observing Notes, by Kevin Kell

The third weekend of November was not bad indeed for doing a little bit of cold weather observing. Friday night, November 16, was the Annual Awards Banquet, and although the skies were clear, the flesh was weak from a long day and we didn't do much more than observe from the parking lot that night.

Saturday night was better, cold but no wind. We spent about 6 hours outside working on the robodome project and achieved a couple of milestones, namely, focusing and autofocusing. Pointing and synchronization are the next problems to tackle.

Comet Holmes "disappeared", at least to us naked eye. In even modest binoculars, however, it was still pretty spectacular. Handheld pictures through the eyepiece (2 sec f4 and f5.5) on a 26mm Plossl show no comet at all anymore. Surface brightness has dropped too much.

We also took some more tripod-mounted 15-second exposures, but have not seen how they turned out.

The Leonid meteor shower peaked that day, and I saw more than 10 in two hours, mostly while not looking up for them. A particularly Big, Low, Slow one went over Kingston around 01:30 Sunday morning.

We then spent another hour Sunday night after the Saskatchewan Roughriders win over BC :) attempting to work on robodome pointing. Amazing how small a target the Moon really is! We failed to achieve a lock on any object. Next time we'll attempt to push a mirror-on-a-stick into the dome, then turn on the Telrad and use it to aim at the target.

My suggestions to those with green laser pointer problems... don't put lint in the battery compartment!

Gleanings from *Regulus* of 30 and 25 Years Ago, by Leo Enright

In December of 1977, thirty years ago, our newsletter was published twice. It was then known simply as “**The Newsletter of the RASC–Kingston Centre and The Queen’s University Astronomy Club**”. As newsletter editor/writer at that time, as well as President, I tried to provide a balance between reports on observing and reports/information about Centre and Society activities and those of the larger world of astronomy.

In the first of the December 1977 newsletters, I reported on the recent discovery of a solar system object that was then known simply as ‘O. K.’, short for ‘Object Kowal’ – called after the discoverer, Dr. Charles Kowal, of the Hale Observatory on Mount Palomar who first detected an object that was thought to be possibly either a comet or an asteroid or a satellite that had long ago escaped from an outer planet. It was out beyond the orbit of Saturn. Its discoverer had become well known for his previous discovery of the thirteenth moon of Jupiter, one that was later named ‘XIII Leda’. As one astronomer said at the time: “If Kowal says it’s there, it’s there!” [This was perhaps the first such object to be discovered displaying characteristics of both a comet and an asteroid, but similar objects are now not unknown.]

That newsletter also had an article about the flood of science-fiction movies that were so popular in 1977. A short time before our December issue was published, *2001– A Space Odyssey* had been extremely successful. *Star Wars* was setting records for attendance. For months we had listened to promotions for *Close Encounters of the Third Kind*. Its attendant subtitle was: “We are not alone!” At that time, the latest extravaganza to try to capture our attention was one called: *Starship Invasions*. Its attendant subtitle was: “We know they are here. What do they want?” In the article, I was tempted to ask if the typical entertainment-seeker of the time was looking for escapism and sensationalism, or was there somewhere a real element of interest in learning or in knowing about the possibilities of CETI (Communication with Extraterrestrial Intelligence). [I think such a question is still quite relevant.]

The second of the December 1977 newsletters provides us with a very interesting comparison of planetary observing then and now—December 1977 and December 2007. In the newsletter’s lead article, I explained some of my recent planetary observing and my observations of certain Messier objects which were near those planets. I had observed Mars in Cancer quite near M44 and was looking forward to following its retrograde motion relative to that large open cluster. [Now, this month (Dec. 2007), Mars, having almost completed 13 orbits of the sky since then – almost 13 complete trips around the ecliptic – is now in Gemini, the constellation next to Cancer, and is now in its retrograde motion for this year.] Jupiter was then in Gemini and very close to M35. [With its going completely around the ecliptic once every 12 years, it has completed two and a half trips around the sky since those observations, and so now (Dec. 2007) Jupiter is in a completely different part of the sky— in Sagittarius and poorly placed for any observations this month.] Most interesting of all was my report on Saturn. I noted that Saturn in the constellation Leo had been close to Regulus for a couple of months. I mentioned its close proximity to three Messier objects in Leo, namely M95, M96, and M105, and I encouraged observing its retrograde motion in respect to the star Regulus. [By now (Dec. 2007) Saturn has made just a bit over ONE trip around the sky. The synodic period of Saturn is very close to 29 years. Just within the past year, Saturn passed by Regulus, where it was in 1977, and is now slightly further east within the constellation Leo than it was in December of 1977.] Anyone who would like to reread this article from the last issue of the newsletter from the year 1977 may find an inspiration for observing three interesting planets AND some Messier objects near them, both then and now.

The second article of that newsletter reported on two auroral displays that had been seen in the first half of the month, not by me, the usual reporter of such events in those days in our Centre, but our sharp-eyed

observer from Amherstview, David Levy. The first event, quite a specular display, was shortly after midnight on December 1st; the second one, featuring an arc and a rayed arc in the north, was between 2:00 and 2:30 a.m. EST on December 11th, 1977. I noted that both sunspot numbers and auroral activity were increasing. [Note: Remember this was slightly less than 3 complete 11-year solar cycles prior to the current solar minimum.]

Other matters of interest in that issue included comments on the new *1978 Observer's Handbook* where I noted information about the frequent lunar occultation of Aldebaran in the coming year. In fact, an Aldebaran occultation would occur in every month of the year except one and twice in July, and all but two of them would be visible from North America! There was also a schedule of the upcoming Centre meeting dates, twice monthly until the end of June, 1978, with topics given until the end of April.

During that month the first meeting was on Tuesday December 6th. Dr. John Percy, RASC First Vice-President and *Observer's Handbook* Editor, spoke on "Pulsating Stars". At the second meeting on Tuesday December 20th, we had a display by members of astronomy-related books and magazines and a slide presentation was also scheduled.

In December, 1982, 30 years ago, **Regulus** was thirteen pages in length – seven pages for the regular newsletter and six pages for the *Regulus Index* which I produced for the first time. I saw a need for an index of the important articles that had appeared in its pages since the time of the first copy that I possessed, namely that of November 1973.

The first article explained the purpose and aims of the *Regulus Index*, and the second article was about our Banquet and Annual Meeting, both of which had taken place on November 26th, 1982. The banquet was prior to the meeting and held at Aunt Lucy's Restaurant. Our Centre Executive elected for 1983 included Terry Hicks as President, with Dr. Douglas continuing as Honorary President. David Levy was to be our Vice-President and Gerald Schieven was to become Secretary and National Council Representative. John Hansen would be Treasurer, and I would be Newsletter Editor/Writer.

That newsletter also included part of an article I had written about the research that had been done at Holleford Crater to assist in its verification as an established meteorite impact site. It also was the fifth newsletter in a row to include a written report from Mr. Gus Johnson, an exceptionally fine observer from Swanton, Maryland. We were, as I noted, proud to count him a member of our Centre. [Note: He continues to this day to send his letters, with observing reports, to me] There was also a letter from our member in Peterborough, Warren Morrison, who just 4 years before had discovered Nova Cygni 1978 and subsequently was awarded the RASC Chilton Prize. His letter commented on a matter of great concern to many observers at that time: the proposal from the US military to launch into space an array of huge orbiting mirrors to light up parts of the night side of the earth. The suggestion was called "the ultimate in light pollution". [Happily, it would not go into production!] The letter also reported on Warren's observations of two comets that were being followed at that time: Comet Austin and Comet d'Arrest. The former he has seen on numerous nights, even naked-eye on a few occasions; the latter was more difficult since it had been low in the evening sky.

That month our meeting was held on December 12th and the speaker was our member Gerald Schieven who was then a graduate student in astronomy at Queen's. His talk was on "The Algonquin Radio Observatory."

Reviewing our Centre's activities of 30 and 25 years ago has certainly presented a wonderful opportunity to reminisce on an enthusiastic and engaged group of individuals who pursued a passion for the sky and for sharing it with others.

RASC-KC Board of Directors

President: Kevin Kell

Vice President: Susan Gagnon

Secretary: Steve Hart

Treasurer: John Pilon

Librarian: David Maguire

Editor: Joseph Benderavage

National Council Rep: John Hurley

2007-2008 Committee Chairs:

Astronomy Day: Vacant

Amateur Telescope Makers: Doug Angle

Awards: Kevin Kell

Banquet: Vacant

Education: Vacant

Equipment Loan: Kevin Kell

Fall 'N' Stars: Vacant

KAON: Susan Gagnon

OAFTN Instructor: Doug Angle, Brian Hunter

Observing: Vacant

Publicity: Vacant

Relay for Life: Vacant

Responsible Lighting: Kim Hay

Sky Is the Limit: Vacant

The Royal Astronomical Society of Canada—Kingston Centre

Newsletter Submission Info:

I can take most common formats, although I prefer plain text. Pictures should be sent as image files in attachments separate from the articles. Please avoid the use of capitals, asterisks etc for formatting, as I use the publishing software's formats for this kind of emphasis.

E-mail: lbenderavage (at) sympatico (dot) ca

Post: Joseph Benderavage, xxxxxxx, Kingston, Ontario, Canada K7M 4B7

2007 Publication Deadlines

For the month (Deadline)

January 2008 (December 21, 2007)

February 2008 (January 25, 2008)

Subscriptions: Members of the Kingston Centre receive Regulus as a benefit of membership. Advertisements are free to members of the Centre. Commercial advertising is \$20/quarter, \$40/half page, \$100/ full page and should be in electronic format. Contributions are more than welcome. Submitted material may be edited for brevity or clarity. Copyright 2007 All rights reserved. Permission is granted to other publications of a similar nature to print material from Regulus provided that credit is given to the author and to Regulus. We would appreciate you letting us know if you do use material published in Regulus.

Target for Tonight, by Susan Gagnon

Cetus

ETU: Mira

Messier: M77

Finest NGC: 246, 936.

Levy List: 56(NGC 270), 238 (NGC 578),
239(NGC 247), 240(NGC 157),
338(NGC 1042), 341(NGC 755).

Deep Sky Challenge: none.

Fornax

ETU: none

Messier: none

Finest NGC: none

Levy List: 224 (IC 1830), 286 (NGC 1360).

Deep Sky Challenge: NGC 1049.

Sculptor

ETU: none

Messier: none

Finest NGC: 253.

Levy List: 223 (NGC 150), 367 (NGC 613)

Deep Sky Challenge: none.

December's list of constellations provides an opportunity to take advantage of perks for our location and season.

Our latitude gives us a definite edge over many Canadian observers when it comes to these southern near-horizon constellations. If you can get near Lake Ontario, even better; there is very little light pollution on the lake.

A second advantage is season. This time of year you can head out shortly after dinner and have great dark skies, observe for a while and still have a good chunk of evening left.

If you have slipped into the mindset that observing has become a big hassle (and considering the amount of clothes we have to put on this time of year, this is not totally untrue), keep things simple:

Plan to find/observe only one or two objects.

Learn a couple of new constellations.

Limit equipment to your binoculars.

Good luck with the weather!

Holleford Crater Tour

On 25 November 2007, Leo Enright led a diverse group of curious enthusiasts on a tour of Holleford Crater to reveal some important historical details about it. It was the 50th anniversary of a diamond drilling program that would prove the crater's meteoric origin. At the time of the impact, no life on land had yet evolved and the site then lay south of the equator, in the vicinity of Brazil. On impact, breccia was blasted out and then washed back into the crater, suggesting an underwater location. Continental drift has resulted in the site's migration to Ontario; the real crater is 300 to 400 metres below ground. It is probably a half mile wide and a half mile deep.



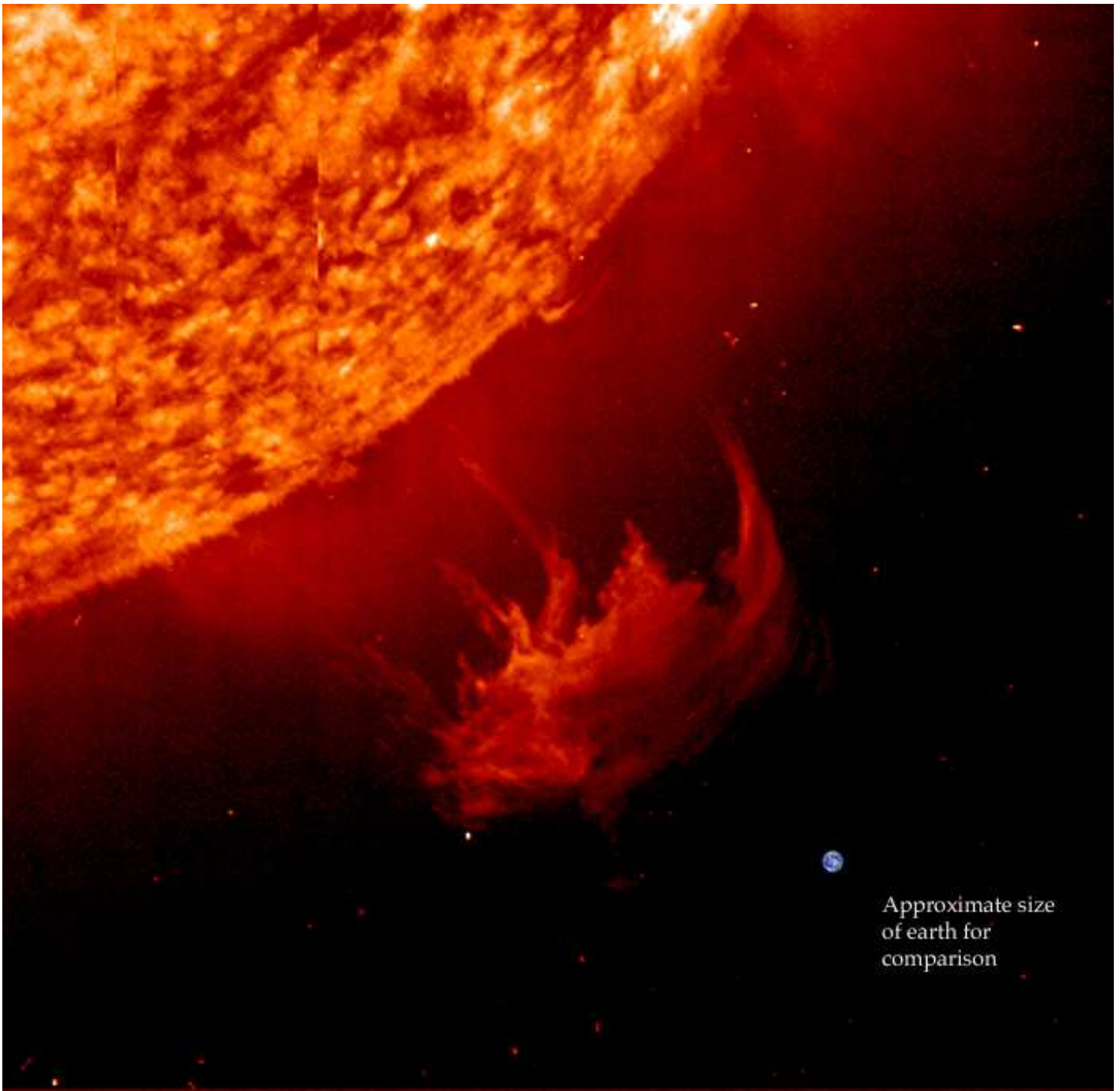
Leo Enright is pointing to the location, near the centre of the crater, of the first drilling undertaken by the department of mines and technical surveys. The project's hopes received a setback when a devastating fire broke out, heavily damaging drilling equipment and related structures. Drilling resumed and, at an 1128' level, the diamond drill bit became stuck and it remains there to this day.



Our field trip continued to the site of the second drilling operation, for which we have no picture. It was here that the investigative team discovered the "smoking gun," detective novel parlance for irrefutable proof of Holleford's cosmic origin, as opposed to existing theories of possible vulcanism as the cause of the crater. That irrefutable proof was the discovery in the team's drill core samples of coesite which is not a naturally occurring substance on earth. After that, the team drilled to 1486' into solid, pre-Cambrian bedrock.



A third location for the drill team was near Mabel's Lane, as seen in this photo. Proof positive had already been discovered in site #2. This third drill site confirmed an invisible underground geological profile of the intrusive object from outer space. Drill hole #3 is now completely covered; today its exact location is known only to cognescenti such as Leo Enright.



There's still time for your
Regulus article, but *hurry*...

Book Review

The Road to Reality, by Roger Penrose, 2004, Random House, London

Real understanding of the underlying principles that determine the actions of our universe is not speedily gained. We should be cautious, to avoid following erroneous assumptions.

This book is about “the relation between mathematics and physics” and how that relation drives the human search for understanding of the universe. In the last century alone, Dirac’s equation for the electron, the general framework of quantum mechanics, and Einstein’s Relativity, are examples of that search. “This book may indeed be used as a genuine guide to the central ideas (and wonders) of modern physics.” It is concerned with “the remarkable relationship between mathematics and the actual behaviour of the physical world.”

The book is part of the author’s “search for those deeper laws that actually govern the universe in which we live.” Understanding those laws will help us know the world and channel them toward our collective benefit. The Ancient Greeks believed that “whatever or whoever” controlled their surroundings did so the way the Greeks, driven by their emotions, would have tried to control things. Slowly they began to recognize patterns in nature and the precision of repetitive astronomical movements. If they believed that events were controlled by whimsical gods, then the gods must have been subject to mathematical laws. Often such beliefs led to mysticism and astrology. Eventually, the idea prevailed that “heavenly” mathematics also held court upon earthly events, gravity, the transformation of matter, and the conservation of mass. Geometry developed from straight lines born from observed rays of sunlight.

Although a mathematician himself, Penrose says that mathematicians “usually feel that they are merely explorers in a world ... far beyond themselves”. This book may be partly or totally in that world; that is for the reader to decide. But in reading his discussion about the Platonic world, the *Axiom of Choice*, and Penrose’s description of cardinal numbers, one begins to feel sorry for mathematicians, especially in the subchapter “Different Sizes of Infinity.” It seems they must choose which system of axioms and which rules of procedure to stick to. Or, *not* make a choice. Artistry should also have a role to play here.

The book conserves the notion that math = truth, when math really can be manipulated to prove whatever may be in the mathematician’s mind. Contrast that with this idea: “Objective mathematical notions must be thought of as timeless entities and are not to be regarded as being conjured into existence at the moment that they are first humanly perceived.”

Penrose has an unusual point of view: that the entire physical world may be governed by mathematical laws. If so, human physical actions would fall under the sway of “ultimate mathematical control” that might, according to probability, permit “some random behaviour.”

He postulates that biology may be controlled by mathematics. DNA that controls the growth of plants is a molecule, and the persistence and reliability of its structure depend crucially upon the rules of quantum mechanics. Plant growth is controlled by the same physical forces that govern the plant’s individual particles. Most forces are electromagnetic, but the strong nuclear force is vital in determining what nuclei are possible; and therefore what kinds of atoms there can be.

And there are many possibilities: the chapter entitled “Speculative theories of the early Universe” describes the shift toward a “significant positive cosmological constant”, which implies a theoretical flat universe; but this is speculative. Another idea is that a hyperbolic universe theory is gaining credibility.

In mathematics, truth had to be differentiated from guesswork. Procedures to do so were established to create “unassailable mathematics, and mathematical proof.” These were the foundations of science: numbers,

arithmetical concepts, a diatonic musical scale of “frequencies determining the principal intervals” of Western music, and Pythagorean Theorem which showed a “precise relationship between the arithmetic of numbers and the geometry of physical space.”

Penrose defines the Platonic world as a mathematical world: “Mathematical objectivity is really what mathematical Platonism is all about.... Accordingly, [it] should not be viewed as something ‘mystical’ or ‘scientific.’” As an example, he cites the Mandelbrot set. “The [Mandelbrot] set is just objectively there in the mathematics itself.” It was, Penrose asserts, an invention of the human mind.

Penrose believes that quantum theory has not yet come together as a theory, and that measurement paradox is its problem. “In my opinion, quantum theory is incomplete.... In my view, general relativity is probably here to stay as a description of spacetime in the large scale limit.” The author states that “In Albert Einstein’s case, his internal insights led ultimately to general relativity, which is very largely a ‘one-person theory.’ Quantum theory, on the other hand, was very much a ‘many-person theory.’”

Penrose asserts that Einstein’s ‘one-person’ approach is “necessary to resolve problems in quantum theory, and that mathematical aesthetics must be an important driving force in addition to physical insight.” Towards the end of the book, he admits that he does not believe that he and others have found the true ‘road to reality’, and even suggests that the road may be a mirage.

Penrose refers to “beauty” and “miracles” as two powerful internal driving forces that have influenced which direction theoretical research will take. “Many of the ideas...in physical theory will also be viewed as compellingly beautiful.” Euclidean geometry, Newtonian dynamics, Maxwell’s electromagnetism, Einstein’s general relativity, quantum mechanics, especially quantum mechanical spin, Dirac’s relativistic wave equation, and the path-integral formalism of quantum field theory (QFT) as developed by Feynman, are all seen as beautiful by Penrose. But some beautiful theories have proven irrelevant, such as Cantor’s theory of the infinite, and Godel’s famous incompleteness theorem and, as well, aspects of “category theory.” Divergences that appeared in QFT’s relationship to general relativity were “miraculously” cancelled out when supersymmetry was brought into the equation. Another miracle is the appearance of mirror symmetries among many disparate string theories that pointed to a grand resolution called “M-Theory”.

The book necessarily contains much mathematical notation and formulae; “I believe that there is still a good deal that you can gain from this book by simply skipping all the formulae and just reading the words.” For those whom are inclined to regard the ubiquitous formulae, icons have been included to indicate three levels of difficulty:

very straightforward; needs a bit of thought; not to be undertaken lightly.

If you want to work through any of the formulae, solutions are available from a website listed in the preface. If you are an expert in mathematics, you may want to work them out anyway, to learn about the author’s different perspectives on many topics, such as supersymmetry, inflationary cosmology, Big Bang, black holes, string theory or M-theory, and quantum theory. Another recommended website is math.ucr.edu/home/baez/week143.html.

This work took eight years to complete. It consists of 1099 pages, including six of prologue, two of epilogue, 36 pages of bibliography (including 50 works written solely or jointly by Roger Penrose himself), 13 pages of index, and, in the middle, 34 chapters of text. The epilogue parallels the prologue, but more than two millennia later. The bibliography is set up alphabetically by author’s last name and, in addition, where possible, includes an identification code for the item in arXiv.org.

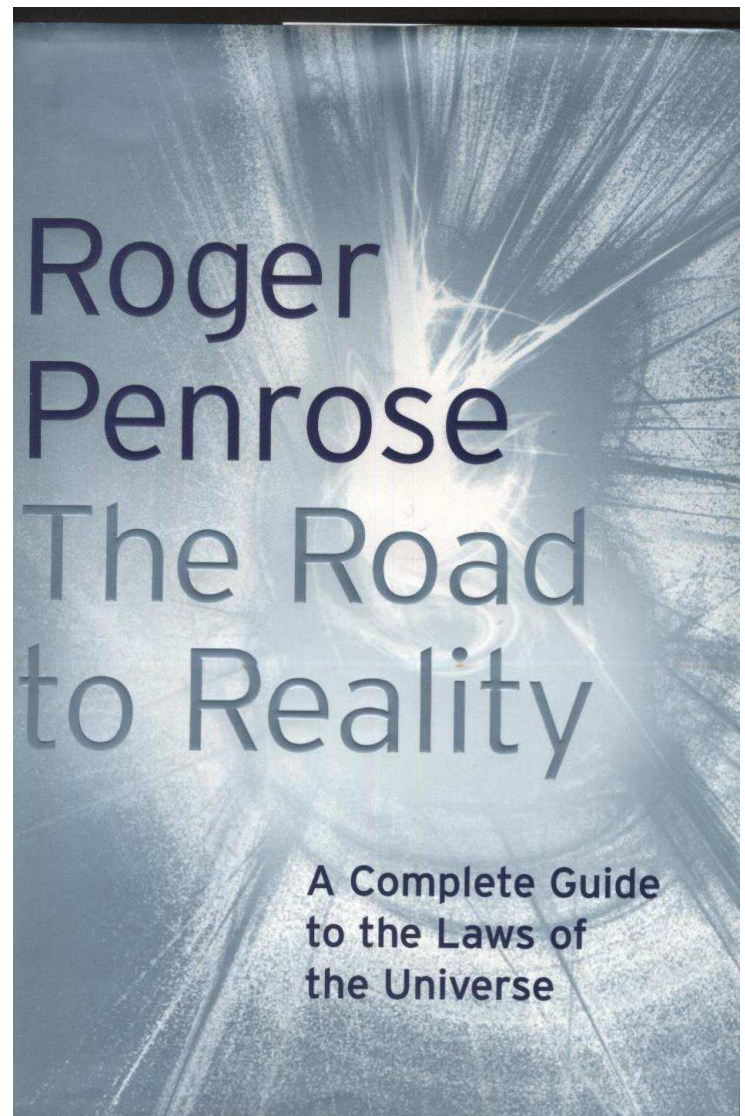
Spontaneity can be lost in a thousand pages if there are many pauses and stops to recapitulate the meaning of a word. Yet, Penrose's delivery is lofty but never stuffy.

Furthermore, the book's profuse illustrations offer redemption. They include a Riemann sphere; gluons; a zigzag picture of the electron; a possible reason for zigzags as interactions with Higgs' field; photon polarization, and hyperbolic de Sitter space-time, as well as some of M. C. Escher's works in reproduction.

This comprehensive tome on the astrophysical universe would not be wasted on your bookshelf. Perhaps no bookshelf should be without it because, eventually, some Pandora will become curious about what's inside. This book can be read at one's leisure but, weighing in at almost 3.5 lb., it is uncomfortable to hold.

Roger Penrose is Emeritus Rouse Ball Professor of Mathematics at the University of Oxford. Among his numerous prizes and awards is the Wolf Prize for Physics, which he shared with Stephen Hawking in 1988, for their joint contribution to our understanding of the universe.

Reviewed by Joseph Benderavage



Kingston Cosmic & Events Calendar, December 2007—January 2008, by Kim Hay and Joseph Benderavage*Date & Time Events*

December 01--Last Quarter moon 7:44; Moon 2.5° to right of Saturn 3:00 am

December 08 -**KAON** Observing Session- Ellis Hall Queen's Observatory 7:30-9:30 p.m. For more info visit <http://130.15.144.99/rasc/Observing/kaon.php> Speaker Kevin Kell: Summer on Mars

December 09- New Moon 12:40

December 14- **Regular Meeting** Stirling Hall Theatre "A" 7:30-10:00 pm. Topic= Member's night

December 14- Geminid Meteors peak 12:00 pm

December 17- First Quarter Moon 5:17

December 21- Moon occults the Pleiades 4:00 pm best in NE of N.America

December 22- Winter Solstice 1:08 am; Ursid Meteor peak 8:00 pm

December 23- Jupiter in conjunction with the Sun; Full Moon 20:16; Moon occults Mars 9:00 pm in extreme NW of N.America

December 24- Mars at opposition

December 25- Christmas Day

December 27- Moon 0.9 °S of Regulus 11:00 pm best in E of N. America

December 31- Last Quarter Moon 2:51

>**PLANETS** for December: *Venus* very low in the SE at dawn; *Mars* rises in the NE in evening twilight, in West at dawn; *Saturn* rises in ENE near 10:30 pm, High in SSW at dawn.

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02- Earth at perihelion (147,099,100 km) 7 pm

04- Quadrantid meteors (ZHR=120) 2 am

05- Venus 7° N of Moon 6 am; Antares 0.5° N of Moon, occultation at 10:00 am

07- Venus 6° N of Antares (38° W)

08- New Moon 11:37 am.

10- Eunomia at opposition (m=8.1)

11- **Reg. Mtg.** Stirling Hall "A" 7:30-10:00 pm; Spkr. Doug Angle: Relativity, Black Holes & Dark Matter

11- Neptune 0.4° N of Moon, occultation at 1:00 am

12- **KAON** Observing Session- Ellis Hall Queen's Observatory 7:30-9:30 p.m. For more information visit <http://130.15.144.99/rasc/Observing/kaon.php> Speaker: Terry Bridges, "Helen Sawyer Hogg."

18- Moon 0.8° N of the Pleiades 2 am best in NW of N America

19- Moon at perigee, 9:00 am; Moon 0.7° N of Mars 6 pm best in NE of N. America

20- Mars 1.1° S of Moon, occultation at midnight

22- Mercury at greatest elongation E (19°); Full Moon 13:35; Neptune 0.3° to left of Mercury visible telescopically soon after sunset; Moon 0.3° N of Beehive (M44)

23- Mercury at ascending node, and 0.3° N of Neptune (18° W)

24- Venus near M20 & M21 visible before sunrise, best in S of N. America; Regulus 0.7° N of Moon, occultation at 15:00

27- Mercury at perihelion

30- Last Quarter Moon 5:03

31- Venus & Jupiter near M22 visible before sunrise, best in S of N. America; Moon at apogee, 4am

PLANETS for January: Mercury very low in WSW in evening twilight, except early in month; Venus very low in SE in morning twilight; Mars in E after dark, sets in NW before dawn; Jupiter: very low in SE in morning twilight, late in month; Saturn rises in ENE in mid-evening, in WSW in morning twilight.

RASC 2008 Observer's Handbook contains more detailed information, & is available from our Treasurer, or from <http://www.store.rasc.ca/>