Nova Notes

The Newsletter of the Halifax Centre of the Royal Astronomical Society of Canada

Volume 33 | Number 1 | February 2002

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In This Issue...

Astrophoto of the Month

The tiny University of Hawaii 24-inch telescope is the left one in this image, which also includes the Gemini, UH 2.2-metre and UK infrared telescopes (right to left) — Mauna Loa is in the distance. This spring, 5 of us will be making the trip to Hawaii; Roy Bishop, Mary Lou Whitehorne, Greg Palman, Bill Thurlow, and myself will leave April 5th and return on the 19th. We have been awarded 5 nights of time for a visual and CCD observing project through Micheal West, an astronomer who is at University of Hawaii at Hilo (formerly at Saint Mary's).

We'll also be observing and photographing as true-amateurs (as opposed to pseudo-professionals! :-) using a 5" refractor, my 13" dob, and various lenses both at the summit and near the 9300-foot astronomer's residence.

—Dave Lane

President's Notes

Mary Lou Whitehorne

Away back in the mists of time, the Centre President was pressed into service to write a regular column for Nova Notes. This was because few members wrote anything for the newsletter and the editor at the time was very desperate for copy—any copy would do! But, no more! Now we have lots of contributors and the Editor is busy editing a quality publication for a vibrant and active Halifax Centre. Nevertheless, I thought I'd put my paddle in.

So here we are, in 2002 (! - How did that happen?!?) and we have a shiny new Executive Committee. Admittedly, some of the faces are recycled but there are a couple of new ones too. See the Executive list elsewhere in this issue. Not only do we have new faces at the Table of Leadership, but there are new faces among the throngs that attend our monthly meetings and who venture out to our St. Croix Observatory for their much-needed Photon Phix.

This is great! We have lots of busy people doing things in the Centre besides just going observing: astronomy education outreach, public observing events, light pollution abatement, Nova East, etc. There is lots going on for anyone who wants to join in. Don't delay; get in gear today! (Dreadful slogan, isn't it?)

Perhaps I should introduce myself, in case some of us haven't met before now. I joined the RASC in 1985, I am a life member, and have already served thirteen years on the Executive Council (this in no way guarantees that I know what I am doing!), although I have not been on Council for the past two years. This is my third term as President, the last two terms were in 1991-92, just before Halifax Centre hosted the 1993 General Assembly (GA). I have been involved in the work of several committees, both nationally and locally; for example: light pollution abatement, constitution, planetarium, property, observatory, Nova East, GA guidelines, Halifax GA organizing committee, public education, and maybe a couple more that seem to have slipped my mind at the moment.

As your incoming President, I invite all members of the Centre to come to the Executive meetings that are held at 7:00 P.M., just before the regular monthly meeting. This is not an exercise in boredom, as some might presume. Rather it is a very entertaining hour where you can observe (there's that pesky word again—"observe") your sometimes-elected officials in action. Executive meetings reveal the truly human side of the club and you get to see how the Centre really runs! Perhaps not the way you think… Why not come and see for yourself? It's the very best way to get to know people, the Centre and what it does, and to have the most fun. Please come; we'd love to have you join us!

2002 looks like it will be another good year for the Halifax Centre. With so many interested, interesting, and involved members, how could it not? I am looking forward to the meetings, the speakers and the events that will come our way over the next twelve months. I hope you are too. See you at St. Mary's on the third Friday of the month! ✯

Mary Lou Whitehorne
President Recycled
ml.whitehorne@stmarys.ca

Astro Ad

I'm parting with some more eyepieces. These are in "used but not abused" condition. Both are 1.25 barrel diameter. Replacement Cost quotes are from reputable Cdn suppliers and do not include taxes or shipping. My sale prices are in Cdn $. All prices are firm. Customer reviews on many of them are at http://www.excelsis.com E-mail me for more info. and photo.

18mm Meade Super Wide
(7 element widefield made in Japan)
67 degree AFOV, ER-14mm
New $250, Sale price $150.

12mm Celestron Orthoscopic
(4 element ortho made in Japan)
42 degree AFOV, ER-11mm
no longer produced, Sale price $50.

Contact Daryl Dewolfe
maknewt@glinx.com
902-542-2357 (evenings please)

Nova Notes
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PO Box 31011
Halifax, Nova Scotia
B3K 5T9

Articles on any aspect of Astronomy will be considered for publication.

Nova Notes is published bi-monthly in February, April, June, August, October and December. The opinions expressed herein are not necessarily those of the Halifax Centre.

"Letters to the Editor" or letters to our resident expert "Gazer" are also most welcome.

Contact the editor at the following:

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Nova Notes is also available as a PDF file on our centre's website at **www.halifax.rasc.ca**

Material for the next issue should reach the editor by Mar. 22

Meeting Report: December 2001

by Dave Chapman

INTRODUCTION

The last meeting of the first year of the third Millennium was called to order by outgoing President David Tindall, shortly after 8:00 P.M. in Loyola 170 of Saint Mary's University. The change of meeting room was decreed by the additional attendance expected that night. (It turned out to be a crowd of 68.) They had all come to experience the celebrated "Rainbow" lecture by our Honorary President, Prof. (retired) Roy Bishop of Acadia University. RASC Halifax Centre last hosted this event countless years ago, so there were many members who never had the pleasure. The long-standing members who had seen the lecture before (including the presenter himself!) had forgotten so much about the topic that it was decided by popular demand to reprise the talk for the enjoyment of all. Following the usual introductory remarks (including the obligatory marketing moments on the part of both the President and newly-inducted Chief Ferengi Steve Tancock), the President launched directly into an introduction of Roy and the talk itself.

THE MAIN EVENT

Roy Bishop is credited with reviving the nearly-expired RASC Halifax Centre in 1971, along with other notable members, and has served the RASC since then in several capacities: Centre President (1974-76), National President (1984-86), Editor of the Observer's Handbook (19 issues with the last in the year 2000), and countless other, more devious roles. He was recognized by the International Astronomical Union, who named asteroid 6902 "Roybishop" in his honour.

[The mention of the Observer's Handbook triggered a second spiel by the President for non-members to join the Society and to receive all the benefits, whose combined "street" value far exceeds the price of membership. Is this argument getting stale? Perhaps the next President should take a different tack, and encourage folks not to join the RASC, so we can rob them blind and fill the coffers with cold, hard, cash. Perhaps reverse psychology would work.]

What can I say? Roy's talk was magnificent, and those who missed it by choice certainly should regret it. However, the function of the meeting reporter is to convey some sense of what transpired, so I will proceed. (But don't expect this to be one of those Pat Kelly reports, which I am convinced contain more facts than are actually presented at the meeting!)

Roy's cultural and historical introduction drew attention to the pervasiveness of the rainbow in logos, cartoons, advertising, song, poetry, and literature. (Examples from the Bible are Genesis 9:13 and Revelations 4:3.) The list of scientists who puzzled over the rainbow read like a Who's Who of Science: Aristotle, Bacon, Snell, Descartes, Newton, Halley, Young, Brewster, Airy, Mie, and Fraser, spanning the years 330 B.C.E to 1983 C.E.

Roy went on to demonstrate that the existence of the rainbow has less to do with the prism-like effect of dispersion of white light in the raindrop, and more to do with the angles of minimum (for the Primary bow) and maximum (for the Secondary bow) angular deviation of the refracted and reflected rays within the spherical raindrops. (The rays that simply refract through the drop and emerge on the other side do not form a bow.) Rays from from a wide range of incident offsets from the drop centre end up emerging within a narrow range of angles and pile up, adding in intensity. This piling up of rays creates the Primary and Secondary rainbows at 42 degrees and 51 degrees from the anti-solar point (i.e. the shadow of your head!) with Alexander's Dark Band between them. Roy used a monochromatic light source (a Helium-Neon laser) and a chemistry flask filled with water to convincingly demonstrate these pile-up effects on the wall and ceiling of the darkened lecture hall.

Throughout the talk, Roy emphasized that experiencing a rainbow is a subjective phenomenon, that there is no "object" in the sky that a group of observers could commonly look at. Each observer sees his own rainbow, which is centred on the shadow of his own head. Roy nearly caused a riot when he stated that the rainbow has no colour, that the sensation of colour was entirely in the eye and/or brain of the beholder. Several folks objected to this, and it made for a lively discussion during the refreshment break. I think I understand Roy's point, so let me attempt to explain: the rainbow is formed by light arriving at the Observer's eye from a cone of directions having a fixed angle relative to the Sun-Observer axis. If there were no dispersion within the raindrop, the rainbow would appear to be a narrow white band. Due to dispersion of light within the water, light of different wavelengths refracts at slightly different angles, broadening the fine bow into a broad band. Thus, observation angle maps into wavelength, more or less. However, the mapping of wavelength into the sensation of colour is not an objective mapping, it depends on the observer (or receptor). If the observer is colour-blind, or hypersensitive to colour sensitive (according to Roy, there are animals with four colour receptors), the sensation of colour in the rainbow will be different from the "typical" experience. Hence, the colour of the rainbow is in the mind, not in the sky. Needless to say, this discussion verges on perceptual psychology and metaphysics. [Roy loves to do this: his talk on "Time" got into Einstein's theories of relativity and left many listeners' minds reeling.] How did I do, Roy?

Roy's talk continued on to advanced rainbow topics, and it is remarkable that there were novel scientific issues involving the rainbow that remained unsolved until the late 20th Century.

I will not attempt to cover these here, but I would like (as best I can) to summarize Roy's list of principal misconceptions regarding the rainbow:

1. The rainbow is not an arc. It is fragments of a conical shell with the apex at the Observer's eye.

2. The rainbow is not an object in a particular place. It is an observed effect in a particular direction.

3. The rainbow does not produce a prism-like spectrum. Rather, each direction has a mixture of wavelengths having a dominant value, the entire mix being perceived as an impure colour.

4. Rainbows in the sky, or in photographs, or on retinas are not coloured. Although rain and sun have been part of Earth's environment for 4 billion years, coloured rainbows on Earth occurred fairly recently with the appearance of animals in which colour vision had evolved. Only within the skulls of such animals do coloured rainbows exist. The eye does not detect the beautiful hues of the rainbow; the brain creates them. We are part of the rainbow.

Before concluding, Roy showed us several lovely rainbow photographs he has taken over the years, including two taken at Isaac Newton's birthplace. These images have been used over and over again in a variety of books, magazines, and philatelic First Day Covers. By way of conclusion, I repeat his final words:

"Science has shown that the so-called 'material' world is far more subtle, mysterious, and profound than anyone ever dreamt, even a century ago. The rainbow is a beautiful example, physically and historically, of the subtlety of reality. The multi-hued rainbow exists in, and is a fitting symbol for the mystical realm which is human consciousness. Here is the site of reality, of the two cultures which the rainbow spans."

[A more complete conclusion of Roy's talk appears elsewhere in this issue, under his own name.]

WHAT'S UP?, HANDBOOK TALK, ETC.
Following the break, we had the traditional What's Up? by outgoing Observing Chair Paul Evans, and the traditional Observer's Handbook Talk, by First Vice President Pat Kelly (again!). Paul projected the sky as rendered by Dave Lane's *Earth Centred Universe* software, and pointed out the locations of the Orion Nebula, the Double Cluster in Persues, and the Andromeda Galaxy, all easy wintertime objects for urban dwellers with binoculars. He reminded us of the hugely popular Members' Nights at Saint Croix Observatory, Dec.15 and Jan.11. We briefly reviewed the Leonid meteor storm, which brought a record-breaking 20 observers to SCO in the wee hours of November 18. Craig Levine recounted a pleasant evening observing the Geminid meteors at a Cape Breton dark sky site, and we discussed the possibility of observing the Quadrantid meteors on January 3, which have a narrow peak of activity in a Moonlit sky. There was also discussion of a penumbral eclipse of the Moon, which was to take place on December 30, but it was agreed that such eclipses were subtle, and would not be of interest to the general public (and even some amateur astronomers!).

Pat Kelly's OH Talk could have been entitled Pat Kelly Unplugged, as this is what happened to his preferred overhead projector between the start and the ends of the meeting. Once the equipment was sorted out, he provided an informative and entertaining explanation of how to use the information on page 240 of the Observer's Handbook pertaining to Double Stars. With the aid of Dave "Tripod" Lane, he simulated an observing session, showing how to determine North and East in the field of view of a refractor and a reflector. During the course of the presentation, Eagle-eyed Dave Tindall found an error (horrors!) in the magnitude information of the Table.

At the very end, Darren Talbot showed us several of his excellent Leonid fireball exposures, a collaboration with Dave Lane. Finally, Dave Tindall called the meeting to a close (I would imagine with great relief), but not before Honorary President Roy Bishop rose to lead a round of applause in recognition of Dave Tindall's 2 years's service as Centre President. A fine evening, indeed.

EPILOGUE
As is often the case, I listened to the jazz broadcast on CBC radio on the drive home over the MacDonald Bridge. The announcer introduced the recording "Misty" (composed by Errol Garner) with a story about the inspiration of the tune. The jazz pianist was sitting on an airplane, waiting to take off, and he looked out the window into the mist and observed a rainbow. It was then he came up with the melody of "Misty", a jazz classic. Yes Roy, life is sometimes mysterious. ✯

The Rainbow

Roy Bishop

[These are the concluding remarks made by Roy in his December 2001 lecture on the rainbow.]

In Norse mythology there is a legend of a rainbow bridge, made by the gods so that people who had earned the right could cross the deep gulf between Earth and Heaven. In the last four centuries the rainbow has become another bridge, a bridge between the "two cultures"— poets and scientists alike have been challenged to describe it. Both descriptions, the artistic and the scientific, are valid. They are complementary. Either description alone is incomplete. However, many scientists and poets alike can be criticized for not crossing the rainbow bridge. Many scientists are ignorant of the arts, and many artsmen are ignorant of science.

Consider two examples of the latter:

Johann Wolfgang von Goethe, the German poet, was a skilled observer concerning the subjective nature of colour vision; however he was scientifically illiterate and had no grasp of what Newton had achieved. In his diatribe against Newton he wrote that Newton's analysis of the rainbow's colours would cripple Nature's heart.

John Keats, the English poet, wrote:

Do not all charms fly
At the mere touch of cold philosophy?
There was an awful rainbow once in heaven;
We know her woof, her texture; she is given
In the dull catalogue of common things.
Philosophy will clip an Angel's wings,
Conquer all mysteries by rule and line,
Empty the haunted air, and gnomed mine —
Unweave a rainbow.

These attitudes demonstrate ignorance of the nature and the substance of science, of the insight into reality achieved by people like Newton. Consider aspects of Newton's description of colours:

He coined the term "spectrum", which comes from the word specter, or ghost. Newton realized deeply the mysterious, non-material nature of colours.

In his "OPTICKS" of 1704 Newton wrote: "And if at any time I speak of light and rays as coloured or endued with colours, I would be understood to speak not philosophically and properly, but grossly, and according to such conceptions as vulgar people in seeing all these experiments would be apt to frame. For the rays to speak properly are not coloured. In them there is nothing else than a certain power or disposition to stir up a sensation of this or that colour."

More recently, Maxwell, Planck, Einstein, Feynman and others have shown us that the light of the rainbow consists of photons, the enigmatic quanta of the electromagnetic field—entities that are neither particles nor waves, that are frozen in their space and our time, that mediate our very thoughts at the molecular level.

Science has shown that the so-called "material" world is far more subtle, mysterious, and profound than anyone ever dreamt, even a century ago. The rainbow is a beautiful example, physically and historically, of the subtlety of reality.

The multi-hued rainbow exists in, and is a fitting symbol for the mystical realm which is human consciousness. Here is the site of reality, of the two cultures which the rainbow spans. ✯

George Ogden Abell
(1927-1983)

an anniversary biography by Dave Chapman

George Ogden Abell (pronounced "a bell") was a distinguished American astronomer who was a careful researcher, a popular teacher, and a successful author. Born in Los Angeles 75 years ago on March 1, 1927, he received his doctorate degree in astronomy from Caltech in 1956. For his graduate thesis, he painstakingly examined photographs of the sky and produced a catalogue of thousands of galaxy clusters. Abell's work provided the first hint that galaxies are not distributed randomly throughout the universe but tend to form clumps and chains.

From the same photographs, Abell later produced a catalogue of 82 faint planetary nebulae in 1966. These objects have nothing to do with planets, but are shells of luminous gas thrown off by the burnt-out stars at their centres. When they were first noticed by British astronomer William Herschel, these nebulae appeared as small disks that reminded him of planets. Abell's catalogue describes a set of unusual spherical-shaped planetary nebulae whose odd chemistry is of particular interest to astronomers.

Abell 1656 *– a very rich galaxy cluster in Coma Berenices. Image from The STScI Digitized Sky Survey http://archive.stsci.edu/cgi-bin/dss_form*

Abell discovered three comets in his astronomical career, one of them a periodic comet that orbits the Sun every seven and one-half years, named 52P/Harrington-Abell. During its most recent visit to the inner Solar system in 1998, Abell's comet was much brighter than expected, and was visible to amateur astronomers in backyard telescopes.

Apart from his astronomical research, Abell is also known as the author of popular astronomy books such as "Realm of the Universe", still in print. In 1983, the year he died, George Abell published a book entitled "Science and the Paranormal". One of the topics he considered was the connection between the lunar month and human behaviour. ✯

Obituary – Anna Myers

It is with great sadness that I must report to you the sudden and unexpected death of one of our Halifax Centre members. Anna Myers was an outstanding proponent of astronomy education. Although she only occasionally attended meetings, she never wavered from her course of sharing her love and knowledge of the stars with those around her. Anna was truly a visionary; it was she who brought to life the first Starlab portable planetarium in the schools of Nova Scotia. Over the past eighteen years Anna worked tirelessly to fire the imaginations of her students through the use of astronomy and Starlab. She never ceased teaching other teachers how to use the stars to bring science to life for their students. Her Starlab was constantly in use and her talents and energy were in great demand. Thousands of students and hundreds of teachers have benefitted from the work and care of this remarkable educator and amateur astronomer. Anna never failed to say "yes" to any request for help from anyone.

Anna Myers was a wonderful friend and over the years of my association with her, I was always and ever aware that I was in the presence of astronomy education greatness. She accomplished much with few resources, save her own energy, knowledge and passion for the subject. She will be sorely missed by many. ✯

Mary Lou Whitehorne

Upcoming Talks

2002 Canadian Association of Physicists (CAP) LECTURE TOUR

Wednesday, February 13th

PULSARS AND GENERAL RELATIVITY
Victoria Kaspi, McGill University

16:00, Room 135 Sir James Dunn Science Building

(Off Coburg Road C260 on the Dal campus map http://www.dal.ca/campus/map/)

Pulsars are rotating neutron stars that have beams of emission that are visible to us as a "pulse" once per rotation period, like a lighthouse. These unusual celestial objects have superb rotational stability, making them the universe's best clocks. In this talk, I describe how the fabulous stability of pulsar rotation is used both to test Einstein's theory of general relativity as well as to make astrophysical measurements having unprecedented and unrivaled precisions.

THE HARLOW SHAPLEY PUBLIC LECTURE

Thursday, March 7th

SUPERNOVAE: CREATIVE CATACLYSMS IN THE GALAXY
presented by David Helfand, Professor of Astronomy at Columbia University

Thursday March 7, beginning at 7pm
Sobey Building Auditorium, Saint Mary's University

Another one bites the dust.

At his residence in Halifax, Nova Scotia, on Saturday, January 26th, 2002, David Lane in his senior years passed away peacefully from his life of freedom after a long struggle, when he proposed to his future wife, Michelle Gallant. When news of his imminent demise was made public, friends rushed to the scene to render aid, but alas, the deed was done and all was too late.

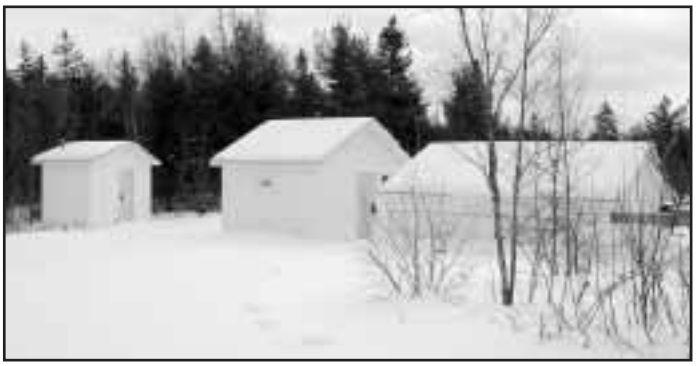
David leaves behind many loved ones, including family, friends, and professional associates. In due consideration of the life now facing Michelle in the future, her name is being forwarded by RASC National Exec. to the Vatican Observatory, south of Rome, in the hopes they can pull some strings and have her fast-tracked for Living Sainthood.

Arrangements are incomplete, times of services to be announced. It is assumed a summer burial is being considered. Visitors will be received ahead of time, also at a time and place to be announced. Other married members of the RASC are asked to consider memorial donations to the "David-Lane-Needs-Money-to-Buy-Toys Because-All-His-Money-Will-Go-to-Practical-Stuff-From-Now-On Fund."

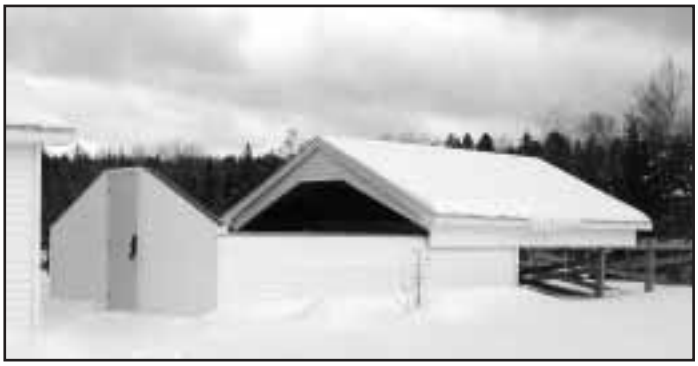
On-line condolences can be posted to the memorial web site at: http://www.anotherpoorbastardbites-thedust.com

Forwarded to Nova Notes by David Tindall, originally written by Joe O'Neil. Joe is a member of the London Centre of the RASC, and is a well-respected seller of astronomy equipment through his internet site. http://www.oneilphoto.on.ca/

The St. Croix Observatory



The St.Croix observatory. Pictured from left to right, the RASCan, the warm room and the roll-off roof observatory.



The roll-off with the roof partially open.

Part of your membership in the Halifax RASC includes access to our observatory, located in the community of St. Croix, NS. The site has grown over the last few years to include a roll-off roof observatory with electrical outlets, a warm-room and washroom facilities. Enjoy dark pristine skies far away from city lights, and the company of like minded observers searching out those faint fuzzies in the night.

Members' Night

Every weekend closest to the new Moon there is a Members' Night at St. Croix. The purpose of members' night is to attract members from the centre to share an evening of observing with other members. It's also a great night for beginners to try out different scopes and see the sky under dark conditions. For more information or transportation arrangements, please contact the Observing Chairman Dave Lane at 826-7956. *Dates for Members' Nights for the following few months are:*

Sat. Feb. 16th | Sat. Mar. 16th | Fri. Apr 12 *(Rain date, Sat. Apr 13)*

Directions from Halifax

(from Bayers Road Shopping Centre)

1. Take Hwy 102 (the Bi-Hi) to Exit 4 (Sackville).
2. Take Hwy 101 to Exit 4 (St. Croix).
3. At the end of the off ramp, turn left.
4. Drive about 1.5 km until you cross the St. Croix River Bridge. You'll see a power dam on your left.
5. Drive about 0.2 km past the bridge and take the first left (Salmon Hole Dam Road).
6. Drive about 1 km until the pavement ends.
7. Drive another 1 km on the dirt road to the site.
8. You will recognize the site by the 3 small white buildings on the left.

Become a St. Croix Key Holder

For a modest key fee, members in good standing for more than a year who have been briefed on observatory can gain access to the St.Croix facility. For more information on becoming a key holder, contact the Observing Chairman Dave Lane at 826-7956.

Adventures at the SCO.

Yup, It's CLEAR

Yup, It's COLD

My telescope is growing MOLD.

Should I go out and freeze my ?

Or stay inside these cozy walls?

Ahem, sorry for the poor poetry… just wondering if there are any hardy-type observers considering venturing to St. Croix tonight. (and I don't mean just to the warm room) :)

- Daryl Dewolfe
(maknewt@glinx.com)

Posted to the RASCals email list in December.

Meeting Announcements

Halifax Centre of the Royal Astronomical Society of Canada

February 15

"Globular Clusters:
Much More Than What Meets the Eyepiece"

by Craig Levine

In my talk I will cover what differentiates globular clusters from other cluster types and uncover the variety within the family of globular clusters. The discussion will include their importance to astronomy and cosmology as distance and age indicators, stellar evolution laboratories, the many peculiar objects contained within them, and of course the more interesting ones available to the visual astronomer.

March 15

"Galileo"

by William Lonc, S. J., Emeritus Professor of Physics,

Father Lonc is a long-time member of the Halifax Centre, whose research interests include, among many other things, radio astronomy and radio telescopes. Other interests include amateur radio, and the subject of his presentation for this month's meeting, Galileo.

Meetings begin at **8:00** P.M.

Members of the general public are welcome.

All members—but especially new ones—are invited to come to the meetings 20 - 30 minutes early to participate in our new informal "Meet and Greet". It's a chance to ask questions about astronomy, the RASC, memberships, or to just say hello.

Room 176 Loyola Building
Saint Mary's University *(See Map Below)*

The Halifax RASC Executive meetings begin at 7:00 P.M., and members are welcome to attend.

Halifax RASC Executive 2002

Honorary President	Dr. Roy Bishop	
President	Mary Lou Whitehorne	865-0235
1st vice-president	Pat Kelly	798-3329
2nd vice-president	Steve Tancock	465-4092
Secretary	Craig Levine	852-1245
Treasurer	Paul Evans	423-4746
Nova Notes Editor	Michael Gatto	453-5486
National Representative	David Lane	826-7956
Librarian	Dr. Michael Falk	422-5173
Observing Chairman	Dave Lane	826-7956
Councilor	Clint Shannon	889-2426
Councilor	Dave Chapman	463-9103
Councilor	John Jarvo	897-0529

Meeting Location

Meetings are held every third Friday of the month, except for the months of July and August. Meetings take place in room 176, Loyola Building (#3 on map) at Saint Mary's University.

1. *McNally*
2. *Sobey Building*
3. ***Loyola Academic Complex***
4. *Loyola Residence*
5. *Patrick Power Library*
6. *Science Building*
7. *Burke Building*
8. *Bookstore*
9. *Alumni Arena*
10. *The Tower*
11. *Rice Residence*

P = Parking