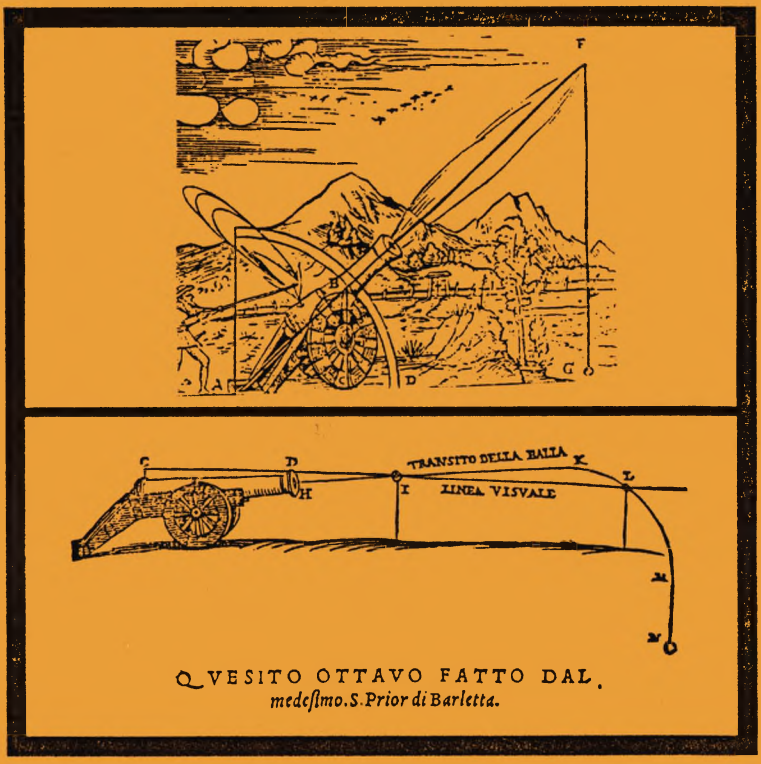
NOVA NOTES



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Halifax Centre

Nov-Dec 1990
Volume 21
Number 6

1990 Halifax Centre Executive

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Notice of Meetings

Date: **Friday, December 14th: 8:00 P.M.** for the main speaker
Place: Nova Scotia Museum, Summer Street, Halifax. Access from the side entrance. Meeting to be held in the lower theatre.
Topic: **Dr. Gary Welch** from the Astronomy Department at Saint Mary's University will be giving a talk on the subject of S0 galaxies.

Date: **Friday, January 18th: 8:00 P.M.** for the main speaker
Place: Nova Scotia Museum, Summer Street, Halifax. Access from the side entrance. Meeting to be held in the lower theatre.
Topic: **Greg Roberts**, a student at the Technical University of Nova Scotia will be talking about the work that he has been doing with computers and digitizing of NASA images. His work has received local and national media coverage.

Date: **Friday, February 16th: 8:00 P.M.** for the main speaker
Place: Nova Scotia Museum, Summer Street, Halifax. Access from the side entrance. Meeting to be held in the lower theatre.
Topic: The speaker for this meeting will be **Dr. Dave Hanes** of Queen's University in Kingston. His talk is entitled: *The Cosmic Distance Scale.*

Halifax Planetarium Public Shows

At the following shows will be on the topic of the current sky. Please note that dates are tenative.

Thursday, January 11th :	7:00 P.M.
Thursday, January 25th:	7:00 P.M.
Thursday, February 8th:	7:00 P.M.
Thursday, February 22nd:	7:00 P.M.

The Halifax Planetarium is located in the Dunn Science Building on the campus of Dalhousie University.

Note: The above list is tentative and subject to change.

About the cover:

The cover shows a two woodcuts. The upper one shows how a cannon ball should fall according to the laws of Aristotle, while the lower drawing is from a 1551 treatise by the Italian mathmetician Tartaglia. It shows that the trajectory of a cannon ball does not follow a straight line as Aristotle had predicted, but instead followed a curving path, which, according to Aristotle, only heavenly bodies were supposed to follow. Tartaglia also determined that 45° was the best angle to use if one wanted to achieve maximum distance.

Editor's Report

Patrick Kelly

As this issue is following so closely on the heels of the last one, a few of the regular columns won't be appearing this time around. As there have not been many new periodicals out, *Periodical Picks* will not appear in this issue. Also, I have not heard from GAZER before "press time" so *Ask GAZER* will also have to wait until the next issue. In order to get enough material for a full issue, I have had to dip rather deeply into my reserve bin of articles from other newsletters. I'm almost down to the bottom, so anyone who has been thinking of writing an article for NOVA NOTES, now is the time to start!

There have been a few things that have happened that are worth passing on. The November meeting was a great success despite the fact that most of the executive was late due to a supper engagement with our guest speaker **Damien Lemay**. Damien gave us a very interesting talk on how amateur astronomers can contribute to astronomy as a science. In addition he also showed us some photographs of two of the observatories that he has built over the years. They were really first class. I guess it will be quite some time before any of us complain about the amount of snow that we have to endure when we observe in the winter!

The Executive has decided to no longer hold formal executive meetings before the regular monthly meetings. This was due to the short amount of time available and the many other things that need to be done (setting up the library, taking memberships, getting the coffee and munchies ready, settling expenses, etc.) before each meeting. However, there will be members of the executive on hand for any members who wish to bring something to our attention. Also, due to poor attendance, Observer's Group meetings have also been put on hold indefinitely.

Members may have read in the *National Newsletter/Bulletin* that the Halifax and Toronto Centres had both put in bids to host the 1993 General Assembly. Instead we will be making an official presentation for the **1994** G.A. at the appropriate time.

Lastly, will be only a few changes in the executive for the upcoming year. **David Lane** takes over as Observing Chairman. **Doug Pitcairn** becomes National Rep, while **Randall Brooks** becomes a councillor. A special welcome goes to two new members of the executive: **Wesley Howie** who is our new secretary and **Greg Roberts** joins as a councillor.

Well, that is all that it on my mind for this issue. I would like to add a personal note that I hope that you all have a very pleasant holiday season and I hope that the upcoming year will be one of your best yet! Ω

Update from Hebron

Robert MacConnell

On Saturday, October 13th, 1990, members of the Hebbville Jr. High Astronomy Club and students from Liverpool Jr. High School were hosted by members of the Maple Grove Astronomy Club, Hebron, Nova Scotia, for an afternoon of activities, fostering an interest in beginning star-gazing.

Before lunch, students were invited to take a "role" as one of the zodiacal constellations so that others present could guess which star group they were portraying. A good mixer before lunch!

In the afternoon, pupils enjoyed a mixture of star fun, from constructing their own pinwheel planispheres and learning how to use it, to a video primer for astronomy: "Celestial Navigation and Astronomy". The afternoon was rounded off with pupils in the school's computer lab using "The Observatory" program which allowed pupils to see the night sky in the daytime!

Before departure, Mr. MacConnell, the group advisor to the Maple Grove Astronomy Club, displayed the club's homemade 10" Dobsonian reflector. At a later date, the Hebbville club hopes to visit the "space barn" exhibit of N.A.S.A. space scientist, Harry Taylor, a resident from nearby Brown River, Digby County. Ω

We

Roy Bishop

We

We, you and I,
We are fed by a star,
We are warmed by a star,
We owe our evolution to a star;
We, animated ashes of ancient stars,
We, who call sun-worshipping cultures,
Primitive

Our Closest Neighbours

Ingemar Furenlid and **Tom Meyla**
reprinted from - **The Electronic Journal of the Astronomical Society of the Atlantic**

Our closest known stellar neighbours in the Milky Way Galaxy, are the stars in the Alpha Centauri system. The two main components in this triple system are called Alpha Centauri A and Alpha Centauri B. The third companion, which is actually the closest of the three, is called Proxima (for proximity) Centauri and is a faint M dwarf star of visual magnitude 11.05. The trinary star system is located about 4.3 light-years from Earth.

Although Alpha Centauri A has been called a twin of the Sun, we have found evidence that this comparison is no longer valid. Co-author Ingemar Furenlid traveled to Chile a few years ago to use the excellent facilities of the European Southern Observatory (E.S.O.) for a detailed study of the spectrum of this star. Flying down the length of South America along the Andes is a beautiful experience; the approach to Santiago is announced by the summit of Mount Aconcagua; a 7800 metre landmark towering over the other peaks.

As an E.S.O. observer, I was met at the airport by an agent carrying a big sign with my name on it. He placed me in a cab and I was promptly taken to the "guest house". Next morning, I was off to a smaller airport for a memorable flight to La Serena, up north and closer to the observatory. The flight, in a seven metre twin engine plane, was done on the last day of one of the biggest storms in recorded history; it was the finest roller coaster I ever rode! The runway in La Serena was a big lake and the pilot's comforting words during final approach were "Let's give it a try, at least we won't burn." Hanging forwards in our seatbelts through cascades of water, we experienced the plane coming to a full stop in only 45 metres! From there, a van took us 160 km to the mountain.

My goal was to conduct a spectroscopic analysis of Alpha Centauri A, and to do this I made observations with a special purpose telescope called the coudé auxiliary telescope. It is located in a separate tower next to the 3.6 metre telescope. A coudé focus is located in a fixed place no matter where the telescope is aimed. In this case, the coudé room housing the échelle spectrometer and the observing room are both in the 3.6 metre telescope's building. This is one of the finest spectrographs in the world and observing here was a delight. Surrounded by TV screens, counters, touch screens and keyboards, I felt as if I were in a satellite. In a typical setup, the observer runs the spectrometer and the night assistant brings in the stars. This run was easy for the assistant as most runs were on the same star. Most of the spectrum of Alpha

Centauri A in the range from 390 nm (blue) to 760 nm (red) was observed in pieces 5 nm long in such a way that the resulting data had unusually high resolution and precision. All went fine: the weather after the storm was excellent and the last needed spectrum was recorded in the morning of the last night. After the long night, we were in a rush to get to bed. The night assistant, however, rushed too quickly and on the way down from the telescope hit a snowbank and rolled his car upside down. He crawled out from under it and walked to his quarters to sleep and some friends righted the car the next day.

Back at Georgia State University the data were reduced in standard fashion and the process of analysis started. The spectra were obtained for a very careful chemical abundance analysis of the Alpha Centauri system. The chemical analysis of stars has come a long way from early qualitative determinations of composition made merely by identifying the spectral line signatures of elements as previously determined in the laboratory. Now we can compare very high quality numeric data obtained at the observatory to results produced by sophisticated computer models of the atmospheres of the stars. In this way one can make high precision quantitative determinations of the abundances of elements in stars.

Before spectra can be interpreted, the effects produced by the electronic equipment must be removed from the raw data. In the spectrometer, a diode array, called a reticon, records the light by collecting a charge on each pixel of the array. The charge is dependent on the total amount of light that has fallen on the pixel. However, charge also collects on pixels in complete darkness and this amount needs to be subtracted . Also, each pixel in the reticon responds to light with a different efficiency and this effect must also be allowed for. For the most part, once these effects are taken care of, the spectrum is ready for analysis. The "spectrum" consists of a string of numbers which give the intensity of the light recorded by each pixel. This string of data must be scaled to a standard level, called a continuum, which represents the amount of light that would be radiated by the star if atoms were not absorbing certain wavelengths of light in the star's atmosphere.

After that one needs to find the relationship between the wavelengths of light observed and the pixels on the chip. In other words, one wants to know which wavelength of light was shining on each pixel. This relationship is called the dispersion solution and has a relatively simple mathematical form.

Once the spectrum is scaled and the dispersion solution known, the spectrum is ready to be measured. When the spectrum is plotted as a graph, with wavelength running horizontally and the intensity vertically, features called absorption lines – caused

by specific chemical elements absorbing certain wavelengths of light – appear as dips in the plot. The strength of each absorption line is measured by finding the area that the dip covers.

The absorption lines are the key to chemical analysis. If two stars are exactly alike in temperature and size, then the star with a higher abundance of chemical elements like carbon, oxygen or iron will show stronger absorption lines. In photographs, the lines will look darker, or when graphed, they will appear deeper.

To measure compositions, we commonly use the Sun as a standard because we know its composition better than that of any other star. Using the same model used to calculate the Sun's composition but on on a similar star gives the relative abundances for that star directly from the ratio of the strengths of the absorption features. For stars which are dissimilar, a more complicated process is required in which differences in the atmospheres of the stars must be accounted for.

When we take the final model calibrated from the Sun and apply it to the spectrum of Alpha Centauri A, we get the following results. Physically, we find the star to have a temperature of 5700 K which is 90 K cooler than the Sun. It appears that the surface gravity is roughly fifty to sixty-five percent the strength of the Sun's, indicating that it is somewhat further along in its evolution than the Sun. This agrees well with the fact that Alpha Centauri A is about ten percent more massive than the Sun, as found by studies of its orbit. As a result of this extra mass, it is aging more rapidly than the Sun. Chemically, we find that atomic elements from carbon through zinc are enriched relative to the Sun by about three percent. This enriched composition is also supported by recent calculations of the interior structure of the star; strong evidence that the result is correct.

The difference in composition between the two stars also gives us clues as to what caused the enrichment. The most enriched elements are zinc, sodium, aluminum, manganese and copper. Less enriched are carbon, oxygen and iron. These findings are consistent with enrichment by a massive supernova explosion. We conclude that the material which formed the Alpha Centauri system was affected by one or more supernova than the material which formed the Sun.

It is a long, arduous path to the observatory. From the observatory to the final result, the road is no less arduous. However, from our planet we have done some very high quality long-range sensor scanning and determined to high precision the chemical and physical characteristics of a very distant body. The precision is, in fact, good enough to begin to piece together some of the family history of our closest neighbours in the Milky Way Subdivision. Alpha Centauri A is sufficiently different from the Sun that we can say for sure it is not a twin! Ω

Space Telescope Quiz

reprinted from - **Orbit** - Hamilton Centre

Now that the Hubble Space Telescope is in orbit, it's time to test your knowledge of this truly "world class" optical instrument; our "window to the universe.

1. The Space Telescope was named after Edwin P. Hubble – a famous, dead astronomer. Was Hubble famous for:
   a) A law relating the velocity of a galaxy to its distance from us?
   b) His fine collection of matchboxes?
   c) An unusual anatomical defect?
   d) All of the above?
2. The primary mirror of the H.S.T. is of unparalleled accuracy. Which of the following best describes its surface?
   a) 1/8th wave
   b) Null figured
   c) Very shiny
   d) If it was scaled up to the size of the Earth, the largest defect would be no taller than a garden gnome.
3. For such an accurate mirror, enormous pointing accuracy (for as long as 24 hours at a time) is necessary. Such precision can be related to:
   a) Having a baseball pitcher stand in San Francisco and throwing strikes to a catcher in New York City.
   b) Blindfolding a drunken Irishman and having him pin the tail on a rhinoceros away over in Kenya.
   c) Mailing a letter in Vancouver and having it arrive at the correct address in Halifax.
4. The Hubble Telescope can see finer details than any other instrument. In fact, it has the capability of seeing:
   a) Volcanoes on Io?
   b) Planets around other stars?
   c) Comet Austin?
   d) Nearly as much as a Questar?
5. Which of the following accessories is **not** on the H.S.T.?
   a) Faint object camera
   b) High speed photometer
   c) Wide field spectrograph
   d) Moto-focus by Jim's Mobile
6. Which of the objects will the H.S.T. **never** observe?
   a) The Sun
   b) The Moon
   c) Halley's Comet
   d) NCC-1701 Ω

New Gift Items
National Office

Wouldn't it be nice to find something astronomical under your Christmas tree this year, instead of the usual tools or bathrobe? The R.A.S.C. has several great gift ideas:

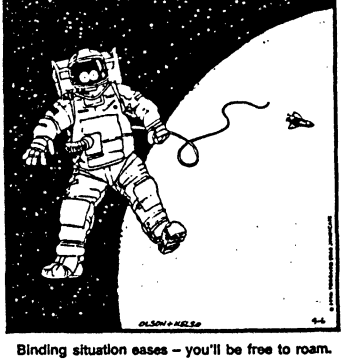
1) Classy white jersey golf shirts, poly/cotton blend material with knitted collar and buttoned openings. Sixes S,M,L,XL with our astronomical society crest screened in navy on the upper left.
$20.00 each
2) Neat looking round vinyl stickers, with the society crest imprinted in navy on a white background, about 3.5" in diameter. These are super for clipboards, camera cases, telescope tubes and luggage for that '91 eclipse trip! **$1.00 each**
3) Handy clear acrylic key chains with metal ring, with our society crest imprinted in navy on both sides of the white insert. These are great for all your keys, and can be spotted easily in the dark if dropped!
$4.00 each

These items are available by sending a Canadian check or money order, payable to Royal Astronomical Society of Canada, to:

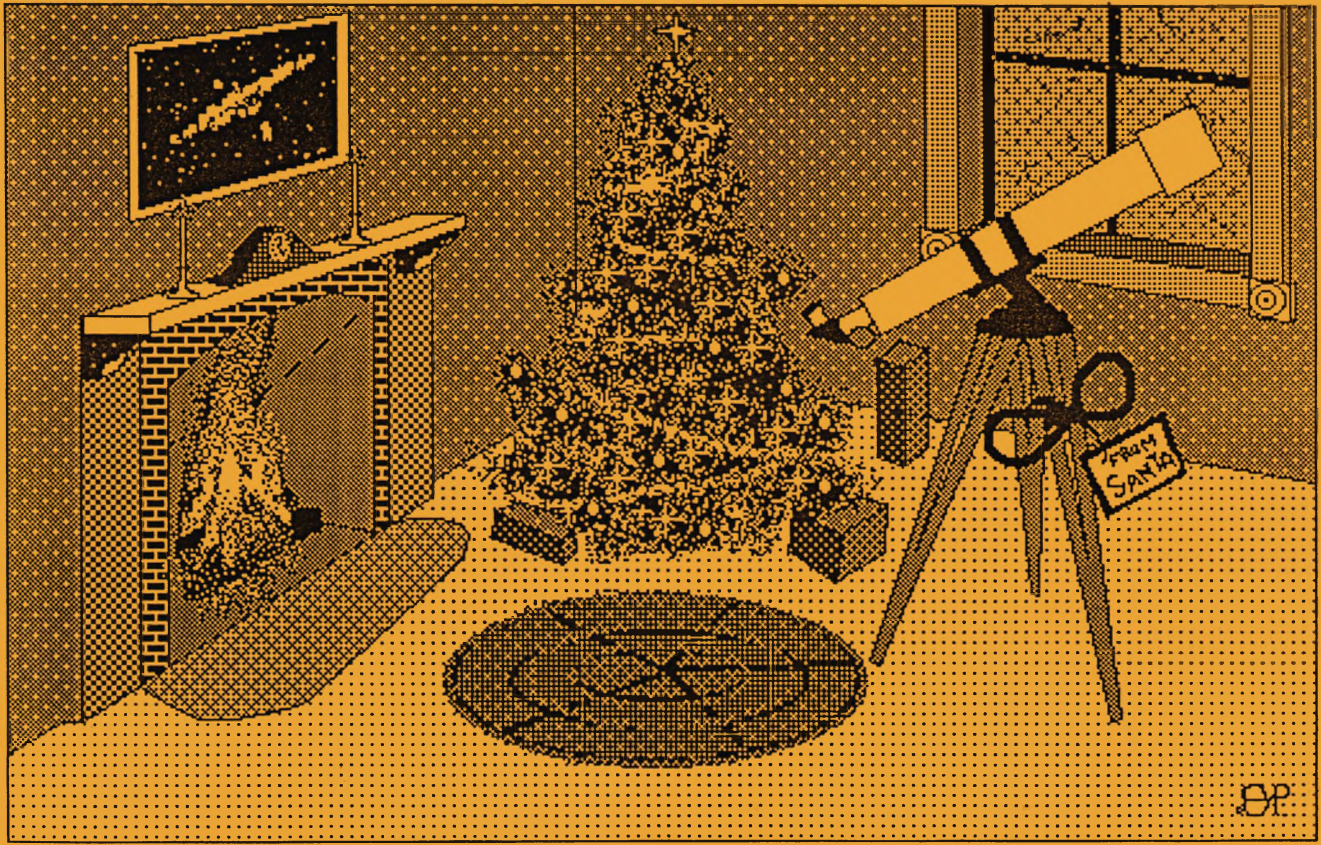
R.A.S.C. Promotional Items
c/o Mrs. Cathy L. Cresswell
78 Tormore Drive
Richmond Hill, Ontario
Canada
L4C 3N5

Please add packaging and postage of: $2 per shirt and $1 per item or batch order of stickers or key chains. You can also contact me by phone at (416) 884-3858. And don't forget – leave this information where Santa can see it! Ω

Horrorscope



Binding situation eases – you'll be free to roam.



From Santa

Your Centre's Executive wishes all of you

a Happy Christmas and clear skies

in a prosperous New Year.

Astro Ads

FOR SALE: MEADE 2120 LX5 10" SCHMIDT-CASSEGRAIN

- complete factory assembly - additional accessories
- price negotiable

All in excellent condition
Call John Muir - (902) 423-6004 (Halifax)

FOR SALE: ASTROSCAN REFLECTOR

- complete with case - used only a few times
- asking $400

Call Doug Pitcairn - (902) 420-7604 (day) 463-7196 (night)

FOR SALE: 4" CRITERION SCHMIDT-CASSEGRAIN

- complete woth case - 30 mm eyepiece
- asking $250

Call Nat Cohen - (902) 434-3103

The Telescopic Shoppe

"Science and Nature for the Atlantic Provinces"

featuring products from: Astronomy magazine, Bausch&Lomb, Bushnell, Celestron, Efstonscience, Hansen Planetarium, Meade, Omcon, Sky & Telescope, Tento and others

Store Hours:
Monday to Friday: 6:00 P.M. – 10:00 P.M.
Saturday: 10:00 A.M. – 5:00 P.M.

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(902) 477-0847

Astronomy - Hobby or Obsession?

Marlene Whitta
reprinted from **Stardust** - Edmonton Centre

Most people have hobbies - those activities in which they participate during their leisure time. Different people are drawn to different interests: some read, some jog, some paint. There are sport jocks, beer drinkers, T.V. veggies; indeed, the list is virtually endless. However, increasing numbers of the population are embracing astronomy as a hobby.

Most hobbies are quite innocuous. They can be therapeutic and very relaxing. They fill in an hour here and there; a couple of minutes before bed-time, or before an appointment. Most pastimes are fun and relatively undemanding of time and/or money.

Astronomy enthusiasts, on the other hand, are a breed apart. Their skins are sallow; their eyes bruised and haunted. They stay up all night long, peering into eyepieces of varying focal lengths, their bodies almost catatonic from lack of sleep and maintaining one position for hours on end. They crawl around on the frozen ground, feeling for objects that have slipped from frozen, stiffened fingers. They emit low, tortured moans as their fingers brush into fragments of cherished eyepieces or much-needed spectacles. What is it about this hobby that can turn intelligent, productive members of society into gibbering, twitching somnambulists?

Of course, it doesn't start that way. The novice develops an interest in the subject and spends an hour here and there, peering at the moon, or perhaps a planet. He reads a book on astronomy - a seemingly innocuous act. Then he peeks at a star, another planet. Before he knows it, he is seeking a view of a star cluster, a distant and faint galaxy, trying to measure the separation of a binary star. Soon he is hooked and has to buy binoculars, a telescope and all the accessories that go with them. He is driven to view more and more distant blurs of light; to penetrate even further the depths of space.

Now the regular civilian has no idea of what is taking place here. He sees the amateur astronomer as an obsessed personality, barely making it through the day in a zombie-like state, waiting for darkness to fall yet again. Heaven knows what he does then - scuttling along in the dark, carrying heavy tube-like objects, mumbling and moaning to himself or to an accomplice using strange code words like M42, NGC 110, M31 - HUT! Furthermore, should a cloudy night keep the astronomy enthusiast indoors, it all falls apart. He cannot watch TV, play cards or even take a nap. He or she is inconsolable and seeks the company of his or her

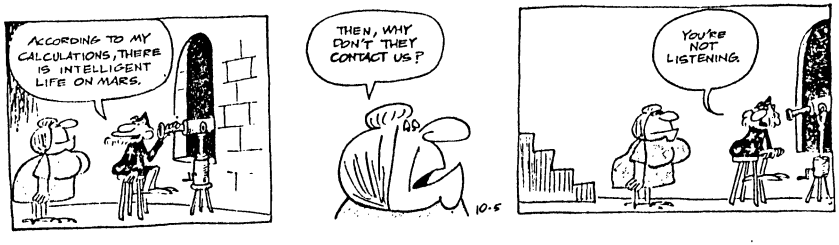
peers so that they can commiserate with each other. They talk about what they've observed in the past, what they could be observing now, and what they hope to observe in the future. They huddle over star charts and computers, talking in monosyllables and imbibing copious amounts of coffee.

To the amateur astronomer, none of this behavior is in any way bizarre. The skin is sallow because there is precious little time to loll around in the sun. Most people must work during the day to keep body and soul together, and to aid in the pursuit of bigger and better equipment. The eyes are bruised and haunted because peering into an eyepiece produces eyestrain. The "rush" that accompanies the observation of distant clusters, nebulæ and galaxies makes it impossible to sleep; therefore the eyes and face acquire a pinched look, interpreted by some as the result of intense mental and physical concentration. Behind this appearance is a mind running at full speed; observing, cataloguing, comparing, analyzing, admiring and appreciating Nature's Best.

The astronomy enthusiast is often seen as being obsessed; but so it is with many hobbies. The runner must run, the painter must paint and the astronomer must observe ... weather conditions permitting. There are many obstacles placed before the would-be observer. Some are natural acts of God, such as hostile weather patterns, dense clouds, gale force winds. Others are man-made obstacles and harder to take, such as city lights, car lights, street lights, porch lights, smoke from fireplaces, visitors, etc.

The one benefit derived from all these obstacles is the development of patience. Even if 29 out of 29 nights are cloudy, the observer knows from experience that if one waits long enough, there will be a clear sky during the dark of the moon. There will be then be tremendous pressure from family and friends to give up that night, but the dedicated observer won't let them get to him. After all, little Johnny can celebrate his birthday any old time, but remember, this is the first clear night in three months!

Who would dare say that astronomy is an obsession? Ω



More Double Shadows

Patrick Kelly

Yes, it's that time of year for me to publish another list of ~~cloudy nights~~, the times when two of Jupiter's moons will have shadows on Jupiter at the same time. This year's initial list had twenty-seven entries, including twelve in January alone! However, when pruned to what was visible from Nova Scotia only eleven are left. I used the 1991 edition of *The Observer's Handbook* as my source of data, and I encourage other to use it to look for other interesting events related to Jupiter's moons.

As the times are in UT, some of these events will occur on the **previous** date once the times are converted to Atlantic time. These dates have been indicated with an asterisk. The column labelled "original" refers to the moon whose shadow is already on Jupiter's disk.

Date (UT)	"Original"	Event	Time (UT)
January 1*	Europa	Io Ingress	1:38
		Europa Egress	2:46
January 6	Ganymede	Io Ingress	9:03
		Ganymede Egress	9:13
January 8*	Europa	Io Ingress	3:32
		Europa Egress	5:22
January 15	Europa	Io Ingress	5:25
		Io Egress	7:42
January 22	Io	Europa Ingress	7:41
		Io Egress	9:36
January 29	Io	Europa Ingress	10:18
		Io Egress	11:30
February 1	Io	Europa Ingress	23:37
		Io Egress	0:27
February 9*	Io	Europa Ingress	2:14
		Io Egress	2:21
June 20*	Io	Ganymede Ingress	1:22
		Io Egress	1:46
November 3	Ganymede	Io Ingress	6:11
		Io Egress	8:28
November 10	Io	Ganymede Ingress	8:57
		Io Egress	10:21

* the previous day when converted to Atlantic time

Jupiter will be near the horizon for the events of January 29th, June 20th and November 3rd. Two dates are of special interest, January 15th and November 3. On these dates Io's shadow catches up to and passes those of Europa and Ganymede

respectively. However, as already mentioned, Jupiter will not be well placed for the one in November. I would like to issue a challenge to all of the astrophotographers in the readership to try and capture a series of images of either of these events. (In case you need more incentive, it is worth pointing out that Sky&Tel would probably be very interested.....) Ω

Oh, Be a Fine...

Alan Paeth

reprinted from - **Pulsar** - Kitchener-Waterloo Centre

In a recent issue of *Sky & Telescope*, internationally renowned Canadian amateur David Levy discussed the standard star color sequence "OBAFGKMRNS". Each letter identifies the spectral class of a star as one goes from blue to red. For instance, Sol (our star) is a G star and is thus somewhat yellowish as seen from beyond the atmosphere.

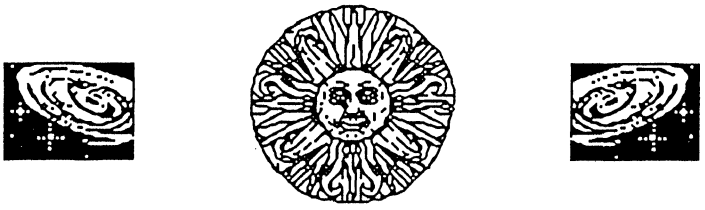
Many astronomers are familiar with the ages old mnemonic (memory aid) for the sequence: "Oh be a fine girl, kiss me right now smack". Levy points out that the phrase may be considered sexist (but I note the substitution of "guy" for "girl" is simple enough) and suggests that finding alternatives makes a nice recreation. *[Editor's note: The book from which I first learned this phrase had "sweetheart" instead of "smack" which always seemed to flow a bit easier from the tongue. However, if one wishes to avoid the sexist implications altogether, one can replace "girl" with "gorilla" in which case "smack" would undoubtedly be more appropriate!]*

In fact, some years ago, Owen Gingerich did a survey in which people were invited to come up with their own mnemonics. I have learned that results were posted in the Caltech Astronomy Library from about 1978 – just as I was graduating from that institution. The abridged list included:

"On Bad Afternoons Fermented Grapes Keep Mrs. Richard Nixon Smiling"
"Oven Baked Ants, Fried Gently, Kept Moist, Retain Natural Succulence"
"Oh Boy, A Flash! Godzilla Kills Mothra! Really Not Surprising"
"Overseas Broadcast: A Flash! Godzilla Kills Mothra! Rodan Named Successor"

You are encouraged to add to this list! My own humble contribution is:

"Old Binoculars Are Fine Glasses; Knowhow Makes Resolving Neptune Simple" Ω



Membership in the R.A.S.C.

If you are reading this newsletter, chances are that you have an interest in astronomy. Have you considered joining the Halifax Centre of the Royal Astronomical Society of Canada? Your membership brings you the following :

- The 1991 Observer's Handbook
- 6 issues of the R.A.S.C. Journal
- 6 issues of the National Newsletter
- 6 issues of NOVA NOTES

You also get borrowing privileges from the Halifax Centre's sizable library which contains a large number of books covering all astronomical subjects. In addition, the Centre has three telescopes which members may borrow for two week periods to learn the basics of observing or to advance their observing programs. Meet new people who share your interest and learn more about this rewarding pastime from other members. Even if you don't have a telescope, you are welcome to come to our observing sessions . Learn the night sky as never before.

Our membership year starts October 1st so now is the best time to join. You can join by filling out the form on the opposite page and bringing it to any of our regular meetings (see the "Notices of Meetings") or by mailing it along with the appropriate fee. For more information, please feel free to contact any of the members on the executive.

Halifax Centre, R.A.S.C.
1991 NEW Membership Application

Name: _____

Address: _____

City _____

Province _____

Postal Code _____

Phone Number _____

Please accept my membership for 1991 in the following category:

☐ Regular $32.00
☐ Youth* $20.00
☐ Senior** $20.00
☐ Life $640.00
☐ Associate*** $5.00

* must be under 21 and enclose proof of age
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NOVA NOTES INDEX

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HALIFAX CENTRE - R. A. S. C.
1991 CALENDAR OF EVENTS

January

S	M	T	W	T	F	S
		1	2	**3**	4	5
6*	**7**	8	9	10	11	12
13	14	**15***	16	17	18	19
20	21	**22***	23	24	25	26
27	28	**29***	**30***	31		

February

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	**8**	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28		

March

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

April

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	**22**	23	24	25	26	27
28	29	30				

Key to calendar:

Regular and Meetings: **bold and shadowed**

Special days: **bold** (On dates marked with an asterisk, the event occurs on the **morning** of the date given. Check your Observer's Handbook for details)

Possible observing sessions: underlined

Special Days:

January 3 - Quadrantid meteor shower
January 6 - Two shadows on Jupiter (5:03 A.M. AST)
January 7 - Two shadows on Jupiter (11:32 P.M. AST)
January 15 - Two shadows on Jupiter (1:25 A.M. AST)
January 22 - Two shadows on Jupiter (3:41 A.M. AST)
January 29 - Two shadows on Jupiter (6:18 A.M. AST)
January 30 - Penumbral lunar eclipse (2:00 A.M. AST)
February 1 - Two shadows on Jupiter (7:37 P.M. AST)
February 8 - Two shadows on Jupiter (10:14 P.M. AST)
April 22 - Lyrid meteor shower

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