NOVA NOTES

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THE NEWSLETTER OF THE HALIFAX CENTRE OF THE RASC
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Notice of Meetings and Other Stuff

ASTROPHOTO OF THE MONTH – NGC 891

This shot is the sum of three 7minute shots taken from Fairview during the full moon. Taken on a Meade 416XT CCD camera and an 8 inch Schmidt Newtonian by Blair MacDonald.

EDITORS REPORT: BY SHAWN MITCHELL

The last two issues of Nova Notes have been very difficult to produce due to a serious lack of material. I currently have nothing for the December issue, which I hope to produce in about 5 weeks (if I have anything to publish). So get out your type writers and computers and write an observing report, or a book report, or a research article, something that you would like to share with other members of the Centre. The December issue is also your last Chance at the 1999 Burke-Gaffney Award. Ω

PRESIDENT'S CORNER: BY CLINT SHANNON

Due to an error of omission in the previous Nova Notes and to set the record straight, Paul Evans' name was missing from the list of airborne observers aboard the Halifax eclipse charter flight.

By the way, Paul is now the proud owner of a 12.5" truss tube dobsonian scope and rumor has it that he is thinking of putting a cot in the warm room at the St. Croix Observatory.

There are a few RASC 2000 Calendars left, so if you have not yet acquired one now is the time.

NOVANOTES, THE NEWSLETTER OF THE ***HALIFAX CENTRE OF THE ROYAL ASTRONOMICAL SOCIETY OF CANADA***, IS PUBLISHED BI-MONTHLY IN FEBRUARY, APRIL, JUNE, AUGUST, OCTOBER, AND DECEMBER. THE OPINIONS EXPRESSED HEREIN ARE NOT NECESSARILY THOSE OF THE *HALIFAX CENTRE*. MATERIAL FOR THE NEXT ISSUE SHOULD REACH THE EDITOR BY **DECEMBER 17TH, 1999**. ARTICLES ON ANY ASPECT OF ASTRONOMY WILL BE CONSIDERED FOR PUBLICATION. "LETTERS TO THE EDITOR" OR TO OUR RESIDENT EXPERT: GAZER ARE ALSO MOST WELCOME. CONTACT THE EDITOR AT:

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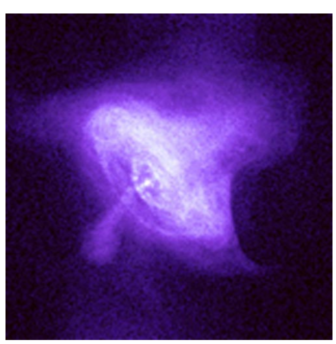
On September 26th we had a very productive "work party" at the St. Croix Observatory comprised of Roy Bishop, Dave Lane, Daryl Dewolfe, Steve Tancock, Mary Lou Whitehorne, Paul Evans and yours truly. The growth in the driveway and surrounds was removed and several more trees were cut down which improved the observing horizon consider-ably. One more work "outing" is planned for this fall to finish off the trim in the warm room and to tidy up the grounds.

A reminder to all to attend the November 19th meeting, if possible, as it is our Annual General Meeting at the Museum. The main speaker will be Randy

Attwood, RASC National President. Randy's talk will be titled "Sending A Spider To the Moon". This talk will take a detailed look at what was involved in the design and construction of the Apollo Lunar Module. Conceived in 1962, the original Lunar Module did not look much like the "Eagle" which made the first lunar landing. Over a period of seven years, as many engineering problems were solved, the design of the LM evolved. Angular in shape, flimsy in construction and bug-like in appearance, the LM was the first true manned spacecraft not meant to fly in the Earth's atmosphere. The talk will be illustrated with many pictures depicting the evolution and construction of the Apollo Lunar Module. A descrip-tion of how the LM was guided to the lunar surface will be presented as well as analysis of the first



lunar landing. Clear skies! Ω

SEPTEMBER MEETING REPORT:
BY DR. ROY BISHOP

President Clint Shannon opened the meeting shortly after 8 p.m. on September 17 at the Nova Scotia Museum. As has been his practice, Clint described what a bargain is membership in the RASC: for only $36 one obtains membership in the Halifax Centre, membership in the national RASC,
The Journal, the Observer's Handbook, SkyNews, Nova Notes, borrowing privileges from the Centre's Library, and use of the Centre's St. Croix Observatory.

Clint announced that the October meeting would be held at the Sobey Building at St. Mary's University. This will be the second time we will have tried this new location. The program will consist of three "mini-talks" by Mary Lou Whitehorne, Steve Tancock, and Michael Falk. The next Nova Notes deadline will be the date of this meeting (Oct 15).

The Annual Meeting of the Centre will be on November 19. Three positions remaining to be filled:

President, Treasurer, and Observing Chairman. Clint asked the audience to consider making nominations.

John Jarvo reported on Nova East which was held at Fundy Park, August 13 to 15. Unfortunately Shawn Mitchell brought his newly completed telescope to Nova East and consequently the weekend was rained out. However, on one day some solar observing was possible. About 35 people attended 10 from the Halifax Centre and 25 from elsewhere. John raised the possibility of bringing Nova East back to Nova Scotia, possibly to Smiley's Park near Windsor and the Centre's St. Croix Observatory. Comments from the audience and a straw vote indicated strong support for this proposal. Negative aspects of the Fundy site include distance, uncertain weather, and the installation of more lights at the Park.

The main event for the evening was presentations by several members on their observing activities during the past summer: David Chapman (adventures with a camera and Ranger telescope in Sequoia and Yosemite National Parks in the southwestern USA), David Lane (the August 11 total solar eclipse from a Piper Navajo, illustrated with video images), Shawn Mitchell (slides illustrating the previous expedition), Clint Shannon (slides illustrating the previous expedition, plus one of David Lane in bed at Nova East), Roy Bishop (the August 11 total solar eclipse from a ship, the "Regal Empress", illustrated with slides), Michael Falk (successful observations of the green flash on the Regal Empress cruise, and an explanation of the phenomenon), Dale Ellis (a possible green flash observed from the Fundy shore), Blair MacDonald (a visit to the Very Large Array in New Mexico, illustrated with slides).

The meeting closed over refreshments provided by Ralph Fraser, our long-term and reliable cookie chairman. Ω

Image Processing 101: By Blair MacDonald

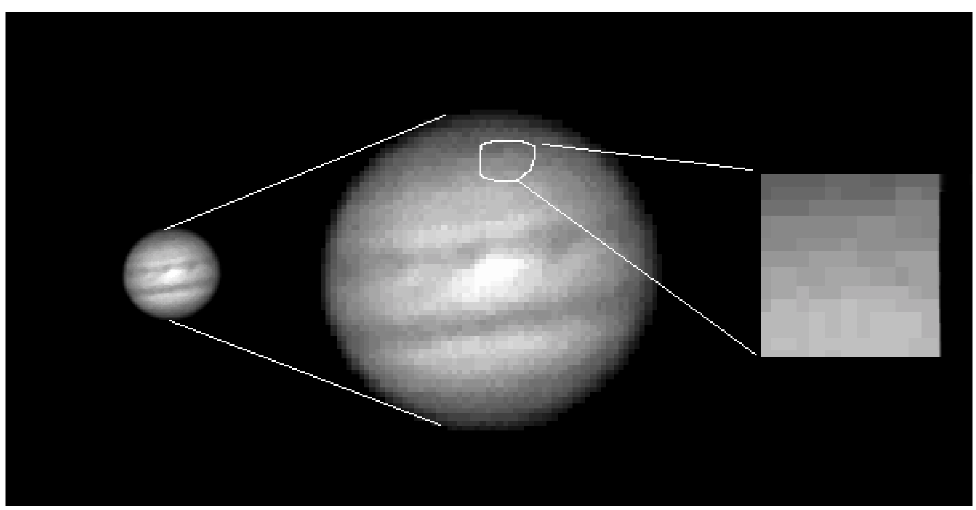
Introduction

I have to start getting more sleep. When the editor asked for more Nova Notes submissions, through the sleep haze produced by year old twins and one to many late night observing sessions, I heard *Tour Boat Positions* and said those two little words that get me in trouble all the time – "I volunteer." Actually, several members had asked for more information after a club talk on image processing so I told Shawn that I would start a somewhat regular column on the topic. This first installment is meant to describe what an image is. That is what the computer represents an image as for processing purposes. The first few columns will be fairly simple on the basics of image representation and noise, but I'm afraid some math will creep in here and there. I will try to include as many Answers to questions from readers as possible (meaning those questions I know the answers to) so feel free to contact me by email at nstn1399@fox.nstn.ca.

What is an Image

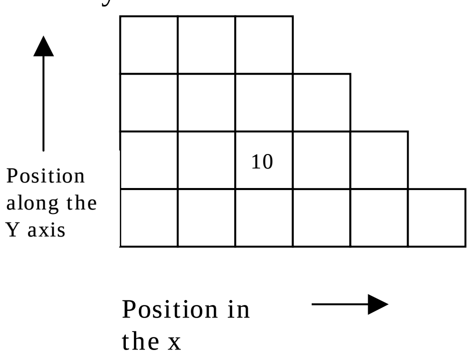
We have all seen the pretty pictures floating around the net and those in the astronomy magazines. These pictures and even those on photographic film are nothing more than a series of dots of varying intensity. The major difference between photographic pictures and their electronic cousins are that the film grains are not regular and rely on having lots of them to fill in the picture. The digital images and those in magazines have a regularly spaced grid of dots called pixels.

A pixel is the smallest element of the picture. It contains the information about all the light that fell on it during an exposure as well as any *noise* that may be present. When the picture is displayed, at normal resolutions, the individual pixels blend into a continuous and smooth picture, as the human eye cannot resolve the individual elements. This can be seen in the picture of Jupiter below:



The image on the far left is a picture of Jupiter taken from my backyard in suburban Halifax. The center image is a magnified view and the pixels are becoming visible. The image on the right is an area shown on the center image, greatly enlarged, the pixels are immediately visible.

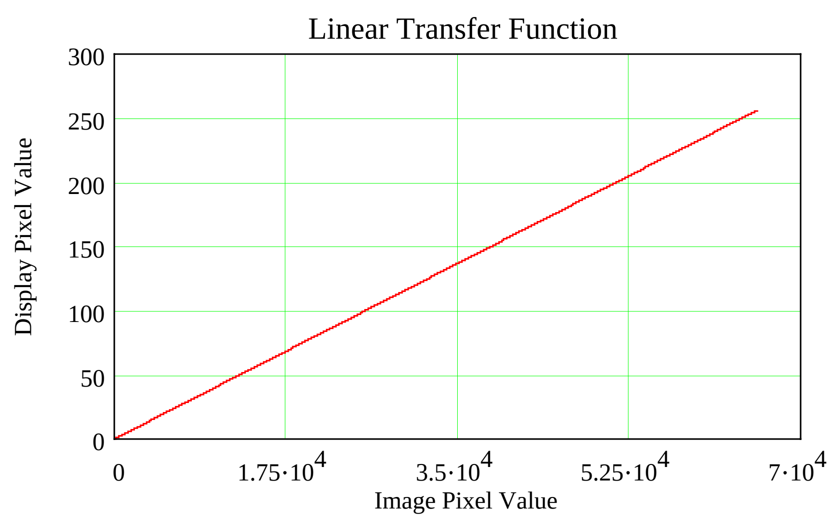
In terms of image processing, these pixels are merely numbers representing the brightness at any given location in the image. You will notice the wording here – *any given location*. This means that somehow the computer must also store information about the location of the pixel as well as its brightness. This is done by storing the brightness value in an array. An array is just a rectangular table of numbers with the position of the element in the table corresponding to the position of the pixel in the picture. So if the third pixel from the left and two pixels up from the bottom of the image has the value 10 then the pixel is represented as follows in the array



Now the nice thing about representing an image as an array is that there is a whole host of mathematical manipulations that apply to arrays which can be used to change and improve the image. Over the course of the next several columns I will try to show the reader how to resize, flip, mirror, filter and deconvolve images, all based on array manipulations. Indeed the modern computer is well suited to this type of processing. All this means that what used to take hours in the darkroom can now be done in a few minutes on a typical PC.

The value of any given pixel depends on two factors: the amount of light collected during the exposure and *noise*. Noise is something we have all seen, snow on a TV picture is a good example, and it set the limits on what can be achieved with image processing. Even a badly focused image can be corrected digitally, after all that is what was done with many of the Hubble Space Telescope images until the corrective optics were installed. The problem is that almost all forms of sharpening an image make the noise worse, sometimes to the point where the original blurry image is more appealing to the eye! For now think, of noise as the random variation in pixel values over and above the value due to the recorded photons. In terms of the processing, it really does not matter how the noise got there, the trick is to minimize the effect on the image. For now just keep in mind that images are represented as arrays of numbers and that the value of any pixel in the image depends only on the light recorded during the exposure and random pixel to pixel variations called noise. In a following column we will examine noise in more detail and show some methods to reduce its effects.

An image, as it is displayed, cannot show all the detail stored in the image array. The reason for this is the limited range of brightness values displayed by computer monitors. Older monitors could display 64 shades of gray while newer ones can get to 256 if you are lucky. For this reason the image values must be mapped or scaled to the display. This can be done by using a display transfer function. Think of this as the plot of a line with the image pixel values on one axis and the display pixel values on the other. This line shows how the pixel values will be mapped to the display and by changing the shape of this line the image can be brightened or the contrast enhanced. In addition, the line does not have to be linear; this is the basis of a log stretch. Both types of transfer functions can be

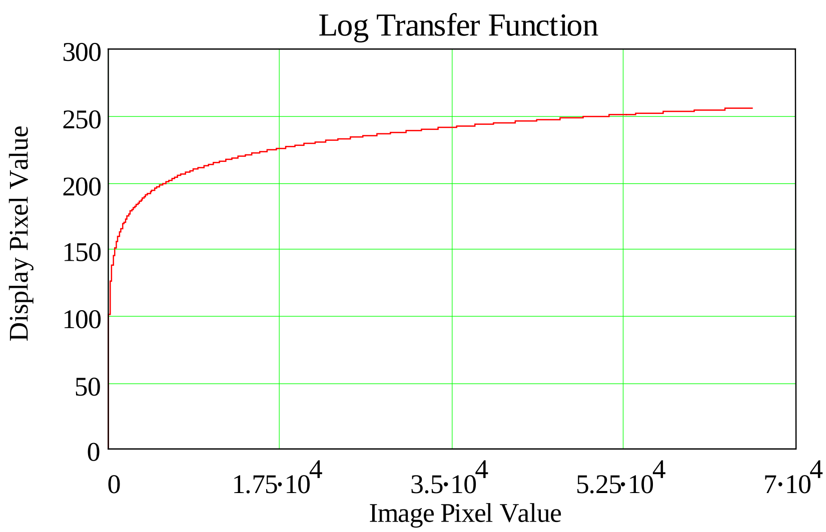


seen below, simply select a pixel value on the X axis and read the corresponding display value from the Y axis.

The expression for the above line is:

$$Y = \frac{256}{\log\left(2^{16}\right)} * X$$

where 256 is the maximum screen pixel value and 2^{16} is the maximum image pixel value.



The expression for the log transfer function is:

$$Y = \frac{256}{\log\left(2^{16}\right)} * \log(X)$$

with 256 being the maximum screen value and 2^{16} is the maximum image pixel value. So far we have seen that an image is represented as an array of pixel values for the purposes of image processing and that each pixel contains both the desired image value plus some unwanted noise. The basics of display stretching has also be shown and it should be kept in mind that this technique forms the basis of image histogram stretching to be shown in a later installment of Image Processing 101. Ω

Treasurer's Report: By David Lane

Halifax Centre 1998/99

1998/99 has been another fine financial year for the Halifax Centre.

At our September 30th year-end, we had a surplus of $1877.43. This surplus resulted primarily from Nova East proceeds ($658.02) and merchandise sales ($796.88). There was also a $300 plus savings in the printing and mailing costs of Nova Notes. The printing was switched from Econo Kopy to the print shop at Saint Mary's University and the practice of mailing copies to other centres was discontinued.

In continuation of past accounting practices, the observatory capital expenditures were expensed but were small this year ($542.40) in comparison to the past several years. Work this past year mainly involved the installation of a propane furnace and the fabrication of a steel peer for the Ultima 8.

Membership levels were stable averaging at about 170 members through the year. Have we reached our peak? Only time will tell.

(as of October 14, 1999)

The only capital expenditures during the year ($751.23) were for some components needed for the 17.5-inch telescope for St. Croix, which should be built this winter.

Our assets continue to grow – counting the observatory, we are now worth (at least on paper) $35,167.76 and have no liabilities. The earliest financial report I could find (without too much effort) in my old issues of Nova Notes was for 1990 and at that time, our equity was $8,621.16 meaning that our assets have grown by $26,546.60 in the past 9 years! I think the centre should be particularly proud that this considerable gain was realised entirely from within – we did not obtain any funding from outside sources.

Respectfully submitted,
Dave Lane, Treasurer

Significant Details of the 1998/99 Income Statement

REVENUES:

Membership Fees $2076.12: Membership fees were down slightly from last year.

Life Members Grant $432.00: Our grant from National Office was the same as last year and represents 30 life members.

Interest $80.85: This was earned mainly in our money market account, but does not include the last quarter of the year (see Assets, Accrued Interest below). Our bank account earns little interest.

Handbook Sales (net) $198.05: Handbook sales were nearly double that of last year.
Sales of Merchandise (net) $598.03: Merchandise sales were strong when compared with last year.

Nova East (Net) $658.02: Nova East attendance was down over last year due to the horrible weather. This resulted in lower attendance and a smaller net profit.

EXPENSES:

Meetings and Newsletter $1,039.82: $151.18 was spent on our meeting treats and meals for out-of-town speakers. Nova Notes cost us $396.26 to print and $470.01 to mail it to our members. We stopped mailing Nova Notes to other Centres this year – it is available for download from the Website.

Insurance $500.00: This is entirely the insurance for the observatory.

Awards and Donations $50.00: This item paid for the Burke-Gaffney Award prize.

Observatory $575.04: This figure also includes the $1 land lease paid in April and some construction materials needed for the year's subdued construction activities. Capital spending to date on the observatory has totalled $19,266.02 since the project was started in the spring of 1996.

Significant Details of the 1998/99 Balance Sheet

ASSETS:
Cash $5,413.94: This represents the cash balance at the Toronto Dominion Bank in Halifax on September 30, 1999.

Undeposited Funds $70.00: $70 in cash was on hand but not deposited at year-end.

Accounts Receivable $244.00: As of September 30, 1999, the Discovery Centre owed us $244 for merchandise sales.

Merchandise Inventory $979.33: This consists of 24-T-Shirts, 33-BOGs, 38-2000 Calendars, 46-centre Pins, and 5-bumper stickers.

Investments $2,000.00: The Halifax Centre holds a money market account with the Toronto Dominion Bank.

Accrued Interest $351.21: Accrued interest on our money market account as reported on quarterly statements from the TD Bank. This does not include income from the last quarter since it was not known at the time that this report was prepared. It will be included in the 1999/2000 financial year.

Estimated Library $2,629.50: Our library's value is probably an estimate of all money spent there since the beginning. There were no additions to the library this year.

Observatory Equipment $3,761.22: The only items added to this amount since last year included mostly mechanical parts needed to build the 17.5-inch telescope for St. Croix.

Estimated Miscellaneous $452.54: These other holdings of the Centre were unchanged this year. Historically, $250 has included a slide projector, a mirror grinding apparatus, and some slides and material available for use at the planetarium.

LIABILITIES:

The Halifax Centre has no liabilities.
Ω

THE TRIFID NEBULA: BY MARY LOU WHITEHORNE

I confess. I have committed the terrible sin of omission. At the October Centre meeting I gave a talk entitled "Nebulae for Dummies," which included, among other things, a slide and short description of the Trifid nebula. The Trifid is one of the night sky's showpiece objects and is made up all the usual nebular stuff: gas and dust with a couple of stars thrown in to make it interesting. If it weren't for the stars being there, the Trifid would be fairly dull since there would be nothing there to light up the gas and dust and make them glow. In other words, it would be a lump of cold, dark gas and dust that would be difficult to see at all in visible light. But the stars are there, so we are treated to a most visually lovely object with three distinct nebular components: dark, bright and reflection.

The process of star formation begins in dark nebulae, and the resulting clusters of hot, new stars are often seen in close proximity to their parent cloud, as is the case with the Trifid. Much of the Trifid's dark components are easy to see - they make up the dust lanes that divide the round, flower-like, emission component of the Trifid into "petals." They are cold, mostly neutral hydrogen gas with some dust included in the mix, and they block the light from the glowing emission nebula.

The Trifid lies approximately 3000 light years distant and the emission portion of the nebula has a diameter of about 40 light years. This round, pink part of the Trifid is mostly ionized hydrogen gas that has been energized by ultraviolet radiation from the hot, bright young stars within, and is glowing in the strong line of hydrogen (H alpha, 656.3nm). The group of stars lying at the heart of the Trifid is dominated by a few very hot, energetic stars of spectral class O and B, and they produce the high energy ultraviolet radiation required to light up the surrounding gas.

This portion of the Trifid is what is known as a Stromgren Sphere: a roughly spherical region of ionized hydrogen (HII) gas surrounding hot O or B stars. The UV radiation ionizes the gas surrounding the star, out to a certain radius (which is determined by the density of the gas and the temperature of the star). There is an equilibrium: the rate of ionization is equal to the rate of recombination of ions with electrons within the sphere. Beyond the Stromgren Radius (in this case about 20 light years) the flux of UV is not enough to maintain ionization and the interstellar gas beyond does not fluoresce.

The third component of the Trifid is the pale, blue reflection nebula. It is glowing with the reflected blue wavelengths of light from a star that is not hot enough to produce an emission nebula. What we see in our telescopes and in most photographs, is the brightest section of a reflection nebula which completely sur-rounds the glowing red Trifid. As best I can determine, the star responsible is that which appears in the middle of the reflection nebula to the north of the emission component of the Trifid.

To sum it up, these nebulae are a mix of gas and dust throughout. It is here that my sin of omission was committed. How the mixture appears to us depends on local circumstance. In the presence of hot, energetic stars, UV from those stars will cause the surrounding gas to fluoresce in a spherical zone out to a certain radius; the so-called Stromgren Radius. Beyond this the gas does not glow with the light of emission, but is transparent. Unless of course there is a region of enhanced density in the gas, or an increased amount of dust particles (or both), in which case we will see a dark nebula. This gas and dust can, and does, extend beyond the Stromgren Radius and it is often observed as a blue reflection nebula if there is a star nearby to provide some light. This star is unlikely to be a hot O or B type star, for if it were, it would produce another emission nebula. More likely it will be a somewhat cooler star that cannot ionize the gas but that can cause the tiny dust particles in the cloud to shine with reflected light. So it becomes possible have the interesting situation where a blue star produces a red emission nebula and a red star produces a blue reflection nebula.

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NOTICE OF MEETINGS AND EVENTS

REGULAR MEETINGS

Date: **Regular Meeting — Friday, Nov 19 at 8pm**; 7pm for the council meeting.

Place: Lower Theater, Nova Scotia Museum of Natural History, Summer Street, Halifax. Access is from the parking lot.

Topic: **Sending a Spider to the Moon**
Speaker: Randy Attwood

Date: **Regular Meeting — Friday, Dec 17 at 8pm**; 7pm for the council meeting.

Place: Lower Theater, Nova Scotia Museum of Natural History, Summer Street, Halifax. Access is from the parking lot.

Topic: **Astronomy and the HMS Endeavour**
Main Speaker: Dr. Roy Bishop

BECOME A ST. CROIX OBSERVATORY 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 centre's new Observatory, which is nearing completion. To become a key holder, contact Observatory Committee Chair, Shawn Mitchell.

JUST WHERE IS THE ST. CROIX OBSERVATORY?

The Centre's Observatory is located in the community of St. Croix, Nova Scotia. To get there from Halifax (Bayers Road Shopping Centre), follow these simple instructions.

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 1.5km until you cross the St. Croix River Bridge. You will see a power dam on your left.*
5. *Drive about 0.2km past the bridge and take the first left (Salmon Hole Dam Road).*
6. *Drive about 1km until the pavement ends.*
7. *Drive another 1km on the dirt road to the site.*
8. *You will recognize the site by the two small white buildings on the left.*

WHAT'S UP:
BY MIKE BOSCHAT

November

Sat.13 - North Taurid Meteor Shower peaks at 9 am 30-40 per hour.

Mon.15 - Transit of Mercury across Sun. We miss it!

Wed.17 - **Leonid Meteor Shower** peaks at 7 pm rates could be in the 1000's per hour!

December

Fri.3 - Mercury Greatest Elongation West 20 degrees -Venus 3 degrees N of Moon

Sun.12 - Mars 0.6 degrees S of Moon - Uranus 0.2 degrees N of Moon

Tue.14 - **Geminid Meteor Shower** peaks at 2 pm - rates about 90 per hour.

Wed.22 - Winter begins at 3:44 am, Ursid Meteor Shower peaks at 7pm - rates variable from 3 to 20 per hour.

Planet Roundup

Mercury: Low in east southeast in morning.
Venus: Prominent in east morning sky.
Mars: Low in southwest after dark, sets 4 hrs after Sun.
Jupiter: Prominent in east southeast at end of evening twilight, sets 3 hours before sunrise.
Saturn: Rises near sunset, sets near sunrise.

1999 HALIFAX CENTRE EXECUTIVE

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	Dave Chapman	463-9103
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