

NOVA NOTES

VOLUME 31 — NUMBER 3 — JUNE 2000

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

NAME FOR ST. CROIX WASHROOM FACILITIES: BY MARY LOU WHITEHORNE

Now that it is finally going to happen, we should give some thought to a proper name for the St. Croix Observatory privy. Many high profile buildings and institutions are given proper names and I see no reason why ours should be left out of the game. There have been plenty of jokes about Mary's Loo and I must concede that there is some small justification for going with something like "The Merry Loo" or "Mary's Loo" or some such. However, there have been several other creative (and of dubious taste?) suggestions made by our members that invoke an astronomical theme. Some examples that use familiar terms include "Uranus," "Black



ASTROPHOTO OF THE MONTH – GRAVITY WELL?

Image of the new facilities at St. Croix taken recently by David Lane. The St. Croix Motley Crew, Starting from the left: Ian Anderson, Larry Bogan, David Lane, Clint Shannon, Paul Evans, Mike Gatto, Shawn Mitchell, Darren Talbot, and Steve Tancock.

Hole," "Dobsonian," "Light Bucket," "Gravity Well," and so on. Aside from these there is the rather prosaic contribution from a member of the RASD that we simply refer to the new facility as the "RAS-Can." Simple but dignified. I like it. Ω

Announcing

Member's Observing Night

When and Where

Halifax Centre's **St. Croix Observatory**
(directions in *Nova Notes*)
on Friday **August 25th** (Cloud day is
Saturday **August 26th**)
at **7:00 pm.**

The purpose of the Member's Night is to encourage Halifax Centre members to share and enjoy the St. Croix Observatory under a dark sky. Telescopes for sharing the view with others are welcome.

Snacks and drinks to share are also welcome!



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 **AUG 16TH, 2000**. 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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Transportation

If you would like to **get a ride** with someone else or if you can **offer a ride** please let Paul Evans know; phone: 902-423-4746; email: evans@hfx.andara.com by August 18th.

If the weather is questionable please check the Halifax RASC email list or call Paul at the phone number above.

MAY MEETING REPORT: BY MARY LOU WHITEHORNE

May's meeting came a week early, on 12 May instead of 19 May, ostensibly because we had a guest speaker from far away, but in reality, it was scheduled this way to avoid conflict with the upcoming Victoria Day Weekend. Regardless, the guest speaker was worth a lot more than a simple change to the meeting schedule!

Dave Tindall opened the meeting and engaged everyone's attention with his warm welcome and his Impeccable British Manners. Having thus charmed everyone with his dry wit, he launched into his own version of The Ferengi Moment by flogging the benefits of membership in the RASC, paying particular attention to the indispensability of the Observer's Handbook. Why any member would chose to stay home and not attend meetings when the evening's entertainment is in a class of such high order is beyond this reporter's comprehension! Ah well! Each to his/her own!

Moving right along, President Tindall proceeded with his report on executive activities. Highlights included the efforts of the executive with regards to moving our meeting place to Saint Mary's University. The latest wrinkle came in the form of notice from the Nova Scotia Museum that, as of September, the Museum will be charging non-profit groups such as ours a nominal fee of \$15.00 per meeting for the use of their facilities. This amounts to \$150.00 per year for us. SMU can offer us space in the Loyola Building at no charge, so a committee has been struck to work out the final

details of making the switch to our new location.

The next item of importance is (as everyone knows) a pet project of mine - the potty at our St. Croix Observatory. Total cost for the facility is projected to be \$3000.00, with \$1500.00 going for the composting unit itself, and the other \$1500.00 being required for the building, which will serve as a tool shed-cum-storage barn as well as a comfort station

At this juncture, the erstwhile Dave Lane took the floor and described the proposed new building, it's location, and the materials that will be used to construct it. He also announced that there will be work parties held to build this new structure and encouraged everyone to contact either himself or Shawn Mitchell if they are interested in contributing to the project. I have already declared my willingness to share in the work and I further encourage anyone who observes at St. Croix and anyone who, at any time in their lives has ever felt the need for a bathroom, that you also offer your services in this regard. Otherwise you run the risk of being denied access when you most need it!!! I have been told that I will be the keeper of the Toilet Keys...

Dave Tindall again took the floor and announced the change of speaker for the June meeting - it will be Dave Lane, speaking about his recent observing experiences at the Canada France Hawaii Telescope on Mauna Kea. Walter Zukauskas will present his video from the AAVSO in the fall.

Breaking away from the RASD for a moment, Paul Evans, our Observing Chairman, claimed center stage for his presentation of What's Up. He waxed poetic on the glories of the Virgo galaxies, the wonderful lack of stinging insects during recent observing sessions and the general beauty of the starry firmament on a clear night. He also encouraged

beginners to take up the challenge of the Mini-Messier Hunt as an excellent way to learn the sky and familiarize oneself with what's up there and how to track it down in your eyepiece. As an incentive to complete the Mini-Messier list, the Centre offers a certificate of observational merit to successful observers. For more information on the Mini-Messier Hunt, get in touch with Paul. His number is on the back of Nova Notes and he is always happy to talk about observing.

Paul also drew attention to planetary conjunctions happening in the sky, as well as to Comet Linear (C1999 S4), which is moving from Triangulum towards Perseus and may become a good binocular, or even naked eye, comet by July.

Dave Lane mentioned Mike Boschat's 3rd comet co-discovery. Mike goes on-line and monitors the daily update images on the SOHO web page and has had three comet co-discoveries using this technique. See the April Nova Notes for more about Mike's recent escapades.

Paul Evans jumped in again and gave a short heads-up on this year's Nova East 2000, an event that is sure to be a great deal of fun and is guaranteed; to have good skies for observing. You will have received a Nova East 2000 brochure with your April Nova Notes. Pay attention, now - it was designed by our shy-but-talented member Mike Gatto. Did you notice that Jupiter casts a shadow on the cover illustration? You didn't? And you call yourselves observers! Be sure to plan on attending this year - you won't regret it.

Returning to the influential RASD, Dave Chapman treated us to a viewing and brief discussion of a recent cartoon that appeared in a local newspaper. Funny and appalling at the same time, it illustrated one very common and potentially very dangerous

misconception regarding how best to observe a solar eclipse.

Finally we come to the Main Event - the Guest speaker was none other than Tom Clark of Tektron Telescope fame, all the way from Florida. His talk, titled "A Lighthearted Look at Amateur Telescope Makers," was certainly worth moving the meeting ahead one week! Tom is here in Nova Scotia for a month or so on vacation. He drove his motor home, which for local use is equipped with an add-on small car - a Saturn wagon. How appropriate - an astronomer driving a Saturn! Of course, I drive a Saturn too; the only difference being that my Saturn IS my motor home!

Tom Clark has built over 100 telescopes; two of which are almost one metre in aperture (you know - a yard - 36 inches - that now defunct unit of linear measure). He owns and operates a machine shop by day and builds scopes of many sizes as a "relaxing side-line." His talk was a humorous tour de force of home-built light buckets. There is another side to this light bucket business, as we saw in one slide: a large white plastic bucket containing, and illuminated from within, a red light source. This was an example of the "perimeter warning light system" that he uses around his large telescopes at star parties. An interesting idea whose time has come, eh, Dust Lane?

Tom went on to show us many unique and innovative design features that many builders have incorporated into their light buckets to make them lighter, stronger, more transportable, and easier to use. There were sonotubes, wooden tubes, truss tubes and even no tubes. There were removable mirror cells, widely varying mirror support systems, and clever modifications to collapse the scope into airline-compatible luggage. It was very apparent that Tom Clark loves the stars,

telescopes, and star parties. His humour and enthusiasm and expertise were wonderful to see. The message was clear that anyone who can tell the difference between a yellow dog and a banana can build themselves a very respectable telescope.

Perhaps one of the evening's most stunning revelations was Tom's admission of the real source for his persistent and chronic case of aperture fever: the fact that his wife can see down to magnitude 7.9 with her unaided eyes! (Darren Talbot and Shawn Mitchell, two of our members known for remarkable minimum visual magnitudes, move over!) He's always trying to see what she can see. Obviously, she will have to be restricted to instruments with only one half the aperture that Tom himself is using!

A few questions to the speaker wrapped up the evening's formal agenda and everybody raced to Ralph's table full of goodies for the post-meeting munchies. Again, many thanks to Ralph Fraser for his continued dedication to the Halifax Centre of The Royal Astronomical Society of Canada. Ω

JUNE MEETING REPORT: BY LARRY BOGAN

A smaller than usual collection of members gathered for the last meeting to be held in the Nova Scotia Museum. We have been meeting in the museum continuously for 30 years. Starting next September, all meetings will be in room 176 of the Loyola Building at St. Mary's University.

President, Dave Tindall, presided over the meeting.

Announcements:

- The Centre Library would move to St. Mary's tonight after the meeting and all were invited to help.

- There is a scheduled work party at the St. Croix observatory on Sunday June 19 and help is needed.

- The **RASC annual meeting 2000** is being held in Winnipeg on July 2 at St. John's College at the University of Manitoba in Winnipeg. (see your Invitation in the last mailing from national) Dave made three points about the meeting.

1. Mary Lou Whitehorne is a candidate for 2nd vice president.

2. There will be a vote to increase the annual dues from \$36 to \$40. This is the first increase since 1992-

3. Dave Lane pointed out that the cost of signing up a new member of the RASC exceeds the member's annual fee AND taken to the extreme, could bankrupt the RASC. The only reason the RASC has done as well as it has is the subsidy from revenue from the *Observer's Handbook*.

3. There will be two new RASC centres to be confirmed: Charlottetown, PEI and Moncton, NB. These will have some small negative effect on the Halifax Centre's membership but beneficial to overall RASC membership.

All were urged to sign and send in their proxies if they are not attending the annual meeting. Mary Lou is going as our representative and can carry any proxy you wish to submit. Extra copies were made available for members present.

Paul Evans, Observing Chairman, presented the summer sky. He had copies of the ECU sky charts of the southern sky for the period available.

. Get out there and observe; there are more deep sky objects available this summer than any time of the year. Choose a good southern horizon get all those objects in Sagittarius and Scorpius.

Paul reminded the members of the opportunity to attend Nova East

on August 4-5 at Smiley's Provincial Park. See the brochure sent out in the last issue of *Nova Notes* for a registration form and information. Activities will include nature walks, talks, tidal bore watching, and evening observing. It's in Nova Scotia this year and when asked for a show of hands for intended attendance there was a majority response from those present of the meeting. Steve Tancock displayed a new official banner of Nova East (very nicely done in my opinion).

An inquiry for attendance to a "Member's Evening at St. Croix" also garnered a favorable response. This will probably take place late in the summer so watch for an announcement in *Nova Notes* and on the Halifax RASC list server. The intention is to socialize and enjoy an evening of observing at the observatory. There will be transportation available by car pooling from Halifax. This will provide an opportunity for members to become familiar with the use and operation of the observatory.

Evening Presentation: Observing on Hawaii by Dave Lane

Dave Lane had the opportunity to go Hawaii and the Canada-France-Hawaii Telescope (CFHT) on Mauna Kea when Dr. Michael West, a faculty member at St. Mary's took a leave of absence to work at the University of Hawaii in Hilo, Hawaii. Dr. West offered Dave the trip in trade for work to set up research computer facilities in Hawaii. Needless to say Dave jumped at the chance.

Dr. West had three nights on the CFHT and Dave was able to accompany him during the sessions. Dave described the geography of the largest island of the Hawaii chain of islands. Two high peaks dominate the island, Mauna Kea and Mauna Loa. The later is an active volcano while Mauna Kea is dormant. Cloud

levels stay below the peaks and so observing excellent on top. The winds are easterly on that latitude so Hilo on the eastern side of the island is very cloudy. A saddle road goes between the two mountains and provides access to the road to the top of Mauna Kea.

(Readers who are interested in learning about Mauna Kea and its observatory can view it on the internet at http://www.ifa.hawaii.edu/mko/mauna_kea.htm)

At the 9300 ft level is a visitor's center and residential area for visiting astronomers. The visitor's center is called the Onizuka Center for International Astronomy (Information on it is available at <http://www.ifa.hawaii.edu/info/vis/>) It is here that astronomers stay for a day or so to get acclimatized to the high altitudes. The road from here to the top is very bad and takes as long to travel as it did from Hilo at sea level (about 40 minutes). At the visitor's center you can obtain a summit tour or stay for an evening of observing with their several moderate-sized amateur telescopes.

The summit is at an altitude of 4200 metres (13800 feet) and above 40% of the atmosphere. The skies are very clear and dry with few cloudy days. Dave gave us a tour of the many telescope domes on top including the Canadian-shared CFHT, Gemini, and Clerk Maxwell telescopes. Dave accompanied Dr. West to the CFHT and was able to describe its layout and operation. The telescope is on the 5th floor with the control rooms below on the 4th floor. The dome was fitted with video cameras and microphones so the telescope operator had a realistic 'feel' of what was going on in the dome even though they were not there.

The research astronomers never operate the telescope but only request positioning. They have their own separate workstation to operate the CCD camera on the telescope. The operator has final decision as to whether the telescope is open on any particular evening. Dave noted that the operator workstation software was not as sophisticated as some amateur control software; it was, however, very accurate and durable.

Dr. West's project imaged the cluster of galaxies in Coma Berenices down to 25th magnitude in three colors (BVR). The intent is to study the tidal stripping of galaxies by each other and detect any intergalactic globular clusters that might exist. The CCD being used was huge with 8000 x 12000 pixels. It was made of many separate CCD chips. In order to remove the vacant image areas between chips, a special scan sequence was initiated for each exposure. See was excellent and star images were only 0.7 to 0.9"arc.

Dave was given the last 15 minutes of Dr. West's observing session to take an image, so he chose the Swan Nebula. I look forward to seeing that image when he has had a chance to process it to remove pixel defects and flat frame it. He also had the opportunity to see the submillimetre telescope when an operator invited him over for a visit. Dave was not as luck when he knocked on the door of the Gemini Telescope.

Dave reported that the visual seeing at the summit of Mauna Kea was not as good as St. Croix because of the effect of oxygen deprivation on his eyes. The best way to utilize the excellent skies of the area is to go back down to the visitor's center. He did that, and showed us many of the images he took from the 9300 foot level. It was pleasing to see the beautiful area of the sky in Scorpius,

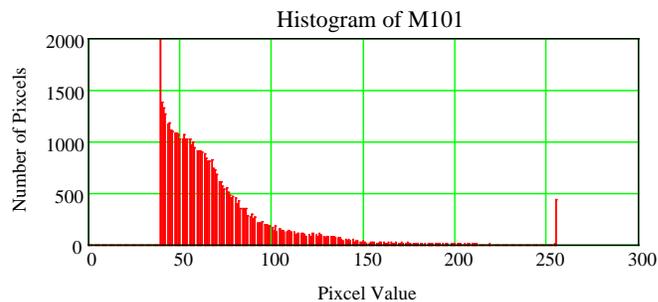
Centaurus, Crux, and Carina with all its dazzling deep sky objects. After questions and thank to Dave, we broke for a brief refreshment break setup by Ralph. Many hands lifted books and boxes and pushed a trolley to move the centre's library to awaiting cars. Off went it went to St. Mary's for storage until next September.

Hope to see you all at Nova East in August if not at St. Croix under clear skies. Ω

**IMAGE PROCESSING 103 :
BY BLAIR MCDONALD**

Histogram Stretches

There are many tools that can be used in image processing to improve the contrast of an image, but none are as simple to use as a class of functions known as histogram functions. These functions increase image contrast or bring out faint detail by changing the shape of the image *histogram*. The image histogram is a map of pixel intensities against the number of pixels of that intensity. The diagram below will give you an idea of just what this means. The horizontal axis is the pixel value (0 to 255 for an eight-bit image) and the vertical axis is the number of pixels at any pixel value.



The majority of the pixels are at a small value, just below 50 and a

small number are at 255. The pixels in the spike at the lower end of the

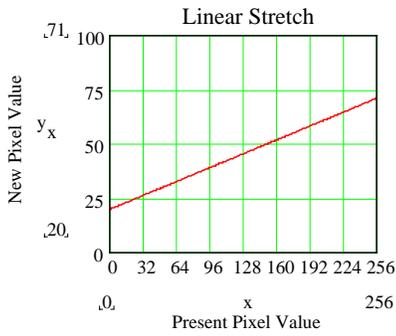


histogram represent the sky background as most of the image is black. The pixels in the small spike at 255 or the upper end of the histogram are from the center of the galaxy and a few stars that are saturated in the image. This histogram shows us that there are many more pixels in the dim area of the image (low pixel values) than there are in the upper or bright area of the histogram. Most of the methods of increasing the image contrast involve shifting some of the pixels from the dim area to the brighter area of the histogram. This is known as histogram stretching. Several classes of histogram stretches are possible. The simplest is a linear stretch. This stretch and all other histogram stretches involve calculating a transfer function to apply to the data. A transfer function is simply a function to be applied to the input data to get the new output values. It can be thought of as a plot

of input values verses output values. The image processing software calculates the transfer function and applies it to the image data to stretch the image. Look at

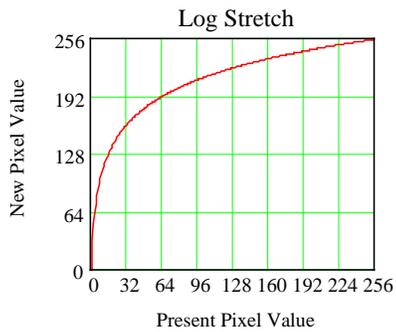
the plot below, the values on the X axis are the present pixel values and

the values on the Yaxis give the new



pixel value for the stretched image.

If the slope of the line is one (X equals Y at any point on the graph) the image is left unchanged. If the slope is greater than one the contrast is increased. A linear stretch is not the only possibility. If you want to enhance the faint detail, you might want to try a log stretch. This requires the transfer function shown below.



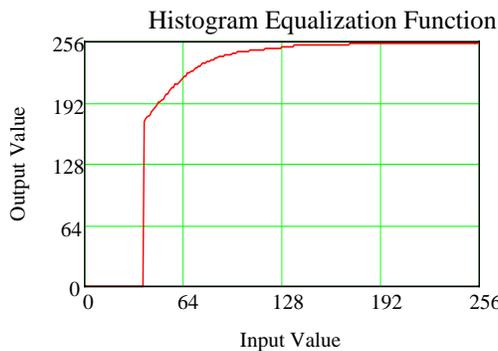
The transfer function has the equation $y_x := \log(x) \cdot \frac{255}{\log(255)}$ and greatly enhances faint detail. The second portion of the expression, $\frac{255}{\log(255)}$, simply scales the result to display on an eight bit display.

One of the slickest algorithms I have come across allows arbitrary histogram shapes to be calculated. It works, by first calculating the transfer function required to produce a flat histogram with an equal number of pixels in all bins. This is called histogram equalization. Once the image is

equalized, a transfer function is calculated to produce an arbitrary shape from the equalized histogram. To equalize the histogram, calculate the transfer function as follows. First, produce a transfer function by calculating the running sum of the raw image histogram. This is done by first counting the number of each pixel value and producing the raw histogram. Once the raw histogram is computed, the running sum is calculated as follows: first create an array with 256 entries all set to zero. Then in the first position place the count in the first raw histogram bin, then in the second position place the sum of the first and second raw histogram bins. The third position will contain the sum of the first through third raw histogram bins, continue the process until all 256 positions have been filled. Mathematically this is expressed as

$$\text{Sum}_x := \sum_{a=0}^x \text{RawHistogram}_a \text{ where } x$$

varies from 0 to 255. Next, normalize this transfer function by multiplying each of its 255 values, by 255 divided by the maximum bin value in the summation and round up to the nearest integer. This will scale the result to fit between 0 and 255 for eight bit images. For the histogram of M101 at the start of this article, this produces the transfer function shown below.



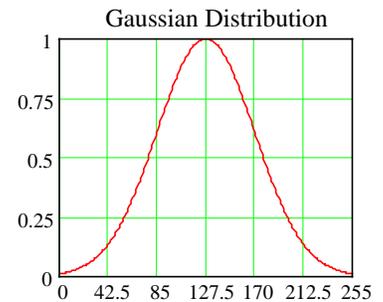
If each of the image pixel values in the original image is replaced by the corresponding value from the Y-axis

of the above plot then the histogram shape of the resulting image will be flat or equalized. The next step is to calculate the transfer function to apply to the equalized image to produce the required histogram in the final image. For this example, we will use the gaussian function for our histogram stretch.

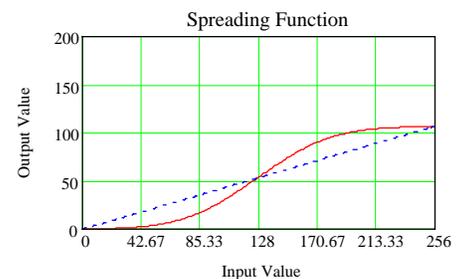
Mathematically, the gaussian

$$\frac{X - \bar{X}}{2 \cdot \sigma^2}$$

function is $Y = e^{-\frac{X - \bar{X}}{2 \cdot \sigma^2}}$ where X is the x value, X bar is the average of all the x values and σ is the standard deviation. This expression will produce a histogram with the following shape.



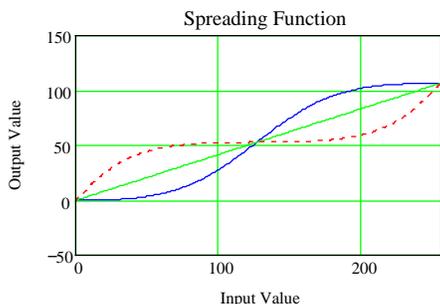
In order to obtain this histogram shape we must take the normalized running sum of this shape, then take its inverse and apply it to the equalized image computed in the steps above. The inverse is used as a transfer function to apply to the equalized image. The transfer function produced by the normalized running sum of the gaussian curve is



To produce the inverse shape rotate the curved line around the straight

diagonal line to produce the following transfer function

If you then take the equalized image, look up each pixel value on the X-axis and replace it with the corresponding value from the Y-axis into the transfer function, you will produce an image with a histogram having a gaussian shape. Compare the image below of M101 with the image at the start of this column and



I think you will see the difference.

For this article I have picked a gaussian shape for the final histogram stretch, but the algorithm works for any arbitrary shape so



experiment with any stretch such log normal,

Exponential or whatever shape will give you the desired detail in the final image. Ω

WHAT'S UP:

BY PAUL EVANS

July

- Sat 1** New Moon.
- Sun 2** Moon at close perigee.
Large Tides.
- Sun 16** Full Moon.
- Sat 22** Comet LINEAR at closest to Earth.
- Sun 23** Comet LINEAR at brightest?
- Tue 25** Comet LINEAR at closest to Sun.
- Wed 26,** Jupiter, Saturn, Moon, Pleides, Hyadaes in East (4 a.m.).
- Thu 27** Mercury at greatest elongation. (Observe in the a.m.)
- Fri 28** Delta Aquarid meteor shower peak.
- Jul 31** New Moon.

August

- Tue 1,** Moon at close perigee.
Large Tides.
- Fri 4,** Nova East!
- Sat 12** Perseid meteor shower peak (3:30 to 4:30 a.m. to avoid the Moon).
- Tue 29** New Moon. Ω

LETTER TO THE EDITOR:

BY DR. DAVID TURNER

Dear Sir,

The June 16 meeting of the RASC Halifax Centre was advertised with the following descriptive sentences: "Have you ever wondered what it would be like to look through a really (sic) big telescope? I mean a really big one?"

After listening to the talk given by Dave Lane at the meeting, in which he described his recent experiences while visiting Mauna Kea and the Canada-France Hawaii

Telescope (CFHT), I realized that I never did receive an answer to the above questions. As Dave himself described it, he never actually "looked" through the CFHT; he simply viewed the finder fields and resulting images from the television monitor in the observer's control room. In fact, it was impossible to actually "look through" the telescope in the Cassegrain imaging configuration used for the observing session, and, even if it were, that would probably have been vetoed by the telescope operator, who kept observers off the observing floor and away from the actual telescope controls. To add to the dilemma, Dave himself pointed out that he was unable to see as much from the top of Mauna Kea as from other dark sites, probably because of oxygen deprivation affecting his vision. One is therefore left to ponder, "What is it actually like to look through a very large telescope?"

My own experiences in the area have been restricted to telescopes no larger than about two metres in aperture, and on each occasion I was disappointed with the results. Views through large telescopes were invariably disappointing relative to those through telescopes of smaller aperture, usually because the larger aperture made it impossible to produce an image that was not affected by seeing effects. Mind you, that was in the era prior to adaptive optics, and it would certainly be interesting to know what it is like to view through a large telescope that is capable of high resolution imaging. Can one actually "view" through such telescopes when the high-resolution optics are enabled, or is one restricted to viewing the resulting images? Perhaps another time and another talk?

Dave Turner Ω

NOTICE OF MEETINGS AND EVENTS

REGULAR MEETINGS

Date: **Regular Meeting — Friday, Sept 15 at 8pm**; 7pm for the council meeting.

Place: Room L176 of the Loyola Building, Saint Mary's University. Access is from the parking lot behind the McNally building on Robie Street.

Topic: **Members Night and Nova East Report**

Date: **Regular Meeting — Friday, Oct 20 at 8pm**; 7pm for the council meeting.

Place: Room L176 of the Loyola Building, Saint Mary's University. Access is from the parking lot behind the McNally building on Robie Street.

Topic:

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.*

ASTRO ADS

To place an ad in
Nova Notes
Contact the editor at
smitchell@ap.stmarys.ca
or call (902)-865-7026

EVENT: BY PAUL EVANS

Hi Everyone,

At the last Halifax Centre meeting on Friday we decided that public observing on the waterfront (behind the Maritime Museum of the Atlantic) will be on Monday, July 10th (or if cloudy Tuesday, July 11th).

If you are able to attend I would appreciate a quick note letting me know you are coming and if you are able to bring a telescope. I would like to be sure that this date will work for at least a few people.

Thanks!

Paul Evans
Observing Chair, Halifax Centre

HALIFAX CENTRE EXECUTIVE

2000 HALIFAX CENTRE EXECUTIVE

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