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ROYAL ASTRONOMICAL SOCIETY OF CANADA
SOCIETE ROYALE D'ASTRONOMIE DU CANADA
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1977 Halifax Centre Executive

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Observing Chairman	Mike Edwards, 8 Sullivan's Hill, Bedford
Editor:	Randall Brooks, Dept of Astronomy Saint Mary's Univ., Halifax

UP COMING MEETINGS

18 March, 8:00 pm at the Nova Scotia Museum, Summer St.

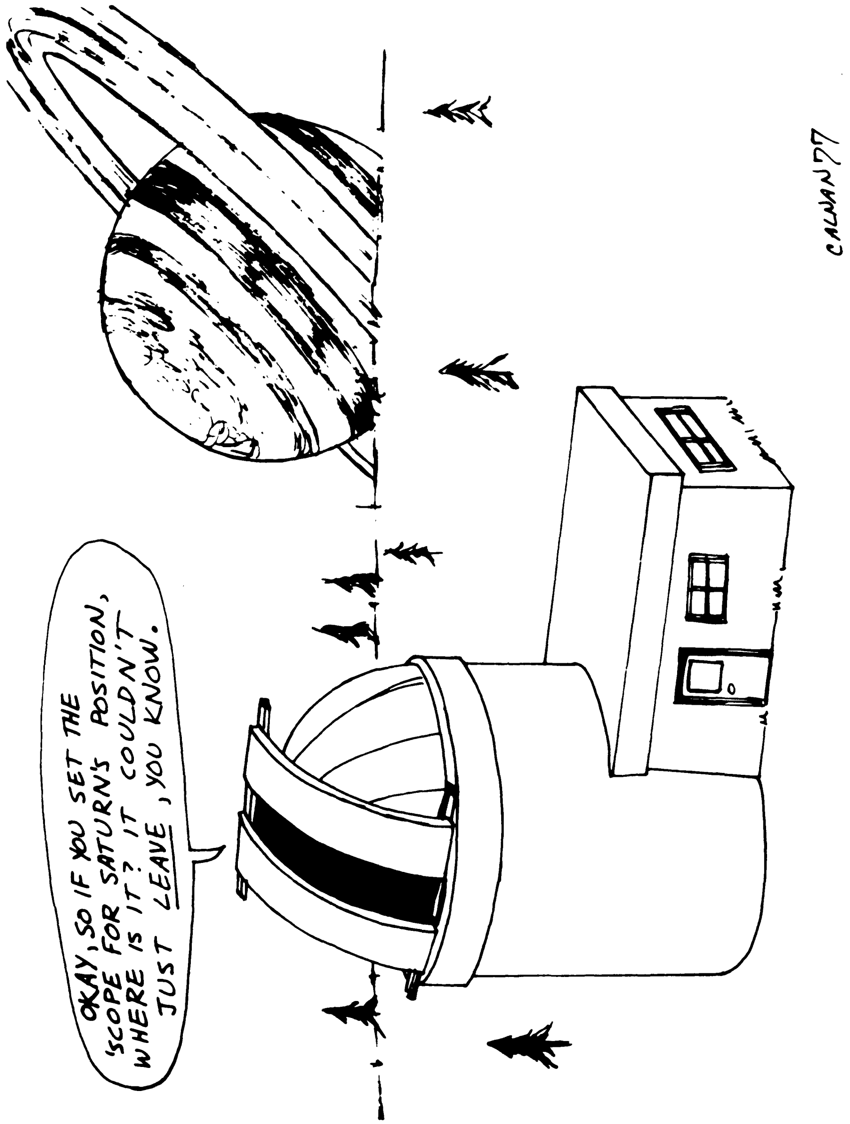
Dr. Charles H. Miller, Mechanical Engineering Dept., Nova Scotia Technical College

Propulsion in Space:
An illustrated talk on propulsion systems for use in gravitational fields and in outer space. Systems ranging from high thrust chemical rockets to low-thrust high specific impulse units will be discussed, with emphasis on plasma arc rockets, including some experimental work.

26 March, 8:30 pm at the Burke-Gaffney Observatory

Observing Meeting: for those not wishing to undertake an observing project, the first ½ to 1 hr will be devoted to general observing and in the case of cloud, a short informal program will be prepared. A tentative suggestion is for a discussion and demonstration of photographic darkroom proceedures--come and learn how to develope your own astronomical films so you can avoid having commercial dealers discarding your astro-shots!

29 April at 8:00 pm at Saint Mary's Univ., Dept. of Physics. Dr. Wm. Lonc of the Physics Dept will describe the radio telescopes he has constructed and will demonstrate how they are used to detect a signal and what the signal reveals about the source. If you would like to see the interferometer etc.,you should go to the roof of the Main Building about 7:30. More complete directions of how to get there will be given in the notice of meeting NOTE THE CHANGE OF DATE FOR THE APRIL MEETING!



Our regular monthly meeting was held Friday, January 21 at 8:00 pm in the Nova Scotia Museum. Dr. David L. DuPuy chaired the meeting, his first formal duty since taking over as President of the Centre. I'm sure I am speaking for all members when I thank Dr. Roy L. Bishop for the fine job he has done for us over the past two years.

Dr. DuPuy made a number of announcements, perhaps the most important of these was that the magazineSky & Telescope is available to our members for only $7.00 per person per annum, provided we all subscribe. A questionnaire is being circulated on this and other matters. Members should be aware of the up-coming Societies Show; Randall Brooks will coordinate our displays again this year.

The guest speaker for the evening was Mr. Walter Zukauskas a man who has been active in the affairs of our Centre for many years and really needs no further introduction. Walter spoke on Amateur Contributions to astronomy, a number of colourful vignettes detailing the particular contributions made by an array of intriguing and sometimes odd-ball characters. The first of these was Grote Reber who, in 1939, succeeded in producing the first radio map of the Milky Way using a homemade radio telescope--a 30 ft parabolic dish. Philip Fauth, cranky and antagonistic, was nevertheless a fine lunar observer and produced an atlas of the entire moon. Joseph Miller Barr, a Canadian who lived at the turn of the century, was something of a recluse. He is remembered for his work on the orbits and the velocity curves of spectroscopic binaries stars. S.W. Burnham was at one time a Civil War stenographer, then a court stenographer and later a clerk of the court, but all the while a part-time astronomer whose forte was double stars. He worked at the Lick Observatory and later at Yerkes with the 40 inch refractor and in the end compiled two volumes of observations. Henry Draper was a pioneer in the field of photography, as applied to stellar spectra. E.C. Pickering, then director of the Harvard Observatory, knew of him and instituted a special survey of stellar spectra by photography. Unfortunately, Draper died shortly after (in 1882). However, his widow subsequently put up the money which permitted the completion of the survey--the

Con't on pg. 38

OBSERVING MEETINGS

The first observing meeting of the year took place on Saturday, February 5th at the Burke-Gaffney Observatory, with a small but interested turnout present.

One of the intentions of these observing meetings is to encourage the Halifax Center to become more active by supplementing the regular meetings with observing sessions and observing related meetings. These are to be quite informal in nature and will take place following the regular public Saturday night observatory tours at S.M.U., as previously announced in Nova Notes.

The first meeting was a type of orientation meeting. There was no specific intention to do any viewing with the telescope, but rather to describe and explain the equipment at the observatory which is available to us for use at our observing meetings. This was done by R.C. Brooks.

It has now become the general rule that these observing meetings will take place eight nights following the regular monthly meeting, whether the sky is clear or not. A shorter program of activities is being planned for the nights which are cloudy.

One item which should receive some attention is the Observing Competition to be held at the General Assembly in Toronto, this July. It would be nice if the Halifax Center had a good display to send to the Assembly in Toronto. Therefore consult the August 1976 Journal of the R.A.S.C, and bring your ideas for a center observing display to the next observing meeting.

Michael P. Edwards
Observing Chairman

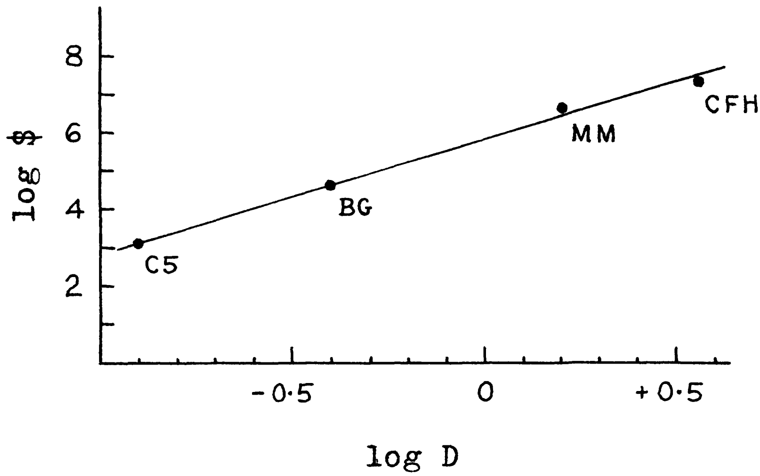
TELESCOPE RAMBLINGS

What Price Infinity ?

On the large scale the basic units of the Universe are the galaxies. Ourselves, the planet beneath us, and all the stars in the sky compose only our local corner of the Milky Way Galaxy; but, aside from this, it is curious that for the unaided eyes there is only one, distinctly visible, full-size galaxy. This is M31, a typical large spiral system and a familiar sight to amateur astronomers.

With the least optical aid other galaxies are accessible. Through the modest telescopes used by amateurs hundreds of galaxies emerge out of the blackness, like dim snowflakes frozen in the eternal night. Most of these are the largest galaxies, spirals or large elliptical systems. Since these are of roughly the same absolute magnitude, the illuminance provided by the dim light each sends to Earth depends only on their distance (R), and this dependence is the familiar inverse square (R^{-2}). The portion of this light intercepted by a telescope varies directly as the area or square of the telescope's aperture (D^2). Thus the distance R at which one of these large galaxies can be detected is directly proportional to the aperture D. Hence the volume of space accessible ($\frac{4}{3}\pi R^3$) is proportional to the cube of the aperture (D^3).

The graph below is a log-log plot of the cost of various astronomical facilities against aperture. (C5 = Celestron 5 telescope



with accessories, BG = Burke-Gaffney Observatory, Halifax, MM = the proposed Mont Mégantic Observatory, CFH = the Canada-France-Hawaii Observatory). The relation is nearly linear which suggests that:

$$\log \$ = \log K + n \log D$$

or

$$\$ = KD^n$$

The constant K is numerically equal to $ when D = 1 meter. This gives $K = 6 \times 10^5$. The exponent n is the slope of the line, which is 3. That is, the cost of an astronomical facility varies as the cube of the aperture (D^3). (For the unaided, dark-adapted human eye: $\$ = (6 \times 10^5)(7 \times 10^{-3})^3 = 21¢$, a rather modest figure.)

Since both the volume of space accessible to a telescope and the cost of a telescope depend in the same way on its aperture (both vary as D^3), the cost of observing the Universe is constant per unit of volume.

To arrive at a number, consider the Andromeda galaxy M31 ($R \sim 2.1 \times 10^6$ l.y.) as being roughly at the limit of the unaided eye ($D \sim 7 \times 10^{-3}$ m):

$$\frac{\$}{\text{Volume}} = \frac{KD^3}{\frac{4}{3}\pi R^3} = \frac{(6 \times 10^5)(7 \times 10^{-3})^3}{\frac{4}{3}\pi(2.1 \times 10^6)^3}$$

$$= 5.3 \times 10^{-21} \ \$/(\text{l.y.})^3$$

$$= 18 \text{¢ per } (\text{Mpc})^3$$

which is a bargain by anyone's standards ! An even better price is available if, instead of vision, photographic or electronic detection is used. This approximately doubles R with little additional expense, and the cost of a cubic megaparsec drops to about 2¢.

Roy L. Bishop
Maktomkus Observatory

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MUSEUM SOCIETIES SHOW--7 MAY to 5 JUNE

The Halifax Centre has again been asked to participate in the Societies Show at the N.S. Museum. Therefore we are looking for suggestions and materials for our display. As was the case last year, all items are insured to a value of $1000 per item. Our bay will again be directly across from the information desk and the possibility of loss or damage is minimal. We are planning a special Sunday afternoon talk (may 8) and will have a topic for the regular meeting of interest to the general public. In conjunction with the May 20 meeting, weather permitting we will have an observing session at the Museum. It has been suggested, that RASC members present a program for the Sat. am Museum programs for children. More news later.

FROM THE CENTRES--VANCOUVER

David Hurd

A Funny Thing Happened On the Way to Australia

Heck, a lot of funny things happened on the way to Australia. There was the night in the Melbourne bistro when we had to wait for hours to get a table. Then Rob Dick, the gourmet cat burgler, swiped someone's dill pickle and Allen Miller (far from being a fussy eater) began slicing his peas in two. Within minutes we were all laughing so hard that the place emptied out. The maitre-de (sic) was so anxious to resume normal business that he tried to take our plates away before we had even finished (it took Miller two hours to get his steak anyway).

Then there was the motel in Mt. Gambier. Of all the places we could choose to stay, we happened to pick the one where the Prime Minister's party would spend the night. We must have given the security men fits when we started skulking around setting up telescopes at 1:00 am.

And then there was the pig farmer; a lovable and fine lady. This all started at the moment of totality. Just when the lights went out, a grey old dog was walking near our little group. Totality caught him in mid-stride. When semi-daylight returned three and a half minutes later, there was the dog, still in mid-stride, petrified and shaking with fear. The girls of our group Penny and Bev finnally succeeded (with the aid of some hand-out food) in calming the dog. Just at that moment, the owner came along.

Imagine if you can, our first impression of the owner; she's in dirty coveralls, driving a pickup full of garbage (literally). The truck is bashed up, rusted through and the door latches don't work. She has to drive, shift gears and hold the door shut all at the same time. Once she found that we had come all the way from Canada just to help her dog survive the eclipse, she couldn't do enough for us. She drove miles out of her way to show us where our motel was. She introduced us to the owner and finally, she went back to her business of running her pig farm single-handed.

But, that wasn't the last we would see of her. Our motel was full of eclipse chasers, most of whom did not see it because of clouds. That evening, as usual, we all got together for a dinner. We felt like celebrating. We'd been lucky to see the eclipse when everyone else hadn't. Who should show up but our pig farmer.....this time dressed in her Sunday dudes. She joined up, knocked back about 3 beers even before all the introductions were done and then invited John Tanner to dance. Now that takes some imagination too. Imagine a 4'5" pig farmer with a low centre of gravity. She'd never seen John standing up--there's our John at 6'6". She issued such a string of expletive-deletives as John unwound himself from the chair, that the whole restaurant must have thought us crazy. They did dance; she staring John straight in the belt buckle and John staring off into space trying to be inconspicuous.

Incidentally, the reason she'd known our motel owner was because of the pig farm. The truck was full of garbage; picked up every day from the local hotels to feed her flock. And the manager was her boy friend (from the sound of things, everyone was). The manager ended up buying rounds of wine and some of us succeeded in closing down the place in the wee hours of the morning.

I guess this article should have some astronomical content. We are after all, an astronomical society. So here goes: first impressions of an eclipse. To begin with, there is absolutely no way that the eclipse lasted 3½ mins. The time flies. This is by far the most common first impression of an eclipse. Second impression. An eclipse is euphoric. Even the hardened eclipse chasers like Ken and John and Allen were walking around shell-shocked after it was over. For the three of us whom it was the first eclipse it was like having one too many drinks. Hell, it was like having 10 too many!

Third impression. Even though the moon blocks sunlight (apparently) all the way through the partial phases and then BLINK, the lights go out. The same thing happens at the end. When totality begins, you might think the stars fade on (perhaps this is a planetarium prejudice). They don't! They blink on! Fourth impression. It is eerie! Blackness overhead. A ghostly glow around the entire horizon. Animals and birds protesting as they lay down for an unscheduled night. Freezing winds resulting from the cool shadow of the moon. I, for one, will admit I'm glad I had company close by when the eclipse took place.

Fifth impression. The eclipse was bright....and so were the prominences and corona. We were looking through cloud and they still exceeded anything I had expected.

Final impression. It was fun! It was worth the money just for the eclipse alone....and the company was an added bonus. Words alone could never describe travelling on an expedition like this. So I won't try. But, there is another eclipse next year slightly closer, in South America. We're already making plans. Ken's been to 5 or 6. That takes a lot of time and money. If you ever have a chance to see an eclipse, and pass it up, you've missed an event of a lifetime. Who knows, perhaps there's a nice little bistro in Caracas, Venezuala, or Bogata, Columbia, where we could all get together next year!

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Minutes Con't:
result: some 225,000 stars classified in the Henry Draper Catalogue. Lord Rosse in Ireland in 1840 possessed the largest telescope in the world, a 72 inch reflector. This was a cumbersome beast compared to present-day models; nevertheless, he was able to see and study the structure of several spiral (and other) nebulae. Last but not least Walter told us about William Huggins, the son of a merchant and a very opportunistic soul. He had heardof Kirchhoff's radiation laws and immediately set to work applying them to stars and to nebulae. He studied spectra both in the physics lab and in the observatory, and, concluded that the Orion Nebula was a gaseous body.

Clearly, Walter could have gone on to spin many more enjoyable vignettes, but since the hour was advancing the meeting adjourned over coffee and informal discussion at about 10:00 pm.

P.H. Reynolds, Secretary

WHAT'S IN A NAME?

The naming of comets and asteroids is one of the romantic throwbacks in which astronomers delight. Comets are named after their discoverers, at least usually. Two notable exceptions are Comets Halley and Encke, named after those who proved that these comets were periodic. Another exception, and one many of us with poor memories are grateful for, followed from a ruling of the International Astronomical Union. The faint, periodic comet formerly known as Comet Pons-Coggia-Winnecke-Forbes is known now as Comet Crommelin, after a British astronomer who studied its motion for many years. But, in the long run, the observers get the credit: Wilson, van den Bergh, Kohoutek among the "casual" comet observers, and Peltier, Pons, Ikeya-Seki, Brooks, Kobayashi-Berger-Milon among the "dedicated" observers.

A more systematic method of keeping track of comets consists of the provisional and permanent designation lists. Upon discovery, a comet is denoted by a letter following the year of discovery with the discoverer's name in parentheses. Comet 1936a(Peltier) was found by Peltier and was the first comet found in 1936. After its orbit had been determined and the date of perihelion established, the comet was given a permanent designation as 1936II(Peltier), which means that the comet was the second in 1936 to pass through perihelion.

Such retroactive systems can occassionally lead to difficulty. The worst case appears to be that involving Comet 1924V(Wolf-2). Comet Wolf passed perihelion on December 30, 1924, and was given its permanent name. A refined study five years later revealed that perihelion actually fell on January 24, 1925. To give Comet Wolf its proper designation would have required changes in the permanent designations of eleven comets of 1925! Comet Wolf is still known as Comet 1924V.

Frequently, the Harvard Announcement Cards report discovery of faint, fast-moving objects which carry the rather cryptic names such as 1971FA. The objects usually turn out to be asteroids, but how do we interpret the cryptogram?

1971FA gives the following information about the object: 1971 is, of course, the year of discovery, F represents the half-month of first observation (e.g. F is the sixth half-month, March 16-31), and A implies that the object is the first discovered in that half-month.

If an orbit can be determined for the object, a permanent number and name will replace the provisional designation. A serial number assigned by Cincinnati Observatory is accompanied by the name. Unlike comets, the discoverers' names are not assigned to objects. Instead, the discoverer is allowed to name his object. In this case object 1971FA became 1864(Daedalus). The chance to become immortal in one sense or another has not been passed up often! Discoverers have named their finds after the conventional Greek minor-deities, home towns, colleges, wives, girl-friends, and, I believe, man's best friends. I wonder if anyone has named an asteroid after themselves?

As with comets, some oddities arise. 1936CA, although it is named Adonis, has no serial number because no orbit for it has ever been found. 1937UB(Hermes) is in the same state. Both are believed to be Apollo-group objects which passed close by the earth, and as far as I know have never been recovered. The asteroid 719(Albert) although permanently designated, is now lost, apparently because of a faulty or inadequate orbit.

If these name games appeal to you, try figuring the rationale for the naming of variable stars: R, S, T, ...

Walter [illegible]

SOME EARLY ASTRONOMY BOOKS

Bill Calnen

Recently I was searching for information on the King's college observatory. During my research I found a large section of astronomy books at Dal's MacDonald Science Library containing a number of nineteenth century volumes. Some of these old books date to the fisrt decades of the nineteenth century, so I decided to collect some information from them which I think you will find interesting and perhaps a bit amusing.

Prices for Reflecting Telescopes by W.S. Jones, Holborn London (1846) pp 258

"FOR SALE"--A 4 ft,7 in aperture gregorian reflector with the verticle motions upon a new invented principle, as well as apparatus to render the tube more steady for observation, according to the addition of apparatus of small speculums, eyepieces, micrometers.

Price: £80 to £120

--stand for above: Three feet long, mounted on a plain brass stand

Price: £23 2s

--1 foot gregorian reflector, on pillar and claw stand, metal 2½" diameter, packed in mahogany box

Price: £6 6s

--7 foot newtonian, 6 in. aperture

Price: £105

Newtonian telescopes were quite common in those days and came with silvered mirrors. Some prices are quoted below for a complete instrument without stand, or with stand.

7" aperture of	7 foot f/l:	£17 10s	or £27 10 (with stand)
9"	10 ft.	£25	or £40
12"	12 ft.	£60	or £90
15"	15 ft.	£120	or £170
18"	18 ft.	£200	or £260

Gregorians of the same aperture were 10-20% more but had somewhat faster focal ratio mirrors.

Lectures on Astronomy by W.H. Prior, 1826, London

Here is a rough outline of some planetary data presented in the third lecture.
Mercury is 3224 miles in diameter and its year is 87 days 23 hrs 15 min and 43.6 sec. This moonless planet has a mean distance from the Sun of 37 million miles. The highest mountains are observed in the southern hemisphere.

Venus is a morning or evening star, 7687 miles in diameter and a distance of 68 million miles from the Sun. It takes 225 days to make one complete orbit around the Sun.

Mars is 4189 English miles in diameter and to make a complete solar orbit takes 686 earth days. The planet's appearance is red and it is rotating with a period of 23 hrs 30 min and 35.6 sec. No satellites are known.

Jupiter is 89,170 English miles in diameter and to make 1 revolution about the Sun requires about 4332 days 14 hrs 27 min and 10.8 sec in its orbit of 494 million miles radius. Its rotating period is 9 hrs 55 min and 49 sec and it is accompanied by four satellites.

Saturn is 79,042 English miles in diameter, revolving around the Sun in 10,759 days 1 hr 51 min and 11.2 sec at a mean distance of about 906 million miles fron the Sun.

Uranus is 35,112 English miles in diameter, 1822 million miles from the Sun. It rotates on its axis but the period is unknown. The orbital period is 30,737 days 18 hrs.

Outlines of Astronomy by Sir John F.W. Herschel and K.H Bart, 1867, London

In this volumn the discovery of Hyperion, a satellite of Saturn, is mentioned. It was obserevd by Mr. Lassell of Liverpool and Prof. Bond of Cambridge (Mass.) on the same evening in September (the 19 th; 1848). They also list the elements for some of the bright comets of that period (many are probably unfamiliar to most now):

Halley's:	retrograde 1835, Nov, 15, $22^h\ 41^m\ 22^s$ **
Encke's:	direct motion, 1845, Aug. 9, $15^h\ 11^m\ 11^s$
Biala's:	direct motion, 1846, Feb.11, $0^h\ 02^m\ 50^s$
Faye's:	direct motion, 1843, Oct.17, $3^h\ 42^m\ 16^s$

**date of perihelion passage

DeVico's: direct motion, 1844, Sept. 2, $11^h\ 36^m\ 53^s$

Brossen's: direct motion, 1846, Feb. 25, $9^h\ 13^m\ 35^s$

Some of the other old books I found were:

The Practical Astronomer by T. Dick,LLD, 1846, New York

The Moon by J. Nasmyth and J. Carpenter, London
(the plates and drawings in this book are particularly beautiful)

Ten Years Work on Mountain Observatory, by George Ellery Hale, 1915, Washington**
(although this book falls outside the nineteenth century it contains excellent photographs and much information on the Mount Wilson Observatory)

The Life of Sir Isaac Newton by George Grant, 1849, Dublin

The Sun Ruler of the Planetary System by Richard A. Proctor B.A., FRAS, 1871, London
(illustrations of the Sun as viewed on Sept. 25 1870 with his 2 in. telescope and he also includes the Eclipses for the years 1858, 1860, 1842, 1869 and 1870 as he saw and drew them)

These are just a few of the books you might find interesting reading during spare time.

**Ed.Note:

The Saint Mary's library has a volume by George Ellery Hale entitled Messages From the Stars. This volume is autographed by Hale and addressed to Mrs. Andrew Carnegie, wife of the American millionaire whose foundation was responsible for the funding of the 200" telescope. You autograph hunters might find this book of interest.

NOTES ON ASTROPHOTOGRAPHY

R.L. BISHOP

Ed. note: This article is reprinted from an article based on a talk by Dr. Bishop several years ago to the Halifax Centre.

ESSENTIAL POINTS:

1) good optics necessary
2) steady supports (tripods, mounts and drives)
3) good seeing (steady atmosphere) for high power work
4) your own dark room is an asset (for black and white photography)

CAMERA:

Any good camera can be used for astrophotography; however 35 mm (or 2¼ x 2¼) SLR cameras are best and most versatile. With such cameras shutter recoil vibration can be avoided for exposures fot $t > 1$ sec by using a cardboard shutter.

Lenses: The best is none too good.

Filters: Most useful are; k2 (yellow) with refractors
ND4, ND5 for the Sun

CAMERA/TELESCOPE CONFIGURATIONS:

1) prime focus; no eyepiece or camera lens--barlow lens may be used to provide a larger and more accessible. image.

2) eyepiece projection;

a)with no camera lens the effective focal length equals the magnification of the telescope times the distance between the eyepiece and the film.

$$EFL = M \times D_{ef}$$

b)with camera lens the effective focal length is magnification of the telescope times the focal length of the camera lens.

$$EFL = M \times fl_c$$

(In both cases effective focal number [f/#] = EFL/D_o

where D_o is diameter of objective or mirror)

SUBJECTS	OPTICAL ARRANGEMENT	TYPICAL EXPOSURES	COMMENTS
STARS	1 For constellation and similar wide angle work, camera alone. 2 Open & globular clusters camera + telescope	1 -1s and longer(stop down to f/3.5 for sharp images over a wide field. 2 No wider than f/4,long t	1 HS color film and f/2 will record all stars seen with eye in 10 s. 2 Large aperatures & long focal length desirable
METEORS	Camera alone. Drive preferable to avoid trails	No wider than f/2.8 Long t.	Patience required (and serendipity!) Meteor showers useful.
COMETS Aurora Zodiacal light	AS for meteors	f/2.8 to f/4 for comets Wider for aurora,etc	Fast film, wide angle low f/# lenses desirable. (And a dark sky)
SUN	Camera + telephoto or telescope. Min. fl 20 in. Danger to eye & camera! Cut intensity with Herschel wedge or ND filter View with objective filter or by projection	For ASA 125: 1/60 s f/16 ND5 filter 1/250 s f/32 ND4 filter	The atmosphere is steadiest in early morning or just after cloudy period. Fine grain film desirable.
MOON	Camera + telephoto or telescope. Min. fl 20 in.	For ASA 32: 1/60 f/8-quart. 1/60 f/5.6 Cresent 1/60 f/16 Full	Fine grain film desirable Good seein essential. Sun or Moon size ~ 1/100 EFL
ECLIPSES	Camera + telephoto or telescope. Min. fl 20 in. Camera alone for multiple exposure sequence.	Solar: partial--as for sun Total; ASA 125 f/11 prominences--1/30s; Corona ¼ to 5s Lunar: partial. ASA 125 f/11 t = 1s, Total 5s	Solar eclipse: plan well the min. or two of totality is unreal. A lunar eclipse in dark sky is very beautiful.
PLANETS	Camera + telescope, Min. fl apx. 4 ft. and aperture of 4 to 6".	f/50 to f/150 desirable ASA 125 f/100 t ~ 1 -10s	Quality optics and steadiness of drive, mount & atmosphere of utmost importance. Good results difficult.
NEBULAE	Prime focus with large aperature and long focal length.	Long exposures (min. useful exp. of 10 min.)	Torn between low f/# for light and long EFL for size. Large reflectors (8" +) best.

Said the Sun to the Earth,"Look at Venus,

That planet that's placed right between us,

Its cities and crouds

Are so covered by clouds,

I doubt that on Venus, they've seen us!"

Calman and Forbes

FOCUSING:

Usual method is use of ground glass screen
Better method is with clear glass screen with a cross-hair on it. (This allows focusing image and cross-hair until both are in sharp focus)

FILMS:

Recommended all purpose films for astrophotography;
B & W--Tri-X; Colour--Kodachrome-X and HS Ektachrome
ASA numbers stated are for moderate light levels and $t < 30s$.
Reciprocity law: $t \propto 1/\text{light intensity}$.
For long exposures this law fails in such a way that the effective ASA drops. The effect varies from film to film and between film types and in the case of colour films, differs amoung the three colour layers with the result that the colour balance is upset. Low temperatures cause ASA number to drop at ordinary light levels but to rise (3 to 10 times!) at low light levels. Dry ice or liquid CO_2 produces $-190^{o}F$--dry ice or a vacuum (0.1 torr) is needed to avoid frost formation on the film. Films should be developed in a contrasty developer such as D-19 and/or over developed (twice normal time) for better contrast.

FOCAL NUMBERS [f/#]:

For extended objects the f/# is a useful parameter but for stars it is of no use. In the later case the aperture is the controlling factor. For sky limited photographs the exposures will be the following:

f/1	$t \approx$ 10 min
f/2	$t \approx$ 1 hr
f/5.6	$t \approx$ all night

Hence for a given aperture, longer focal lengths (larger f/#) can photograph fainter stars. The size of the finest details projected on film $\cong \lambda \times f/\#$ (λ = wavelength of light). Thus for low f/#'s (<30) need fine grain film to make use of the resolving power of the optics.

DRIVES:

The Earth rotates. Hence the use of an equartorial mount with slow motion drive in RA (and Dec) to compensate is necessary for extended photos. A guiding scope is essential. No drive is needed for exposures of 10 sec or less if using the camera lens or less than ¼ sec through telescope.

FILMS FOR ASTROPHOTOGRAPHY

With the beginning of our observing group, an obvious topic for review is that of choosing a film for different subjects and with differing purposes in mind. In general one must consider the type of telescope and the speed or focal ratio of the instrument. For extended exposures a drive mechanism, whether mechanical or electric, is very desireable if not a necessity. A camera may be held to the eyepiece of the telescope for short exposures of the moon or sun but will not give good results without the waste of film. Hence a camera with a detachable lens is very desirable so that an adaptor may be employed to couple camera to telescope. An adaptor is available for most camera types when using the B-G Obs. telescope. Since most of you will be using the 16" for astrophotos, the comments about the film types will pertain to its use. The focal ratio of the 16" is f/11 and the 3½" finders are f/15 with fields of view on 35mm film of ½° and 1½° resp. Cameras may also be piggy-backed on the 16" allowing the use of long focal length lenses.

The film types are listed by increasing speed (ASA no).

<u>PANATOMIC-X</u> ASA 32 Excellant for the moon--fine grained with resulting high resolution. Contrast moderate and colour response panchromatic.

<u>HIGH CONTRAST COPY</u> ASA 32 The extremely high contrast of this film makes its usefulness limited and should only be used on Moon, Sun, Mars and Jupiter. Grain is extremely fine with a resulting extremely high resolution. Exposure should not exceed 10 s and the colour sen. is panchromatic.

<u>H & W VTE</u> ASA 64 Suitable for Venus, Saturn, Moon and if using a Schmidt camera, deep sky objects. As with HCC the useful exposure range is 0 to 10 s. Contrast is moderate and the fine grain gives high resolution. Colour sensitivity is panchromatic

<u>PLUS-X</u> ASA 125 Its moderate speed makes this film an excellant choice for general lunar and planetary work. The grain is moderate but allows magnification up to several times when printing. Contrast is moderate and

	Pan-X	HCC	VTE	Plus-X	SO-410	Infrared	103a-O	103a-F	Tri-X	103a-E	Tri-X	Record.
ASA	32	32	64	125	160	160	400	400	400	640	1200	3200
Resolution	vh	vh	h	h	m	m	f	f	f	f	p	vp
Sensitivity	p	p	p	p	p/r	r	b	b/r	p	r	p	p/r
Development	76	19	76	76	19	76	19	19	19	19	19*	76
Exposure	s	s	s	m	m/l	m*	m/l	m/l	m/l	m/l	m/l	m/l
SUBJECTS:												
Sun	e	fg	g	e	vg	?	p	p	vg	p	p	p
Moon	e	fg	g	e	e	g	f	f	vg	f	f	p
Lunar Ecl.	g	p	g	vg	g	vg	fg	fg	vg	fg	fg	g
Venus	g	f	g	vg	vg	?	g	fg	g	fg	fg	fg
Mars	fg	p	g	g	vg	?	fg	g	g	g	fg	fg
Jupiter	fg	p	g	g	vg	g	f	fg	g	fg	fg	fg
Saturn	fg	p	fg	g	vg	f	f	fg	g	fg	fg	f
Meteors	f	p	f	fg	fg	?	g	g	vg	g	vg	vg
Comets	fg	p	fg	g	g	fg	fg	fg	g	g	g	f
Stars (fixed Cam)	g	p	fg	g	g	fg	e	e	e	e	g	f g
Nebulae	p	p	p	g	g	gvg	g	e	vg	e	vg	g
Galaxies & Globular Cl	p	p	p	fg	f	fg	vg	g	g	g	fg	?

CODE: Under resolution; p-poor, f-fair, m-moderate, h-high
Under sensitivity; p-panchromatic, r-red, b-blue

Developers normally used are Kodak D-76 and D-19; some films can be developed in either and the '*' by Tri-X indicates forced development.

CODE: (con't)
Under Exposure s-0 to 10 s; m--10s to 1m; l--1m up. The '*' under infrared is to remind users that a filter must be used in some applications and the response may change.

PLUS-X (con't) colour sensitivity is panchromatic.

SO-410 ASA 160 The very fine grain of this film makes it one of the best for lunar photos at any magnification. Under good seeing conditions it is good for the brighter planets and to some degree because of its extened red response, it is useful for nebular shots. Contrast is very high and resolution very high for its speed.

Infrared (high speed) ASA 160 The use of blue cut-off filters is recommended but not necessary. This film can be used for daytime lunar photos if sky is clear and dry. Grain size is fine with good resolution resulting.

103a-O ASA 400 This film is used by professional astronomers but can be obtained from a couple of sources in 35mm format. The lack of resiprocity failure makes this type amoung the best for long exposures. Grain is coarse with low resolution. Contrast is moderately high.

103a-F ASA 400 Although the emulsion is not necessarily the same as other 103a films, the properties are general the same. This film has an extended red response which makes it especially useful for emission nebulae.

103a-E ASA 640 See 103a-O & F. Response is red sensitive.

TRI-X ASA 400 & 1200 Tri-X is proba bly the most widely used emulsion because of its versitily and high speed. Contrast is high with moderate grain and resolution when developed normally. When force developed (twice normal time apx.) the grain becomes coarse and resolution drops considerably but brings out faint features which would otherwise be lost in printing. Very good for lunar work especially if the seeing is only fair. Colour response is panchromatic; exposures longer than 10 min. suffer resiprocity failure.

2475 RECORDING ASA 3200 Use is usually in fixed cameras for meteors or comets and force developed. Coarse grained and low resolution are victims of the very high speed. Constellations show well with this extended red film.

POLAROID ASA 3200-4000 Results have been poor with this low resolution type of material. The cold conditions make it unsuitable for observatory use unless special measures are adopted for exposure and development. Contrast is low. Definitely not recommended.

Personal use will dictate which film you will choose most often. Availability and cost as well as developing proceedures are factors which you will want to consider but the prime factor in choosing your film should be the type of objects you intend to shoot on a particular night. In general for Halifax, one is wise to choose a moderate to high speed film with high contrast--Tri-X and Plus-X are best for general use.

If you intend to do any amount of astrophotography, you should do the development yourself. Commercial establishments are not equipped to give acceptable results without special handling and hence additional cost. For about $25 you can get the necessary equipment to do the job--a loading bag and light tight developing canister. The chemicals can be mixed in small quantities and cost very little and with very little practice, you can get consistantly good results and can very developing times etc. to give the results you want. For B & W films only 3 steps are necessarly; development, stop bath (or simply a water bath); and fixer. The whole process takes only 30 to 40 min., including wash time, and you then can inspect your film and reshot if necessary.

The information contained in this short review has been compiled form information and experience gained by Bill Calnen, John MacNeil and myself. It is intended only as a general guide for beginners and you may decide you like other types than those suggested and to some extent personal experience is the best guide.

R. Brooks

CANADA"S OLDEST OBSERVATORY(?)

Thor Hiyadalh

On the basis of recent archeological "detective work", Dr. Helge Knødel has announced the discovery of what may be Canada's earliest astronomical observatory at the remote northern Newfoundland settlement of L'Anse aux Meadows.

In a letter to the journal Nature, Dr. Knødel describes the circumstances surrounding the discovery of what he terms "almost certainly an eleventh-century astronomical observatory". The stucture was unearthed during a dig at the north-east of the island, where the remains of a Norse settlement dating from around the year 1000 were discovered in 1964. Located about 100 meters from the main site, a hummock which marked the remains of the observatory had gone unnoticed until last summer when Dr. Knødel began his investigation.

Little remains of the structure itself, but the remains of a stone foundation and other artifacts have allowed Dr. Knødel, a Norwegian archeologist, to put forward a possible reconstruction of the building. The foundation is about 6 by 8 meters and made of rocks fitted together without mortar. Several post holes surrounding the foundation, presumably marking the position of uprights which supported the walls. Near the north end of the structure is a small pit where some bits of charcoal and an iron nail were found. Dr. knødel believes this was an ember hearth, a common feature in the other houses at the site.

However, this site differs from the others in several respects; there were several arch-shaped pieces of wood found near the structure, the site lacked the usual signs of habitation (rubbish heap, untensils, etc.), and the size of the building is much smaller than the houses at the site. These facts, plus the exciting discovery of portions of the actual observing instrument, led Dr. Knødel to conclude that this was indeed a crude astronomical observatory.

The observing instrument was apparently a primitive 2-lens refractor with an objective of Iceland spar, a mineral similar to quartz that is used today by the optical industry. The objective was some 20 cm in diameter and mounted in a long wooden box in lieu of a tube.

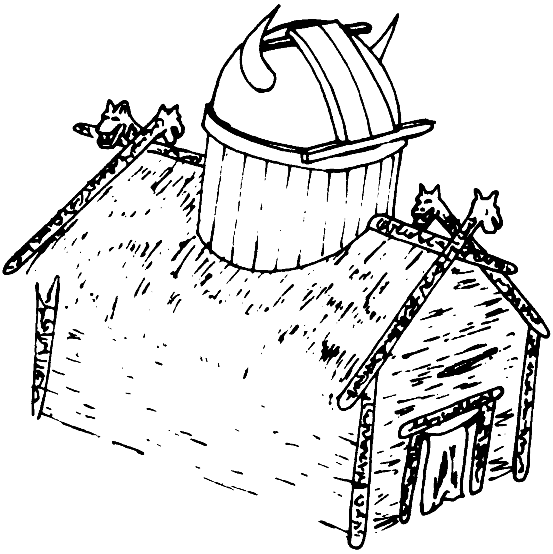
The arc-shaped forms of wood suggest that the Viking astronomers went so far as to equip their observatory with a dome of some sort as protection from the extremes of weather at such high latitudes. A sketch based on Dr. knødel's work, shows how the observatory may have looked.

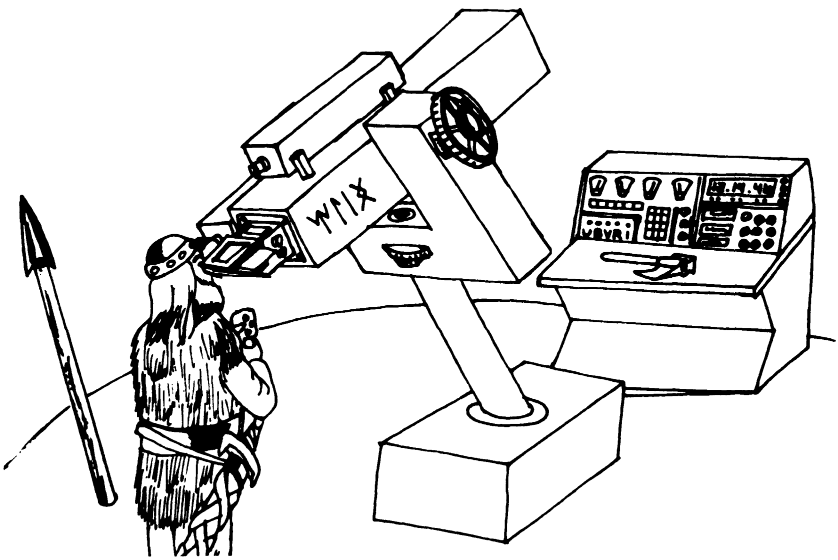
"There is no way of determining what sort of observations were made with this instrument, but it may have served as a sort of transit instrument to keep track of time and to establish longitude", says Dr. Knødel. "This discovery has been dated by the radioactive carbon method to the year 1000 AD ± 15 years, in excellent agreement with the rest of the site. I believe the evidence for the structure being an astronomical observatory is compelling, and, if true, certainly establishes it as the oldest in Canada, predating other contenders by at least a good 700 years. This should put an end to the squabble over who's observatory was first, once and for all!"

Dr. Knødel, in reply to spectulation by some archeologists that Irish monks may been blown off course to Canada and could have established an observatory prior to that of the Norsemen, said that "even if those idiot Irish did make it to Canada, they certainly wouldn't have built an observatory. A brewery or a pub, maybe. But an observatory? Impossible!"

(Reprinted from: Icelandic Journal of Physics and Astronomy)

Watch future issues of NOVA NOTES for further revelations of early reports of observatories--remember you saw it first in NOVA NOTES!





ASTRONOMICAL CALENDAR

Diane Brooks

March/April

1Mar 1804--Harding found the third asteroid, Juno
1966--earliest planetary contact by Venera 3 (USSR)

2 Mar 1840--death of H.W. Olbers
1972--Atlas SLV-3C launcher left Earth at unprecedented 31,700 mph

3 Mar 1727--death of Newton

4 Mar 1774--Wm. Herchel's first recorded of the Orion Neb.
1866--Norman Lockyer began observations of Sun with a spectroscope
1960--grey chondrite fireball seen & heard (& found?) at Brudenheim, ALBT.

6 Mar 1937--birth of Valentina Tereshkova, first woman in space

7 Mar 1962--first spectrogram obtained with Victoria 48"
1962--first orbiting observatory (OAO 1) launched
1970--first solar eclipse covered by TV
1973--Comet Kohoutek discovered

8 Mar 1804--Alvin Clark born, best maker of large objectives

9 Mar 1934--Yuri Gagarin born

1 Mar 1811--Urbin Leverrier, discover of Neptune ,born
16 th cent.--equinox was on this date towards end of cent.

3 Mar 1781-- Herschel discovered Uranus
1931--discovery of Pluto announced (see Jan 23 & 29)
1933--death of Innes, discover of many southern double stars
(?)--Percival Lowell born

4 Mar 1879--Einstein born
1999--last day Pluto is closer to Sun than Neptune

5 Mar 1964--Comet Schwassmann/Wachmann suddenly brightened by six mags. from 18 to 12.

6 Mar 1926--Robert Goddard launches first liquid fuel rocket
1966--first space rendezvous/docking, Gemini 8/Agena 8

7 Mar 1716--first occurance of aurora in Eng. for 142 yrs
1725--Mercury, Venus, Mars, Jupiter were so close as to be visible in same telescopic field
1846--death of F.W. Bessel
1966--Trailblazer II rocket launched to act as an artificial meteor to determine the relation between brightness and mass of a meteor

18 Mar 1934--great detonating fireball seen in western Can.
1965--first space walk by Aleksey Leonov (Voshod II)
19 Mar 1848--Moon much brighter than normal during eclipse
21 Mar 1892--asteroid, Svea, discovered by Max Wolf of Heidelberg--vernal equinox
22 Mar 1799--birth of Argelander, catalogued & charted 324,000 stars and founded science of variable star observation
1877--transit of "Vulcan" predicted
--earliest date for Easter
25 Mar 1655--Titan discovered by Huygens
1934--a 200" blank cast for Palomar was unsuccessful
1960--death of Ralph Wilson, of Mount Wilson Obser.
1969--Moon at highest point in modern times (+28^{o} 43')
26 Mar 1859--Lescarbault "discovered" Vulcan
27 Mar 1968--Yuri Gagarin killed in plane crash
28 Mar 1802--discovery of Pallus by Olbers
29 Mar 370--sunspot described as "like a plum" in Ma Twan Lin's Encyclopedia
1807--Vesta discovered by Olbers
30 Mar 1961--death of P.J. Melotte, discover of Jupiter VIII
31 Mar 1966--Earliest moon orbiter, Luna X

1 Ap 1958--death of W. Rabe, known for extensive measurements of double stars
2 Ap 1845--Fizeau & Faucault obtained first successful photo of sunspots by daguerreotype
1878--first publication of <u>Selenographic Journal</u>, the first magazine devoted to lunar studies
4 Ap 355--sunspot described as like a "peach" in Ma Twan Lin's Encyclopedia
1895 Crossley telescope donated to Lick Observatory
1960--Project Ozma begun
6 Ap 218--Halley's Comet associated with death of Emperor Macrinus in Rome
374--Chinese Encyclopedia of Ma Twan Lin describes naked eye sunspot as "like a duck"
7 Ap 1959--first meteorite fall photographed by Ceplecha of Czechoslovakia ,(the Pribram Meteorite)
8 Ap 1947--largest recorded sunspot, 7,000 million sq. mi.
--Vela 12 launched into longest period Earth orbit, (about 1 million years)
9 Ap 1956--death of Stanley Sykes, Lowell's instrument maker and machinist for 60 years

10 Ap 1977--Easter on the first Sunday after the full moon on or after March 21

11 Ap 1875--death of Heinrich Schwabe, discoverer of 11 yr sunspot cycle

1946--Royal Observatory moved from Greenwich to Herstmonceux Castle

12 Ap 1961--first manned space flight by Yuri Gagarin

16 Ap --mean solar time agrees with apparent time

17 Ap 1960--Humason discovered 12th mag. nova in spiral galaxy, NGC 4496 in Virgo

18 Ap 1955--Einstein died

19 Ap 1910--Halley's Comet passed perihelion

21 Ap --Maximum concentration of Lyrids

22 Ap 1972--Apollo XVI launched, spent longest time on Moon

23 Ap 1958--death of Knut Lundmark, studied distances, motions and nature of galaxies

1967--Komarov died, Soyuz I crashed with Komarov being first in-flight casualty of space travel

24 Ap 1967--Surveyor III recorded temperature drop on Moon during eclipse

25 Ap 1642--Moon disappeared completely during eclipse believed caused by material left in atmosphere by eruption of Vesuvius year before

--latest date for Easter

26 Ap 1803--at 1:00 pm 2-3,000 stones fell near L'Aigle, FR

1962--first international satellite launched (US/UK, Ariel 1)

27 Ap 1848--5th Mag. nova discovered in OPH by J.R. Hind

1857--Harvard 15" photographed first double star

1932--K. Reinmuth discovered asteroid, Apollo

28 Ap 1960--Dutch astronomer Antonie Pannekoek died

1965--prediction by Halliday of Dom. Obs.,Ottawa, of occultation by Pluto does not occur thus giving an upper limit for the planet's diameter

1974--last perihelion passage of periodic Comet Encke

29 Ap 1597--Tycho Brahe, his family and assistants leave his observatory at Hveen for Copenhagen to become astrologer/astronomer to the King

7 May to 5 June: Societies Show: collect your observing results, photos and whateveryou have and give them to R. Brooks or give me a call at 434-7274 or 422-7361 ext 255.

Observing the Sun

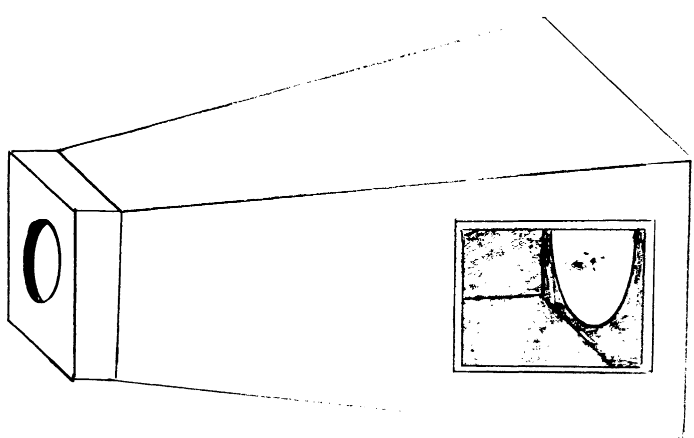
The Sun is the only star on which we can observe in detail daily changes. No other star can be studied in such an easy way by amateurs since all that is necessary is a small telescope, a screen made of white paper and steady air. Of course it hepls to have a few spots visible, but these are not the only features one can look for. Before I describe some mechanical aids for solar observing let's see what we are looking at when we look at the Sun in visible light. And let me make a caution which I can 't stress enough. NEVER LOOK AT THE SUN DIRECTLY WITH OR WITHOUT A TELESCOPE WITHOUT PROPER PROTECTION AND IF YOU ARE IN DOUBT ABOUT THE EFFECTIVENESS OF THE PROTECTION DO NOT USE IT.

The Sun is composed of several zones of which we only see the very upper layers. The light primarily is produced in the photosphere which is several thousand miles thick. Its temperature is about 5800° kelvin but becomes cooler as you move outwards. This leads to the first observation you can make. Using a filter or projection screen, look at the surface and note how the disc appears to become darker towards the edge. This is known as "limb darkening" and is caused by the fact that your are looking through more gas towards the edge which allows us to see only higher layers of the photosphere where the temperature is lower and hence slightly darker.

Next above the photosphere is the chromospere, a region where the density is lower and the temperature higher. It is however only 1-2,000 miles thick and is only observed by amateurs just before or after the onset of totality during a solar eclipse. Above this layer again, is the corona which has temperatures of a couple of million degrees. That may sound strange since the Sun's surface is only a few thousand degrees, but the temperature in the corona is not a temperature in the normal sense but is what is refered to as an electron temperature. Such a temperature is used in regions where the number of particles is very low and actually refers to the speed at which the particles move. The corona is devided into 2 parts,the inner and outer corona. The inner corona rises about ½ to 1 million miles above the solar surface, the exact height depending on the sunspot activity. The outer corona extends into the far reaches of interplanetary space and the aurora are caused by its interaction with our atmosphere. It, like the inner corona, depends strongly on solar activity. The corona can only be observed during eclipses or from spacecraft high above the earth's atmoshpere.

EQUIPMENT

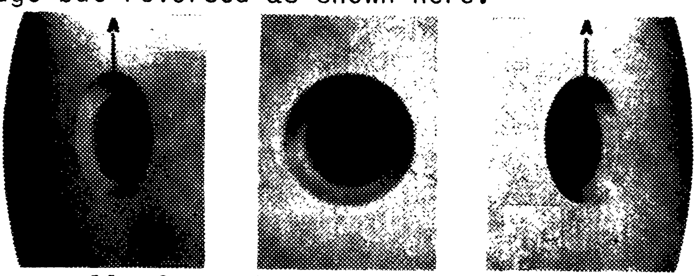
Most small telescopes come equipped with a filter to be attached to an eyepiece. Such a filter is not failsafe and they have been known to crack in use and eye damage might result. Hence inspect it carefully before using it each time for any damage. The most satisfactory method of observing employs a filter placed over the objective and most light is reflected away from the telescope before entering the instrument. These filters are expensive and hence few amateurs have one; however if you are partiularly fascinated in solar observing, consider aquiring such a filter. The cheapest and,from my point of view, the safest method is to construct a projection box as shown below. The box is made of balsa wood which is easily obtained from a hobby store. One views the Sun throuh the hole cut in one side as it shines on a sheet of white paper at the back. The purpose of the box is of course to block stray light from the Sun and sky. A piece of cardboard fitted over the back of the telescope and a piece of paper held behind the eyepiece can achieve the same thing with slightly poorer results. A drive on the telescope is an asset but not necessary.



WHAT TO LOOK FOR

Sunspots: sunspots will be the first thing you will pick out. These vary in size and number and you may observe for weeks without seeing any. They are normally found from the equator to about 40^{o} N & S, and this varies according to how far the Sun is into its 11 year cycle. At the beginning, the majority will be further from the equator which is the case at the present. This cycle would appear to be a poor one for observing since the numbers of spots is well below average for the second year of the cycle. Therefore, have patience in spot counting. You should also estimate the size of spots which are exceptionally large by comparing them with the diameter of the Sun (796,000 mi.). Some can be 70 or 80,000 miles in diameter with areas of millions of square miles. The dark region (umbra) is surrounded by the greyish penumbra which may have a diameter of over 100,000 miles!

Wilson Effect: the Sun rotates with a period of 27 days. This motion carries spots around from the back side and as they appear around the edge, they appear elongated with the penumbra wider on the side towards the edge of the Sun. This effect is known as the Wilson Effect. It tells us that spots are depressions in the atmosphere of the Sun shaped like a saucer with the umbra at the bottom. As the spots approach the centre of the solar disc the effect disappears and then latter reappears as they approach the other edge but reversed as shown here.



Flares: usually found in the midst of sunspots, flares are caused by extremely bright clouds which appear above the chromosphere. They differ from prominences in size, brightness and duration and are the source of some of the strongest of solar radiations. They can appear in 10-15 minutes and will last up to several hours. Flares also cause radio communication problems.

Faculae: these irregular, extensive bright patches are most easily observed near the edge of the solar disc and are just above the surface. They appear frequently just before and in the area of new spots.

Solar Rotation: by observing a large group of spots for a number of days you can verify that the Sun is rotating and you may be able to think of a way to measure the time for one rotation and the daily rotation angle. This requires that you keep an accurate record of the position of the spot during its period of visibility. To do this, draw several circles about 1½ or 2" in diameter on a piece of paper. Each day plot the position as carefully as possible recording the day and time, seeing conditions etc. Incidently, the best time for solar observing is usually in the morning when the Sun is 30° above the horizon. Later in the day,the ground heats up causing disturbances in the air.

Summary of What to Look For and What to Record:

1) with proper protection (welders glass) look for any naked eye spots[this can be done at sunset thro clouds].

2) make detailed drawings of spots daily

3) make counts of all spots visible, even faint ones

4) Look for spots exhibiting the Wilson Effect

5) Note any faculae or flairs

6) estimate diameter of largest spots and make detailed drawings of these with high magnifation

7) keep an eye during night observations for any aurora especially after observing large active sunspots.

Solar observing can be more comfortable than night time exploits and can be very satisfying especially if you keep at it regularly and record the observations. However, be especially CAREFUL because even a fration of a second exposure to direct sunlight will cause permanent eye damage and you might never see the delights of the Orion Nebula or Saturn again.

BK

OBSERVING REMINDERS

Sun 20 Mar--Equinox at 01:43, see P. 40 of <u>Obser. Hdbk</u>.
for description of why the day is greater than the 12 hours one is taught to expect

Thur 24 Mar--Ceres at opposition, mag will be 6.5 and it is 2.37 AU's from the Sun.

Sat 2 Ap--Pluto at opposition, distance 4.42 x 10^9km +14m.

Sun 3 Ap--Lunar eclipse with contacts at 22:05, 23:30, 00:18, 01:06, 02:32; magnitude of eclipse is only 0.198 which means the centre of the moon passes well away from the centre of the Earth's shadow.

Wed 6 Ap--Venus at inferior conjunction--a none observing event!

Sat 10 Ap--Mercury at greatest Eastern elongation. It will be 17° above the horizon at sunset and will have an apparent diameter of 7".5 which will be easily resolved in even small telescopes. Best of year.

Sun 11 Ap--Comet Grigg-Skjellerup at perihelion will be only 0.18 AU from Earth at that time and may attain a mag. of 9-10.

Mon 18 Ap--New Moon and an annular eclipse of Sun visible in South America but few will make an effort to view because of the minor scientific and even less aesthetic value

Fri 22 Ap--Lyrids, only redeeming value of this meteor shower is the new moon. Only 15 meteors/hr

Sat 30 Ap--a triple header! Mars at perihelion, Uranus at opposition and Mercury at inferior conjunction

Thur 5 May--an opportunity to find Neptune easily, its only 3° south of Moon; η (eta) Aquarid meteors will be even less entertaining than Lyrids. Only 20/hr but the full moon will harass your eyes.

Wed 11 May--Venus at greatest brilliancy for year, -4.7 m.

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SOCIETIES SHOW-- N.S. MUSEUM

May 7---June 5

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MARCH/APRIL NOVA NOTES Vol 8 No 2

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