NOVA

December, 1979
Vancouver, Canada

c/o Allen Stoneberg
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IN THIS ISSUE
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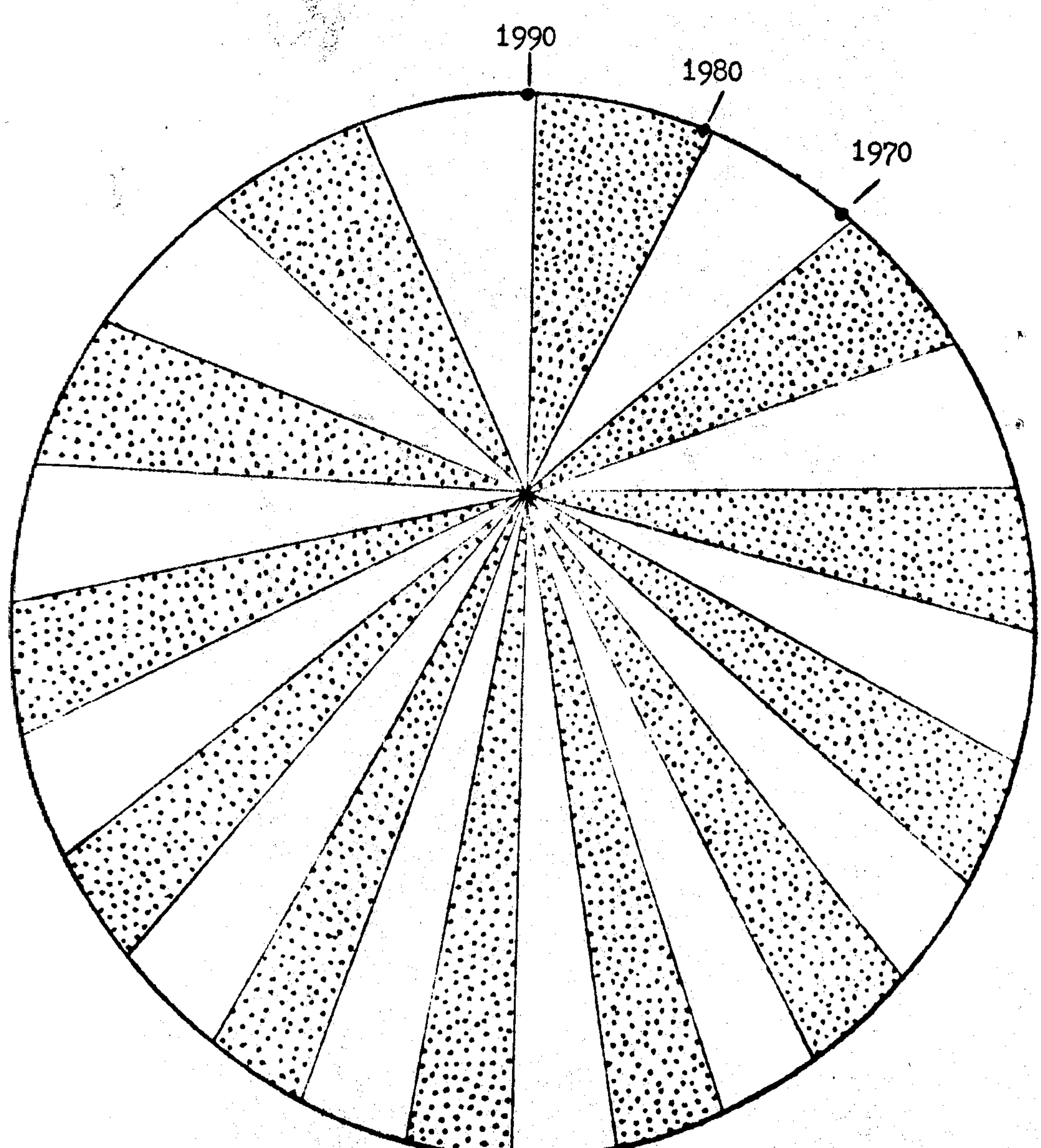

P L U T O ' S   O R B I T

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DECEMBER **NOVA** 1979

A NEWSLETTER OF THE VANCOUVER CENTRE
ROYAL ASTRONOMICAL SOCIETY OF CANADA

Allen Stoneberg, Gregg Winter and Gordon Herke .... Editors

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EDITORIAL

We, the editors, would like to comment on the great number of articles that have flooded the pages of this month's NOVA. We are not sure what has inspired so many people to write the (said) articles but it seems that people are actually getting involved once again with NOVA. This involvement shows not only that certain people are truly interested in the center's activities but also that they are participating in astronomical activities outside the center (and sharing them with the rest of us through NOVA).

Our only regret has been the absence of articles from the younger members of our society in this issue. (You're not going to let this happen again, are you?? Why not start the new year off on the right foot and get some articles in?)

It turns out that we had done several articles ourselves including astronomically bewildering crossword puzzles that for all (or for most) had to be left out to allow room for far more (we thought) interesting articles. So, if you would rather not see the crossword puzzle (believe us, you wouldn't), you'll keep those articles coming, or we might be forced to expose you to it!

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LAST MONTH'S MEETING

At 8:00 Stan Sullivan opened the meeting. David Hurd, Planetarium Staff Scientist, was the main speaker. First, he described his trip to Australian Observatories. The purpose of the trip was to take photographic panorama shots for an upcoming planetarium show. Dave discusses another aspect of Australian astronomy in an article in this issue. Second, Dave displayed some impressive Hydrogen-Alpha photos of the sun which were taken through the new Ziess 6" coudé.

The meeting continued with slides of recent sunspot groups taken by Basil Chiu. The photos were taken on successive days, to show the rotation of the sun and the developement of the sunspots. Next, Peter Sykes showed us his slides of Cygnus and the moon. Lastly, Dave Dodge demonstrated what lengths amateurs will go to in order to get a 14" telescope. He revealed the 14½" soda glass blank he intends to grind to f-5. Good luck, Dave. (His reward for this incredible display of bravery was the nomination for vice-president on this year's council.)

NEXT MONTH'S MEETING

The next meeting of the R.A.S.C. will be on December 11 th, at 8:00 P.M. in the auditorium of the Museum & Planetarium complex. This should be a great meeting. First, the 1980 elections will be held. I hope you'll appreciate the fact that there is actually an election; the council usually gets in by acclamation. Your vote is important, so USE IT WISELY.

The speaker will be none other than John R. Percy, National President of the R.A.S.C. His talk will be entitled: "Observing Variable Stars for Fun and Profit." Dr. Percy is an excellent speaker, so don't miss this meeting.

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TAURUS MAJORIS

* The winner of last month's contest was Sally Baker. Congradulations, Sally. Her answers were the first recieved from about fifty contest entries. Maybe we should have another contest.

* Doreen McLeod has informed us that the R.A.S.C. Handbooks for 1980 are here and can be picked up at the December meeting.

* The deadline for contributions to January's NOVA is Friday, December 21.

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WANTED: GOOD ASTRONOMICAL SLIDES — John R. Percy

The Royal Astronomical Society of Canada maintains a collection of 35 mm astronomical slides as part of its National Library. These slides are available for loan to Centers and individual members.

We are asking you, therefore, to consider donating two or three of your best slides to the collection. We would especially like slides with a special significance to the society, such as amateur and professional observatories and telescopes, planetariums, historical sites, or Canadian astronomers, past and present. We would also like good slides of astronomical objects.

We tend to be selective in what slides we accept, so send us your best! Include a brief caption and the name of the photographer.

Please send your donations to: Slide Collection, Royal Astronomical Society of Canada, 124 Merton Street, Toronto, Ontario. M4S 2Z2.

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FOR SALE:

1 Cyclops, made by Brad Meyers. 178 mm, f-2.5, adjustable iris to f-16. $130.00.

1 Celestron Williams Cold Camera (complete). $150.00. Phone: Gregg at 277-2549. (Sorry, no dry ice.)

We couldn't find anything to fit in at the top of this page, so we just decided not to put anything up here. (exept the previous statement)(and that).

IN PRAISE OF BINOCULARS (part 1) J. Karl Miller

Many of our members may not be aware that they may be the owners of what can only be described as a precision telescope. As a matter of fact, they are likely to own two of these marvelous devices. I'm sure that for only one of them, in times past, a king's ransom would have been paid. I'm talking about the sometimes abused, often taken for granted, and most versatile and useful of optical instruments: a pair of binoculars.

Binoculars are a pair of refracting telescopes, aligned exactly parallel with each other which afford a stereoscopic view of the world around us. Who of us has not marveled at the way in which binoculars enable us to make the small large, bring the far close, and make the invisible visible? These things are certainly evident when we employ binoculars for observations of the marvels of our earth (I'm thinking here of birdwatching, for instance). But the useful-ness of binoculars does not stop here.

I'm sure that most of us enjoy a trip in an airplane. Unfortunately, many of us may not be able to afford this pleasure often, considering the price of the fare. A trip to the moon is (for the present at least) out of the question for most of us. The younger members of our association may have a real driving wish to take part in a spaceflight (I know my son does, and I'm not averse to it myself), but there is a vast difference between dreams and reality, except......

You know you can take a trip into space, any clear night! Not only that, you can go to any destination, at the drop of a hat. I'm sure you know what I'm alluding to: our means of travel, our spaceship, is a pair of binoculars. The view through a pair of binoculars, if trained on the sky, is what can be expected to be the view out of one of the portholes of a future spaceship. A trip into space -- and it costs nothing!

Besides being a "spaceship" this marvelous instrument also constitutes a "time machine", for when we look into space, we are also looking backwards in time. We can only speculate what is going on there right now.

Letme say here that any pair of binoculars will provide you with the pleasures I have cited. This is not the end of usefulness of this type of optical instrument. Binoculars are being used as telephoto lenses, for macrophotography and for astronomical photography. Many beautiful and scientifically useful photographs have been taken with the aid of binoculars.

If you are interested in furthering our scientific knowledge, your pair of binoculars becomes a precision research tool in your hands. For astronomical research, the fields of variable star work, comet hunting and meteor astronomy, as well as solar work, offer great challenges. If you are interested in "star gazing" and "space excursions", binoculars are the most useful means. As a matter of fact, for some astronomical research, binoculars are the only useful tools.

With such a useful piece of equipment easily within reach (literally) of most of us, let us get a little more familiar with these beautiful instruments.

To begin with, being precision instruments, they should be treated exactly as you would any other optical equipment, such as your camera. This means that it should be protected from excessive mechanical shocks and excessively damp and/or corrosive surroundings. With a modicum of care, binoculars will give a lifetime of service. Many binoculars of 50 year vintage are still in constant use.

For those of us who may have only a vague idea of how binoculars work, I'll attempt a short description of them.

As stated before, binoculars are a pair of precision refracting telescopes. Like all telescopes, they would provide to the user an upside-down vision of whatever is being examined. For astronomical views (our travels in space) this would not be a problem. (Remember, there is no up or down in space). For viewing terrestrial subjects, however, this is not very convenient. Provision is made, therefore, to "invert" the images. This is done by means of a suitable arrangement of glass prisms. It is the positioning of the prisms which suffers when a pair of binoculars is treated roughly; the result of such mistreatment is that "crossed-eyes" feeling when looking through the binoculars that have been dropped, or otherwise kicked about.

Each half of a pair of binoculars, then, consists of an "objective" and an eyepiece. The light entering the "objective" travels through the inverting prisms and finally through the ocular (eyepiece). This is exactly the same arrangement as that of any other "refractor". The only difference is the use of inverting prisms. The "objective" is the "window" to the world and as such acts just like one. If it is large, a lot of light will be admitted; a smaller objective admits less light.

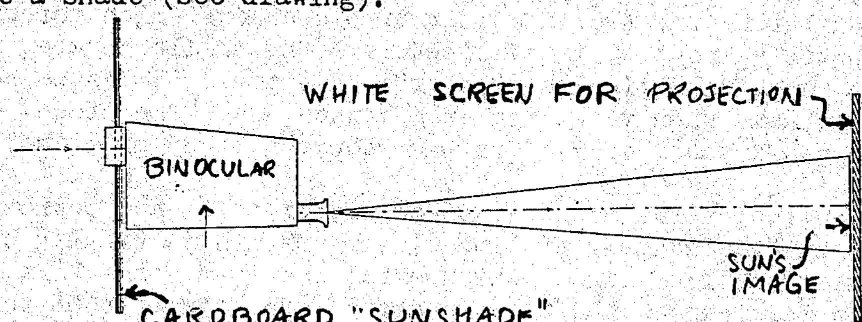
On most binoculars, you will find engraved, among other things, a couple of numbers, for example 6 X 30, 7 X 35, 7 X 50, 10 X 50 and similar. It is the larger number of the two in a pair of binoculars which refers to the diameter of the objective, quoted in millimeters. The smaller number in the combination 7 X 35, say, signifies the "power". The power indicates how much larger any object appears when viewed through binoculars. Therefore, a 7 X 35 pair of binoculars has a power of 7 X with objectives of 35 mm diameter.

These figures portray a number of characteristics and performance parameters of this particular pair of binoculars. One in particular has importance. The diameter of the "pencil of light" which exits the eyepiece. This is of a fixed size and is determined by the above numbers. The diameter of this pencil of light is given by $\frac{35}{7} = 5$ mm, i.e. diameter of objective divided by the power.

A pair of 7 X 50 binoculars would have a light pencil of $\frac{50}{7} = 7.1$ mm. This is almost exactly the diameter of the pupil of your eyes, when they are fully dark-adapted. Since any "light pencil" larger than that cannot be fully used by the human eye, an "exit pupil" larger than approximately 7 mm adds nothing to the amount of light which can enter the eye. For this reason, binoculars with exit pupils of approximately 7 mm are called "night glasses". It is the amount of light which enters our eyes that determines how many stars we will see on our "space travels". The size of the exit pupil (this is the "light pencil") in relation to the size of the human pupil determines to a large degree the intensity with which we see star clusters and nebulae in the night sky.

What is the nature of scientific observations which can be made with binoculars? Well, the possibilities are manifold. Let us consider the nearest star, our sun. Granted that a pair of binoculars will not elicit its deepest secrets, but scientifically useful information can be had by counting sunspots, for example. How can this be done? There are two ways: (1) direct observation, (2) photography. A word of warning here: NEVER look at the sun directly through binoculars. This is patently impossible without protective optical devices. You cannot even look at the sun with the naked eye. This can result in damage to your eyesight. We have evolved an instinctive protective reaction to bright light (our eyelids, and the ability for the iris of the eye to contract in order to cut down on the amount of light entering our eyes). These are good, and biologically successful adaptations, **not meant to be tested with binoculars.**

Well then, how can we use binoculars for direct solar observations? Again, there are two methods. The most popular, and least expensive, is by "eyepiece projection". (This is quite akin to projecting slides onto a screen.) Here the objective forms a bright image of the sun in its focus. This extremely bright (and hot) image is then projected by the eyepiece onto a screen. Focusing is done with the same mechanism that is used to "sharpen" the image when looking through binoculars at other subjects. The fact that the sun's image is hot points out a potential problem with this method of observation: It is possible that the eyepiece of the binoculars used for projection might be damaged by heat, if the observation is carried on over a long time. To cut the heat down, a set of cardboard rings (or similar) can be used to decrease the diameter of the objective lenses. This acts like partially pulling a windowshade down. Unfortunately, this results in a fainter projected image. It is therefore useful to "shade" the projection screen from all extraneous light, just like you do when you use your slide projector. At its simplest, a piece of cardboard can act like a shade (see drawing).



When projecting, use the lens covers on one of the two binocular halves, otherwise you'll be projecting two images. The projection of two images of the sun can be used to check the alignment of the binoculars, by the way. The two images should be centered as closely as possible on an imaginary line parallel to the line connecting the centres of the eyepieces, and the image centres should have the same distance as the eyepieces. If the two images depart greatly from the "orientation" of the eyepieces, alignment is poor and the binoculars may not be very comfortable to look through ("crossed-eyes" feeling).

The "projection method" is best suited to observation of the sun when several people are present. The "light pollution" inevitably present makes perception of fine detail difficult.

...to be continued in next month's NOVA

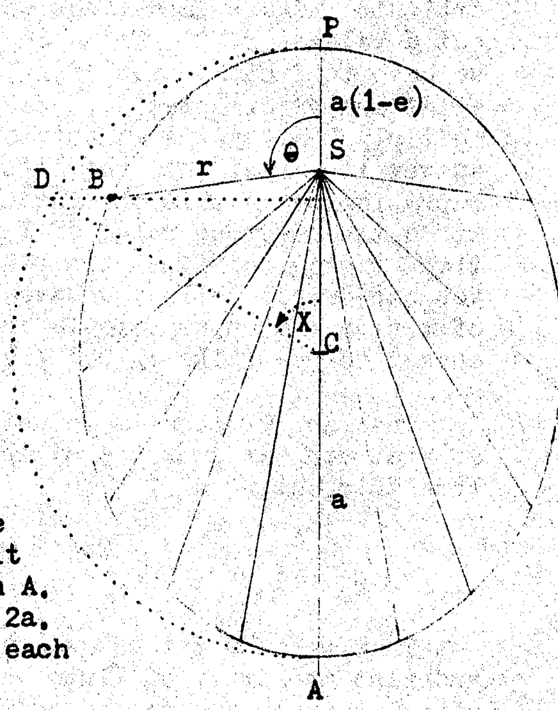
ASTRO CALCS, ANYONE? Tom Tothill

When I think what the great calculators of the past like Kepler, Newton or Bessel could have done with the kind of calculator one can buy for about thirty dollars nowadays, I am filled with an acute sense of humility. What, I ask, can I do?

It would be nice to be able to calculate a comet orbit, and its path across the sky. It would be lovely to figure out how far Venus is moved out of its orbit as it passes inside the earth. The trouble is, celestial mechanics is a subject that starts to get difficult on Page Two and is generally left to the experts with large computers.

An ellipse is not, of course, a difficult thing to calculate, or to draw by well-known methods. The problem arises when we want to calculate it on the basis of time. By Kepler's law, planets sweep out equal areas in equal times and since we know the area of the whole orbit and the time to complete the trip we can easily calculate what area the planet should sweep out in a week or a month or whatever interval we choose. But what angle does the planet sweep at the sun to give that area? Believe it or not, despite the complexities of higher mathematics, nobody has yet come up with an exact mathematical formula for the area of an ellipse swept by such an angle, or conversely the angle required to sweep out a given area.

So in practice the problem is solved by trial-and-error methods. A computer is set up to take a first guess at the answer, calculate the resulting error, and use the error to calculate a better guess, and then on around the loop again until the error becomes too small to be important. This is very tedious to do by hand but is ideal work for a programmable computer. It can zip around the loop a thousand times and come up with the answer in the blink of an eye.



The orbit on the right is for an asteroid with eccentricity e = 0.6 (the sun S is 0.6 of the way from the centre of the ellipse C to the perihelion point P.) The speed around the orbit is four times as fast at P as it is at aphelion A. The width of the orbit is 0.8 times the length 2a. The orbit is divided into 12 'monthly' stripes each of which has the same area.

Starting the motion at perihelion, the values of Θ are obtained by the trial-and-error process already mentioned, using a roundabout method called the "Excentric Anomaly" purely because it shortens the trials by simplifying the mathematics. Then the radius r of the body from the sun can be calculated from

$$r = a\ (1 - e^2)/(1 + e \text{ Cos } \Theta)$$

which is the equation of the ellipse, measured from the sun S.

The construction of the Excentric Anomaly (actually the angle X) is shown dotted in the figure. A circumscribing circle is drawn around the ellipse and a perpendicular is put through the body B to the circle at D. From D a line is drawn to the centre of the ellipse at C, making an angle X with the direction of perihelion. As B sweeps around the ellipse, for every value of θ there is a corresponding value of X. But near perihelion when θ is changing very fast, X increases more slowly, and conversely when θ is changing slowly near aphelion X increases more rapidly. The angle X therefore behaves in a more even way around the ellipse than the angle θ. It turns out that the equation of the ellipse in terms of X is also simpler:

$$r = a\,(1 - e \cos X)$$

The rate of increase of X with time is

$$dX/dt = 2\pi a / r T$$

where T is the period of the whole orbit. This can be integrated using the previous equation for r/a and we get:

$$2\pi t / T = X - e \sin X$$

The left hand side of this equation expresses the fractional time of the orbit in radians, and since we know T and can choose t as we wish, we can work out a value for it. To match that value on the right hand side of the equation we have to find a value of X (in radians also) that fits. This is where the trial and error comes in. We guess a value of X, get its Sin on the calculator, multiply that by the eccentricity e, and subtract the result from X. If the answer is larger than the left hand side, try a smaller X, and so forth. A rapid improvement is obtained by taking the error (left - right) and adding it to the previous value of X for the second guess, whether positive or negative. Three to five tries by this procedure will give you angles as close as you can draw. While you have the final X in the calculator, work out the value of r from the upper formula and tabulate it against the t/T values you have chosen to use (like 1/12, 2/12, etc.).

The last problem is to work out the values of θ to go with the values of X so that you can draw the stripe lines, and measure the values of r along them. Work this out from

$$\cos\theta = \frac{\cos X - e}{1 - e \cos X}$$

That was the method used to draw the ellipse illustrating this article and also the orbit of Pluto on the front cover. For Pluto I used 24 equal time intervals around the orbit so each stripe represents 247.7/24 years or 10.32 years.

Pluto's perihelion will come in 1989 and for the next 19 years Pluto will be nearer to the sun than Neptune, but considerably north of Neptune's near-circular orbit.

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P.S. Who's MISSIER - Messier's daughter?

MAPLE RIDGE OBSERVATORY

On Monday November 5th a delegation from the Maple Ridge Amateur Astronomers Society went before the Maple Ridge Town Council to present a brief, drawn up by Mr. Dan Graham (one of the club's directors) for a proposed observatory in Maple Ridge. Speaking on behalf of the M.R.A.A.S. was Mr. William R. Spencer, the vice-president.

Mr. Spencer placed before the council the proposal for the observatory, to be located on the top of Thornhill. The observatory will be on ten acres of land, just east of the B.C. Tel. microwave tower.

In the 12 page brief, the project is broken into four phases. Phase 1 involves obtaining the property and clearing it as soon as possible and getting the road right of way and parking area built, so the site can be used for observing with portable telescopes as soon as possible. Phase 2 would be the actual construction of the building housing the telescope with a twenty foot dome, once the funds are available from grants from governments, businesses and individuals. Phase 3 involves the construction of a larger building with classrooms, a darkroom, kitchenette, washrooms, office space and a camping area. Phase 4 would see the construction of a Library, more office space, a workshop for mirror grinding and telescope making, a dormatory and a lounge, additional classroom space, and machine shop. William Spencer stated: "Not only would this fully-functional facility serve superbly as a vital educational institution for the community, it would allow amateur astronomers from all over, the opportunity to give greater observational contribution to astronomical research."

The complete installation would be called "The Maple Ridge Observatory", and it would be fully owned by the people of Maple Ridge, and fully administered by the Maple Ridge Amateur Astronomers Society. The proposed telescope is a 60 cm. Ritchey-Chretien Telescope on a fork mount with electric focusser, and 6 inch F-4 guidescope. Additional equipment includes: 8" Schmidt camera, Hydrogen Alpha filters, Photomultiplier, spectrograph and image intensifier.

The entire project is now in the hands of the town planner; regular observing sessions are carried on every clear night, which have been many, at the usual place, and those who have driven out here through the fog have been rewarded by dark clear skies (usually), and have observed till the wee hours of the morning in the freezing cold.

Wally J. Hodgson, President, M.R.A.A.S.

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FOR SALE:

6" f-5 mirror (alluminized) $20.00. Contact Bill Hodgson at 462-9157.

A RARE OCCULTATION

Art Holmes

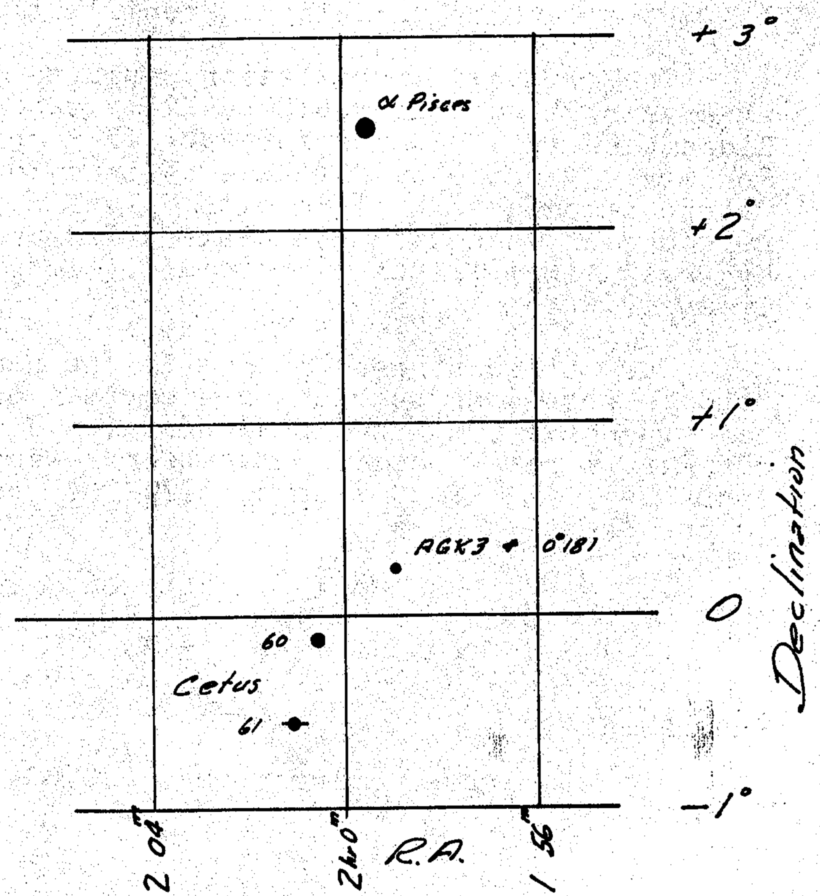
The Royal Greenwich Observatory has recently sent me the elements for the possible occultation of a star by 451 Patientia, a body of which I have never heard, but apparently a minor planet of approximately 140 km. radius.

The limits of the occultation are unfortunately outside the Vancouver area. I have plotted the southern limit as tabulated on a portion of a B. C. map. This limit extended northward passes just west of Prince George. The northern limit passes slightly to the west of Kitimat and Terrace. It would appear that one would need to be as far west as Comox or Campbell River to catch this occultation.

The data given shows that observing the occultation would be difficult. The sun, having set only 40 minutes earlier, will be only 6° below the horizon, and the star is of magnitude 7.8 only. However, my calculations show the star to be very nearly on the meridian at this time and it is quite easy to identify from its relationship with alpha Pisces and 60 & 61 Cetus. The sketch shows these positions to scale and I have observed this star on several nights of mediocre seeing and at lower altitudes than it will be at the time of occultation.

Since the predicted occultation takes place at approximately 17:24 PST on Sunday January 13, 1980, if a break of good weather was forecast I could take part in an expedition to the Comox-Campbell River area for a try at this occultation.

Data and maps will be available for those contemplating going on this expedition at the December meeting.



ASTRONOMY P.R. IN AUSTRALIA

David Hurd

In a world where every scientist has to fight for his research dollars, Australian astronomers have taken somewhat of a new approach. In the more isolated out-back regions of the country (where it's 50 miles to the nearest pub and 100 miles to a movie house), astronomy has become almost an entertainment industry. Almost every observatory has extensive, and very sophisticated, visitor programs. The resulting public awareness of astronomy has led to what appears to be a generous flow of government research money.

Parkes Radio Observatory was one of three observatories Robin Goldie and I visited on our recent trip to Australia. Despite the fact that automobile ignition systems interfere with radio observation, the first thing you notice are the direction signs leading to an enormous visitor parking lot....less than 100 yards from the 240 foot dish. Pathways lead to a visitor reception centre featuring an astronomical store, a photo gallery and many a/v displays in a multi-screen theatre.

As it happens, Robin and I were in Parkes to get panoramic views for future use in the Planetarium, and this meant that we had to wander around various parts of the grounds. This we were permitted to do because we arrived early, before the crowds that show up later on (who would have followed us out into the otherwise restricted fields). Parkes receives hundreds of visitors daily; last year there were 80,000 visitors!

Four hundred miles north of Parkes is Siding Springs Observatory. Our arrival here was a somewhat long process. We arrived in mid-day only to follow half a dozen tour buses up the narrow winding road. Siding Springs mountain is the highest in the Warrnumbungle Range. It's about 600 miles from both Sidney and Bisbane in the middle of a fairly populated, rich farming area. <u>THE</u> place to go on a weekend, or to take visitors, is the observatory. Again there was a gift shop, large display area and other facilities. The observatory is so anxious to have visitors, it's even open at night. At Parkes, they ask you to turn off car ignitions as quickly as possible; at Siding Springs, they ask that low beams only be used at the summit. These are minor inconveniences compared to North American Observatories that lock their gates at dusk. (Did you know that at least four Vancouver members were once accidentally locked <u>IN</u> at Kitt Peak!)

Successful P.R. leads to public awareness and government funding. As a bonus, who knows which bus load of kids holds a future amateur astronomer or a budding Nobel winner. I wish there was as much interest in Canadian observatories.