R E G U L U S

THE NEWSLETTER OF THE

ROYAL ASTRONOMICAL SOCIETY OF CANADA - KINGSTON CENTRE

JANUARY, FEBRUARY, 1987

COMET LEVY
DAVID'S DISCOVERY — THE FIRST ONE OF 1987

Our member in Tucson has done it again! David Levy has begun the year, 1987, in the right way by making its first comet discovery. Early in the morning of Monday, January 5, while observing with "Jupiter", his 16-inch reflector, David noticed a faint object of eleventh magnitude not far from the star Alpha Ophiuchi. He suspected a comet but because of the approaching morning twilight, he could not make the definite confirmation of motion which he wished. On the following morning, he was still frustrated in his wish to make this confirmation, this time because of cloudy weather - a fact with which we have become all too familiar in this area and at this time of year! Finally, on the morning of January 7, David was able to confirm that there indeed was motion and it was a comet, one that appeared to be moving almost due south.

All of our members who are anxious to observe David's most recent find should be cautioned that it may be difficult to see in the morning sky for several reasons: it is faint and quite diffuse (with little condensation), and its southward motion will add to the challenge, as well the fact that it is expected to brighten little from the eleventh magnitude it showed at the time of discovery. Computations by Dr. Brian Marsden show that the comet reached perihelion on December 18 and its orbit is presently such that it is moving somewhat toward the earth as it retreats from the sun.

We are all very happy at this accomplishnent by David. I hope he remembers to go back a dozen issues in this periodical and see my prediction (Nov.-Dec., 1984, page 1, following the discovery of Comet Levy-Rudenko) that there were then in the solar system a couple of Comets Levy between magnitudes 23 and 20, awaiting discovery in due course. The first of these discoveries has just taken place and we await the next one, also "in due course"!

Sincerest congratulations to David! A second Comet Levy (this one a non-hyphenated comet)! Another tremendous accomplishnent!

BUILDING A REFRACTOR
by Larry Manuel

[**EDITOR'S NOTE:** On November 14, 1986, the members of our Centre were treated to a very fine talk by Larry Manuel who explained his recent telescope-building project, an unusually ambitious one involving a refractor. I am very pleased that Larry has submitted a summary of that talk for publication in our newsletter.]

Early in 1986, I decided that I would like to build a refractor. I am keenly interested in optics, especially refractors, and I wanted a new telescope, too. I settled on a 3-inch f/15 Fraunhofer doublet with the lens design from a computer programme written by John A. Church, published in Sky and Telescope, November, 1984. This is an aplanatic doublet, corrected for coma and spherical aberration, and of course, corrected for secondary spectrum as much as the glass will allow. A long-focus 3-inch glass is almost free of colour, and is relatively easy to figure for residual spherical aberration.

I ordered the glass disks from Amateur Optics in England and they arrived in about two months. By that time I had ray-traced the design to check it, and it was a good design. I worked from Amateur Telescope Making, Volume III, Wyld's article on

ray-tracing, but would not recommend that for anyone else, since Kingslake's book, Fundamentals of Lens Design has much easier methods outlined.

A spherometer and wedge-measuring jig were necessary and I built these while the glass was on order. Also, four grinding tools were needed: every surface has a different radius of curvature. I made these of 80mm diameter, 1/4-inch thick aluminum disks and epoxied on 1-inch square facets of 1/4-inch thick plate glass. It is necessary to bevel all edges of the glass facets during fine grinding or glass will flake off the sharp edges and cause scratches; I know this from experience.

I ground the curves by hand using silicon carbide and then aluminum oxide lapping powder. It is important to be very thorough in fine grinding to remove pits from the large abrasives used for rough grinding. I found two hours with 5 micron to save many hours in polishing. Also, the more time spent polishing the more accurate the surface will be, that is, with less deviation from the desired sphere.

I began polishing by hand, and found it slow, and hard to polish out the pits. I borrowed a lapidary grinding and polishing machine, and eventually went back to fine grinding, and subsequently polishing was faster. Cerium oxide was used for polishing, but it usually left sleeks (micro-scratches). Optical rouge would always eliminate these sleeks.

I built a square wooden tube with a 20-inch, 3-inch OD copper tube as focusser draw tube, sliding on teflon bearings. This allows me to use a 2-inch OD eyepiece and have a fully baffled focusser tube to reduce stray light - which is important for contrast. There are nine knife-edge baffles altogether.

The focussing mechanism was experimental, and is a success. It consists of a 3/16-inch diameter drill rod running in four ball bearings with a 5/32-inch braided nylon cord wrapped five times around the shaft for friction. Both ends of the nylon are attached to the drawtube which is then "winched" back and forth. A check with a dial indicator shows that focussing precision of 1/100 of a millimetre or less is possible, with negligible backlash.

The mount is a fork-type equatorial, from an 8-inch f/5 and is a gift. I mounted the optical tube so that the eyepiece height is relatively constant as the tube swings around the sky; this is convenient.

First light was November 2, 1984 with observations of M31, NGC205, M15, and Jupiter. A Ronchi test on Capella revealed some spherical aberration and a turned edge. On November 4, I took it to a dark site and observed some of my favourite objects, M81 and M82, for example. I may have glimpsed NGC6207, a small galaxy 1/2° from M13. The images were brighter than with the 74mm f/12 I had been using before, but star images were not pinpoints and light was scattered over the field because of the aberrations mentioned above. The clear aperture turned out to be 81mm, as I bored the fibreglass cell (Amateur Optics) on a lathe to clean it up and maximize the use of the glass.

I have spent two weeks thinking about and doing figuring - the conclusion being that I had best return to 5 micron and grind by hand carefully to eliminate the turned edge. I suspect that the turned edge originated from "rocking effects" on the machine during fine grinding.

I will polish by hand with cerium oxide and then rouge to eliminate sleeks. Polishing by hand is probably better than by machine for a small lens. Cerium oxide polishes fast and I anticipate a good polish in an hour or two. When conditions are correct, the sound produced is like that of fine sandpaper. With no turned edge, figuring will be relatively easy.

I have glass and cells to make a 4-inch and then a 6-inch refractor. I have thought about making them both 48-inch focal length. Now I am thinking of making a 4-inch f/20 and then a 6-inch f/15. I plan to move to a dark site in 1987 and then will be able permanently to mount those planned "long eyes."

I would enjoy talking with or writing to someone interested in building refractors whether one makes or buys the objective. (You may call after 11 p.m. if you wish.)

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M33: VISUAL OBSERVATION OF SPIRAL STRUCTURE

by Larry Manuel

On the night of October 30-31, 1986, I was observing with Terry Dickinson and Mark Sorensen at Terry's home near Yarker, Ontario. I suggested that we try to see the spiral structure in the great spiral galaxy in Triangulum, Messier 33, which was near the zenith at about 10:30 p.m. Sixth magnitude stars were visible overhead, but M33 was not visible to the naked eye, although I did see it naked-eye five days later from that site.

We used Terry's 5-inch f/12 apochromatic refractor and started with a 40mm eyepiece giving 38X and a 1.7° true field. M33 was clearly visible covering about 1/2° of sky, but the spiral structure was not evident. I suggested that we not discuss which way we saw the arms curve out from the nucleus until all three of us were sure we either could or could not discern them.

Next we tried a 13mm Nagler giving 120X and a 2/3° true field. I looked several times, always throwing a sweater over my head and bunching it around the heated eyepiece to block stray light. This reduction in stray light makes for greater detail being visible in faint objects for me. The spiral structure never jumped out at me; this was a threshold object at best.

I asked Terry to explain his technique for averted vision and I found it worked well, being easier to do than the fabled "look **there** by looking everywhere but **there** technique". I slowly scanned around in the field of view, always looking slightly outside the dimmest extensions of the galaxy, letting my eye swivel in a circular fashion, stopping often (I hoped) to allow my retina/brain to integrate the light for 5 seconds or so.

I soon decided that I could see two spiral arms extending clockwise out from the nucleus, the arms about 180 degrees from each other. Three bright knots of nebulosity were visible, not all in the arms.

The three of us could see this much detail and our observed directions of the curve of the spiral arms agreed. The direction that we saw the arms curved is reversed from the true direction since we were using a mirror-type star diagonal which gives an upright image, but one that is reversed left to right.

I tried a 9mm Nagler at 170X with a 1/2° true field for the sake of experiment, but the arms were more difficult or impossible to detect. I was excited about this observation and sent a postcard to Walter Scott Houston about it. I soon received a Stellafane postcard in return, signed 'Twinky.'

The same night Mark and I were using our 80mm binoculars; his are 15X, mine 11x. I had observed the Helix Nebula, NGC7293 in Aquarius, several weeks before and wanted to show Mark where it was. We were using a large flashlight to point out deep sky objects to each other. Attached to the front is a 2-foot long cardboard tube to allow only the pencil beam of light into the sky. This is handy for naked eye work, but I also found it successful for binocular work. When I found the Helix in the 11 x 80's, it was easy to hold the binoculars in one hand, the flashlight in the other, and flash the bulb on and off, directing Mark to the Helix with his 11 x 80's. The light just about washed out the Helix completely, and only by seeing it with the bulb off could we see it with the bulb on. It occurred to me that this would be very handy for groups with binoculars or wide-field telescopes. It may also be an easy way to compare surface brightnesses of various objects, with a rheostat controlling the bulb and calibrating it on known objects. I wish I had access to a low-power He-Ne laser to try it out as a sky-pointer. Perhaps it could be attached to an equatorially driven telescope for star party work? I'm also curious if someone could try this, and see if parallax is a problem for large groups. The laser beam may be too narrow and it might work better with the beam expanded.

We observed NGC253, a large bright galaxy in Cetus, and NGC2403, a fairly bright galaxy in Camelopardalis, which is a nice binocular object, especially in 15 x 80's. M74, which is a large spiral galaxy in Pisces, fainter than M33, was easy to find in binoculars and appeared more spectacular in 15 x 80's than 11 x 80's. We had continual dewing problems with our 80mm binoculars, especially the eyepieces. Terry's 5-inch is equipped with heaters that I built on both ends of the finder, the main objective, and the eyepiece. The heaters have worked remarkably well on the 5-inch. I have built heaters for 80mm binoculars - eyepieces and objectives - and will be testing them along

with a black-cloth "monk's hood." This is attached with Velcro to the binoculars or to a telescope's finder and eyepiece at the same time.

Low Surface Brightness and Small Lenses

by Larry Manuel

On the night of November 30-31, Mark Sorensen and I observed near Yarker, Ontario. From my observing programme we set out searching for two relatively nearby galaxies. Using SkyAtlas 2000.0, 11X80- and 16X80-binoculars and LED-equipped flashlights, we searched for close to an hour without luck. When I have difficulty finding a new object, I take a quick glance at an easy familiar object (e.g. M31 or M33) to keep my observing spirit up. In desperation, Mark used a 3-inch refractor that Terry Dickinson had observed Jupiter with before we arrived. Neither of us found NGC147 and NGC185 - our goal. Later Terry brought out a 26mm Plossl eyepiece and Mark exchanged the 7mm Nagler for a wider field, lower power view. Soon Mark found the two galaxies using 35X and a 1.4° field.

At 130X and 0.6° field, it was not possible to locate these two, but once found, they stood the higher magnification well. NGC185 is noticeably brighter than NGC147, and we saw NGC185 in the 15X80's but not in the 11X80's, once we knew where to look. Both are large and faint, and hence difficult to see because of their low surface brightnesses. Terry came out later and after his eyes were dark-adapted, he saw both of them in the 3-inch.

We knew from our reading that both are distant companions of M31 and are relatively close to us. It was fun to discuss their dimness and remark that they must be small galaxies; otherwise, we would be able to see them much more clearly. All this with a 3-inch! I read later that NGC147 - in terms of intrinsic luminosity - is one of the faintest galaxies known.

Two more more galaxies that we found with the 3-inch at 35x are near M81 and M82. NGC2976 is brighter and larger than NGC3077. Neither approaches the size or brightness of M81 and M82. NGC2976 and NGC3077 are members of the M81/M82 group of galaxies, but all four will not quite fit into the low-power field. These two small galaxies were visible at 130X, but not in binoculars.

Summary

Object	Constellation	Position h m	° '	Size	Magnitude		Note*
NGC147	Cassiopeia	0 33.1	+48 31 (2000)	6.5X3.8	12.1	9.5	
NGC185	Cassiopeia	0 38.9	+48 20 (2000)	3.5X2.8	11.8	9.2	
NGC2976	Ursa Major	9 43.2	+68 08 (1950)	3.4X1.3	10.8	___	
NGC3077	Ursa Major	9 59.4	+68 58 (1950)	2.6X1.9	11.0	___	

The size is given in arc minutes according to Burnham's Celestial Handbook.
*The first Magnitude listed is that given in Burnham's Celestial Handbook.
The second Magnitude, where listed, is that given in Deep Sky magazine.

I am impressed with the performance of a small refractor for deep sky observing. One need not become discouraged by the lack of a 17.5-inch reflector and a perfectly dark site. I have since observed all four objects with the club's 10-inch reflector and found that the galaxies appear brighter, but the sky background is also brighter; so there is little net improvement in visibility. I will report further after experimenting with my own 3-inch refractors.

FOR YOUR COMPENDIUM OF ESOTERIC FACTS

Most of us have heard that enormous numbers of tiny and microscopic meteors emter the earth's atmosphere every day and are not usually noticed at all. Did you know that the number of these tiny meteors is estimated to be about **100 million per day,** most of which burn up undetected and filter down to earth as tiny dust particles. In other words, tons of such dust particles descend to the earth's surface every single day. Over time the amount becomes enormous in terms of weight and volume. Again estimates put the amount at about four million tons per year; in quantity it is enough to cover the surface of the planet to a depth of one inch over a period of five thousand years. Remember that the dust that accumulates on your car's bumper and on your bookshelves and among your astronomy magazines may be material that has fallen from the sky and may be as old as the solar system itself.

REPORTS AND OTHER ITEMS

1. Cloudy weather has again prevented much of the observation that our members did plan or could have planned over the past two months. Your editor did manage to view the Quadrantid Meteor Shower on the night of January 3-4. In the early evening the numbers were quite disappointing - a fact that could have been expected since the radiant was very low, for a certain while even below the northern horizon. After midnight the numbers picked up and many of them were fairly bright. At 2:19 a.m. local time, there was an amazingly bright fireball of magnitude between -8 and -10, and it left a wide bright trail for eight to ten seconds, at least.
   Solar observers will have noticed that the sunspot numbers have remained quite low in early January.

2. As suggested in our last issue, the decision has been taken to have one regular meeting per month - on the second Friday. The second gathering will be an observing session and will be on a Friday or Saturday night usually later in the month, and closer to the new moon. "Contact persons" for these Observing Sessions are Mark Sorensen (542-7610), Larry Manuel (544-5857), and Mark Kaye.

3. The dates for upcoming meetings are:
   February 13 Members'Night: Our Favorite Astronomy Books
   March 13
   April 10
   May 8
   June 12

   Remember all our meetings are in Room D-207 in MacIntosh-Corry Hall on the Queen's University campus, and they begin at 8:00 p.m..

4. All our members are urged to consider contributions they can make to our Astronomy Day displays and activities on Saturday May 9. At the time of this publication, we lack details about our venture for this year, but we have agreed in principle to participate in the national and international activities by amateur astronomers on that date.

5. Here is a reminder that it is certainly not too early to plan to attend this year's General Assembly of the Society which will be May 15 to 18 in Toronto.

6. Over the next two months a number of objects are worthy of our attention: (1) Venus which in its brilliance dominates the morning sky, (2) the Zodiacal Light which, over the next couple of months, will be making its appearance in the evening sky at about the time of the end of astronomical twilight, (3) the lunar occultation of the bright star Spica on the morning of February 18, and (4) the appearance of the planet Mercury in the western evening sky in early February with its greatest eastern elongation being on February 12. (Let's see how many observations of this planet we can manage at this elongation.

7. My special thanks go to Larry Manuel for his good efforts to make a contribution to our newsletter. In this issue he has provided us with no less than three interesting articles. Let's have more members following Larry's example.

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Clear skies!
Good observing!

Leo Enright