Volume 29 #6 and 7
June/July 1988

The Prairie Astronomer

The Tale of a Newsletter

by John Lortz

And so, what DID happen to last month's newsletter? I'll bet you've been wondering that for an entire month now. You've probably also been wondering if you were going to get a newsletter THIS month. Well, needless to say, it's a long and sad story. Ok, it's not so sad, except for the fact that no one got newsletters last month.

Anyway, as it happens, the week before the last meeting I was scheduled to be out of town on a project. Not wanting to shirk my duties as newsletter editor, I finished up the newsletter a week early and passed the duties of printing out the pages (and then copying the newsletter) to a trusted friend. The newsletter was passed to this friend in the form of a floppy disk, which turned out to be my first mistake.

Well, I left town with great confidence that the newsletter would be out on time with no problems. What I had not expected was that my trusted friend (who is also a computer wizz kid) has a trusted dog (in the form of a great dane) who loves floppies as much as the frisbee's she chases. I'm sure you get the picture.

Upon my return the following week, I listened with horror at what had happened to my precious newsletter, and frantically began searching for the backup. This is where mistake number two enters in. No backup!!! HA... and I'm suppose to be the director of an MIS department. Well, at that point I had two choices... reconstruct the newsletter from scratch (about 6 hours work) or combine the July newsletter with the June newsletter and throw myself on the mercy of the PAC membership. I decided to do the latter.

So, let me profusely apologize for the inconvience I have caused you and make the promise that I'll never let it happen again.... (somebody's famous last words!)

President's Message for June, 1988

by Del Motycka

A great big thanks to Dave Kiple and his "bobcat". Dave and his machine moved tons of earth and crushed rock. We leveled the area around the pedestrian access and laid the forms for the concrete slab. Steve Bornemeier, Ron Debus, Dan Neville, Dave Knisely, Ced Gibb and myself participated in this work on the morning of June 11th. While Dave and his bobcat were available, he hauled rock and earth to the location of two abandoned pipes and placed a shoulder at the edge of one of the parking lots. He really "spruced the place up" for the club. We filled the abandoned pipes with earth and rock so we can seal them with concrete at the time we pour the slab over the old pedestrian access.

On the morning of June 18th, the concrete work was complete. Dave Knisely arranged for delivery at 8 a.m. and shortly thereafter the slab was poured. We filled the two pipes with concrete and placed the excess in various other places.

My thanks to the following who helped in this work:

Dave Knisely
Ced Gibb
Steve Bornemeier
Ron Veys

Someone left a shovel at the spring cleanup. It was left with me so if it is yours, please contact me so you can get it back.

The Prairie Astronomer is published monthly by the Prairie Astronomy Club, Inc., and is free to all club members. Membership status and expiration date is listed on the mailing label. Membership dues are: Junior Members and Newsletter Only Subscribers...$8/yr; Regular Members...$22/yr; Family Memberships...$25/yr; Address all new memberships, renewals, or questions to THE PRAIRIE ASTRONOMY CLUB, INC., P.O. BOX 80553, LINCOLN, NE 68501. For other club information contact one of the following officers: Del Motycka (Pres) 489-2520, Ron Veys (V.Pres) 464-1449, Kim Ellen Owen (Sec) 423-7440, Dan Neville(Tres) 476-7772, Ron Debus (2nd V.Pres) 435-5688. All newsletter comments and articles should be sent to Newsletter Editor JOHN LORTZ, 9255 CADY AVE #14, OMAHA, NE 68134 no later than 7 days before monthly club meetings. Club meetings are held the last Tuesday of each month at Hyde Observatory in Lincoln, NE.

Observing Chairman's Report

by David Knisely

August brings the annual Prairie Astronomy Club Picnic and Star Party at Hyde Observatory on Saturday, August 13th. We will start our get together with some talk and games late in the afternoon and will begin eating at 6:00 p.m. sharp. After about 7:30 p.m., we will all head out to the Atlas site (weather permitting) for the star party and hopefully a good showing of the Persied meteor shower which will be near maximum that night.

Open clusters abound in the late summer sky, and there is no group better than M11, the Wild Duck Cluster. Visible to the naked eye under good conditions, the cluster can be found about a degree and a half west and one half south of Eta Scuti. M11 will appear as a fuzzy triangular patch with some stars mixed in when viewed in a 60mm refractor. The view in a six inch is spectacular with over 100 stars being easily seen, as well as the bright foreground star in the middle of the cluster. Larger telescopes make the cluster lose its triangular appearance and show an enormous number of very faint background stars.

For those of you who like color, take a look at the faint variable star V Aquilae. It is about half a degree east of 12 Aquilae in the south part of the constellation and shows a deep red hue when viewed in a four inch or larger instrument. This star has its deepest red color when it is near minimum.

A bit farther north in Vulpecula is the large and easy open cluster known as "Brocchi's Cluster", or "The Coathanger". It can be seen as a small fuzzy cloud with the eye, and it is best viewed in binoculars to get an idea of just what it is named for. On the east edge of the Coathanger is the challenging open cluster NGC 6802. Visible as a faint cigar shaped fuzzy patch in a six inch, the cluster does not resolve well unless 8 inch or larger apertures are used. This object breaks into several sub clusters in a 10 inch and is rather rich, although the stars are very faint. Also in the area is the Dumbell nebula, M27. This large planetary can be found about three and a third degrees north of Gamma Sagittae and is visible in binoculars, although it requires a four inch to show much of the dumbell shape. The use of nebular filters greatly improves the view, enhancing the large faint "wings" of light off the sides of the dumbell.

One of the most spectacular and yet difficult nebulae in the entire sky has got to be the Veil Nebula, NGC 6992 and

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6960. NGC 6960 runs north-south through the star 52 Cygni and can just be glimsed in a 4.25 inch RFT equipped with the OIII filter as a faint streak. An 8 inch will show it broadening on the south end without a filter, but he improvement with a filter is amazing. Much fine filametary detail becomes visible and the star no longer drowns out much of the nebula. The view in a 10 inch using the OIII filter is absolutely spectacular, showing virtually all the fine filaments and nebulosity that is shown in long exposure photographs. NGC 6992 is even more amazing. It is a huge arc that can be just seen in a pair of 10x50 binoculars about two degrees east and a half north of 52 Cygni. The view i an 8 inch is ho-hum until you put in a UHC or OIII filter. The massive arc then jumps out at you showing an incredible amount of structure even to the inexperienced eye. A 10 inch even hints at some color in the brighter filaments, but only when using the OIII filter at low power.

Another nebula that responds will to the use of nebular filters is the North American Nebula, NGC 7000. Located about three degrees east and one south of Deneb, the object is just visible as a hazy patch to the naked eye. However, put an OIII filter in a 4 inch rich-field at low power, and the North American shape becomes fairly easy to most people. Larger scopes with filters reveal detail in the nebula, but they don't have the field necessary to get a good view. A six inch RFT and the OIII seems to be the best combination to use when viewing this object.

Sky and Telescope News

From the Compuserve Info Service

JULY 15, 1988

REGULUS OCCULTATION JULY 16TH

On Saturday afternoon or evening (depending on your location), the waxing crescent Moon will occult 1.4-magnitude Regulus in Leo for observers throughout most of the United States and Canada. To find the times of disappearance and reappearance for your locality, see the diagrams on page 63 of the July SKY & TELESCOPE.

SUNSPOT GROUP RETURNS

A giant sunspot group associated with energetic flares last June 23rd and 24th has rotated back onto the Sun's visible face. The spots are not as impressive as they were before, but you can still see them with no more aid than a safe solar filter held in front of your eyes.

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JULY 8, 1988

THE YOUNG LUNAR CRESCENT

How soon after new Moon can you spot the thin lunar crescent in evening twilight? The record for the earliest naked-eye sighting is 15.4 hours. This Thursday, July 14th, you will have an opportunity to try to beat this record and also help astronomers figure out what factors are most important in determining first visibility. Find a site with a clear, flat western horizon and be there by half an hour after sunset. Scan the twilight sky a few degrees above the horizon. Binoculars may help you find the Moon, but try to spot it without them, too. Then report your viewing conditions and observations -- positive or negative -- to Moonwatch, U. S. Naval Observatory, Washington, D.C. 20392. More details and a convenient report form appear on page 34 of the July SKY & TELESCOPE.

LUNAR OCCULTATION

On Saturday, July 16th, the waxing crescent Moon will occult 1.4-magnitude Regulus in Leo for observers throughout most of the United States and Canada. To find the times of disappearance and reappearance for your location, see the diagrams on page 63 of the July S&T.

MARTIAN DUST STORM

Mars, near magnitude -1 in Aquarius, continues to make a fine sight for early morning telescopic observers. The huge dust storm seen a few weeks ago seems to have subsided or to have rotated out of view. The south polar cap is again quite prominent. A blue filter will help show clouds near the limb and in the northern hemipshere.

JULY 1, 1988

MORE ABOUT THE SUNSPOT GROUP

The giant complex is changing its appearance dramatically from day to day. Many individual sunspot umbras are crossed by bright streaks, called light bridges, and a wealth of other umbral and penumbral detail is visible telescopically. On June 30th the complex covered about 0.3% of the Sun's visible hemisphere, making it about half the size of the largest sunspot group on record. On July 1st two other sunspot groups were also visible to the unaided eye, though they were much smaller than the giant complex. (Remember to observe safely!)

Despite its imposing appearance, the giant complex has yet to produce any major solar flares that might cause auroral displays. Giant spot groups tend to be most frequent before sunspot maximum is reached.

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JUNE 29, 1988

SUPER SUNSPOT GROUP

An enormous naked-eye sunspot group now graces the Sun's visible hemisphere. Joe Rao of New York City's CompuWeather reports that he first saw it rounding the Sun's limb last Saturday. Today it is roughly halfway to the center of the disk. Our own Alan MacRobert says the group appeared elongated, and possible double, when he observed it on Tuesday the 28th. Be sure to use a safe solar filter if you look for the spot yourself, whether or not you use a telesope.

In yet another sign of very high solar activity, a major flare erupted at 7:30 Universal time today. Although the Moon is near full this week, you might want to look every evening for an aurora. It normally occurs at arctic and antarctic latitudes, but intense solar activity can cause displays across the northern United States.

JUNE 24, 1988

AURORA ALERT!

Shortly after noon on June 23rd, S&T's Steve O'Meara noticed an enormous naked-eye sunspot group near the limb at around the 5 o'clock position. The Space Environment Lab in Boulder, Colorado, reports that at 9 hours Universal time the same day a major flare erupted near the center of the solar disk. Then, at 16 hours UT on the 24th, a strong X-ray event occurred in the southwestern part of the disk. This all suggests that observers in mid-northern latitudes should look for an aurora when darkness falls each night this wekend.

MARTIAN DUST STORM

A major dust storm continues to rage on the planet Mars, now well positioned for telescopic observation in Aquarius in the predawn sky. IAU Circular 4617 reports that on June 18th the yellowish haze was centered at longitude 260 degrees, latitude -50 degrees. Today the storm stretches more than 8,000 kilometers across the red planet's Earth-facing southern hemisphere. Currently Mars shines at magnitude -0.7 and presents a disk nearly 13 arc seconds across.

CH CYGNI

This variable star, well known for its erratic behavior, is acting up again. Located just beyond the Swan's northwest wing tip, this semiregular variable normally ranges between magnitude 6-1/2 and 8-1/2. But Peter Garnavich of the University of Washington and Janet Mattei of the American Association of Variable Star Observers report it has faded to a level not seen since records began to be kept for it in 1926. In early February the star was 8th magnitude, but by the end of May it had dimmed to nearly 9th. A finder chart for this star

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was printed in SKY & TELESCOPE for July, 1986, page 57.

MARTIAN DUST STORM

A major dust storm has flared up on Mars. Kermit Rhea of Arkansas first detected the yellow cloud on June 13th in Hellas. Jeff Beish and Don Parker of Florida independently discovered it the next morning. By the 15th Parker found the storm peanut-shaped with two brilliant cloud centers. On the 16th dust sliced across Tyrrhenium Mare, Hesperia, and Cimmerium Mare. The cloud cast a noticeable shadow, evidence of its great height. Although this region around central meridian 280 degrees is rotating off the limb for Western observers, the entire limb can be seen glazed yellow. Meanwhile, Eastern Hemisphere observers have been notified of the storm, and will let us know if it threatens to engulf the entire red planet.

Flights of the Phoenix

(or the Genealogy of a Telescope)

by Steve Dodson

This is the story of four telescopes built over a period of ten years, each new one fathered in some sense by the one before. It is a story stretching across a continent and an ocean, bringing together materials, ideas, and skills from far-flung places. In telling the story I also hope to give you some ideas that might be useful to you.

The story begins, appropriately, with telescope maker extroardinaire John Dobson, whose acquaintance we renewed on-line a few weeks ago when I reported here on his address to the Stellafane Conference. At that time John explained that he invented the famous large-aperture scopes and founded the San Francisco Sidewalk Astronomers in order to make the universe as visible as possible to the greatest possible number of this Earth's citizens. During the Sidewalk Astronomers National Parks tours the famous 24-inch "Delphinium" (so named because it had mauve flowers painted on it) stood head and shoulders above the scopes around it, both in terms of its size and in terms of the ease with which it rendered faint details such as wispy galactic spiral arms visible to untrained eyes. Its 13 foot focal length made possible the superb views which made the climb up the tall side-braced ladder worthwhile to hundreds of thousands of people over the scope's distinguished career. The 24 will be out on tour again next summer with a new 24-inch mirror John made this summer.

In the shadow of Delphinium stood the 18-inch "Little One", and a variety of smaller scopes. Then in 1978 these scopes were joined by a new 22-inch reflector belonging to Gerard Pardeil-

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han, a young man who learned the art of mirror-making from John Dobson and went on to become a professional optician working on exotic massive lenses and mirrors. He has also served the public as president of the San Francisco Sidewalk Astronomers during most of the 80's.

John and Gerard made the 22-inch mirror from a thin (1 5\16-inch thick) pyrex blank. In order to figure the mirror (obtain an accurate parabolic surface) they built the tube assembly and hauled it up the stairs to Gerard's apartment. To picture this you have to imagine a piece of heavy artillery capable of nearly blocking-off the staircase. The average land-lord might be a bit disconcerted! With the front of the tube up against the window at the far end of his apartment Gerard could barely get his door closed.

The unsilvered mirror was placed in its cell and the telescope was focussed on a distant insulator on a telephone pole. The point-like glint of sunlight on the glazing of the insulator worked like an artificial star so that the mirror's curve could be "read" by studying star images just inside and outside the focal point. Of course you couldn't do this through just any window. But then again Gerard's window wasn't ordinary! John and Gerard had already salvaged a piece of parallel polished plate glass from a broken store display window and fitted it to Gerard's window frame. This kind of glass, which used to be common, is far better optically than window glass or even the newer "float" glass. In fact the Sidewalk Astronomers use it for the optical windows at the front of their Sun Scopes (Described by John Dobson in his Stellafane talk as reported here). The only way to get parallel polished plate is to check-out broken store windows by observing the reflections of straight vertical lines such as the edges of buildings across the street. The reflections from the front and back surfaces of the glass should each be straight and they must remain parallel to each other as you move your head from side-to-side. If they do make sure you are there when the glass company removes the glass and take all you can even if you don't plan on replacing your window glasses!

Gerard's scope was soon a strong performer on Sidewalk Astronomer's tours. At a long f/7.3 (focal length 7.3 times the mirror's diameter) this telescope stood as tall as the 24-inch Delphinium. Thus Gerard christened it "long Eye". As in the case of the biggest Sidewalk Astronomer's instruments the mirror and optics travelled inside the vehicle which towed a trailer bearing the mounting. Photos of both instruments can be seen accompanying John's article in April 1980 Sky and Telescope.

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On one of the early trips with the 22-inch Long Eye's trailer tongue sheared off and Gerard watched with unbelieving eyes glued to the rear view mirror as the scope careened on its own down the interstate and off into the ditch. He was so shocked John had to ask him to pull over and stop. He thought it was all over. But John is a very energetic, persuasive person, and occasionally a bit stubborn when it comes to something important like a big telescope. Of course the optical components were still safe in the vehicle. They picked up the pieces, and in a few days the scope had been rebuilt.

Gerard called the new 22-inch scope the Phoenix, after the mythological bird that was reborn, rising from its own ashes. The Phoenix provided "voyager-like" views of Jupiter and Saturn from the rim of Grand Canyon and other National Parks.

Around the time that the Phoenix rose from the "ashes" of Long Eye other telescope makers around the world were beginning to try out a revolutionary tracking device invented by the Frenchman Adrien Poncet (See Sky and Telescope February 1980 page 163). This remarkably simple "equatorial table" or "Poncet platform" could be slipped under a camera or an altazimuth-mounted telescope to make it track the stars just as if it were on an equatorial mounting.

Having followed these developments a BIG question came to me in the Fall of 1980. See the question and my answer next week!

GENEALOGY OF A TELESCOPE, PART 2 Steve Dodson

As described last week two major telescope-making developments of the sixties and seventies were becoming widely noticed in 1980. John Dobson's giant large-aperture scopes were becoming recognized for their unparalleled views of faint deep-sky objects, and a variety of non-equatorial instruments were tracking the stars on Poncet platforms.

Could these two developments be merged? Could a full-scale Dobsonian Telescope be given sidereal tracking ability on a Poncet platform? If so why was there no published photo of a scope of greater aperture than 10 inches mounted in this manner?

I studied these questions in detail and it seemed that part of the answer to this last question was a centre of gravity problem. Although the Poncet table has no visible polar axis it is supported under its southern edge by a pivot and rotates about an axis through this pivot.

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The axis of rotation is a polar axis because it is perpendicular to the inclined plane at the other end of the table, which is orientated to face the celestial pole. The centre of gravity of the typical Poncet-mounted telescope lies well above the axis of rotation of the platform, and hence the arrangement is inherently unstable. Add this to the fact that the Dobsonian rocker base or fork is designed from the beginning to remain vertical and you are inviting serious problems with flexure and instability.

Up to a certain size this combination would work but a "full-sized" Dobsonian on a standard Poncet platform would be unmanageable and probably dangerous, capable of falling over on top of the line of enthusiasts waiting to look! No wonder this approach has never been seen applied to a longer scope than the 79-inch focal length Odyssey 17 1/2.

In the Fall of 1980 I figure out a way to modify both the Dobsonian mount and the Poncet platform to produce a stable combination. My solution also allowed a lowering of the centre of gravity and integration of the mounting base with road gear for a very stable towing configuration (See Sky and Telescope August 1984 or TM #14). No such heavy work as lifting telescope mountings or tubes off a trailer would be necessary, and preparation of the telescope at the observing site could be done by one person. The Poncet platform now looked like a large ring which doubled as an azimuth bearing. After I had made some sketches of this arrangement a feeling of amazement hit me. Why hadn't anybody done this yet??

After puzzling over this for a while it hit me that I should decide to be the one to do it! Since I wanted to test the concept in minimum time, the first step would be to buy a mirror large enough to demonstrate the strengths of my design. I new it would have to be bigger than the Odyssey. I placed an ad in Sky and Telescope which appeared in the December 1980 issue.

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Early in December I came home late after a meeting and my wife greeted me with the news that a young man from Berkeley California had phoned in response to my ad. Gerard Pardeilhan! I knew him! I had recently re-read John Dobson's article and had seen the photo of Gerard and the 22-inch mirror. This indeed was the mirror Gerard offered to sell me. I was thrilled. I told him I was hoping one of the Sidewalk Astronomers would see my ad. Twenty-two inches of aperture and 13 feet of focal length were more than I had planned on, but we soon made a deal. This would certainly be a big enough scope to test my concept!

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Now that I was committed to go ahead I made a scale model which made more exact planing possible and verified that my design worked in 3 dimensions as well as two. The model checked out so well that I became very enthusiastic about getting under way. Good thing, because every free moment during the next 7 months would have to be devoted to strenuous construction efforts in order to have a finished scope in time for Stellafane 1981. By mid-January, in spite of the Northern Ontario Winter the front porch of my home began to fill up with wood, sawdust, and finished pieces.

By happy coincidence the laboratory where I taught grade ten science the year before lay vacant due to declining enrollments. It had a 14 foot-long counter that was perfect for building my tube assembly. Students helped me carry a 12 foot long 30 inch diameter 80 pound sonotube up the stairs to the classroom. Three months later the tube was 14 feet long, 270 pounds heavier, and fully painted and fibreglassed on the inside. It was very strong at the attachment points for the altitude bearings and mirror cell and had a low centre of gravity because of the laminated wood structure I had built inside the lower third of the sonotube and extending beyond it.

The tube could not be carried back down the stairs it had come up! By another happy coincidence the president of the Ontario Rock Climbers Association was the Chemistry teacher across the hall. He and his climbing club lowered my telescope down three stories from the roof outside the window of the classroom where I had worked. There was a heart-stopping moment between when we pushed the tube over the edge and when the ropes became fully tensioned. The rest of the assembly in my back yard was arduous but less eventful. A couple of weeks after this dramatic move workmen came and tore out the counter where I had worked, converting the lab to a computer room. How lucky I had been! I was lucky a third time when I found that the steel infra-structure of my mounting and roadgear could be built in the school welding shop as part of class projects. I paid only for materials and the students got to participate in an unusual project! The telescope saw first light about 50 hours before I had to begin the trek to Stellafane, where it won two prizes. The mounting succeeded so well it almost begged to take on an even bigger scope!...About which more next week.

GENEALOGY OF A TELESCOPE -- PART III Steve Dodson

By the time Stellafane 1981 arrived the 22-inch reflector was in its third life. Gerard Pardeilhan had called it "The Phoenix" when he rebuilt it after all but the optics had been virtually destroyed. I

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called my mobile Poncet-Dobsonian hybrid incorporating Gerard's mirror "Phoenix II"!

Just as I was finishing setting up Phoenix II at Stellafane I was thrilled to the famous deep-sky authority Walter Scott Houston strolling up Breezy Hill in my direction, attracted by the sight of my orange-trimmed blue tube, which stood vertically with its 16-foot high top end cutting into the beautiful blue sky. He had the trademark curved pipe clenched between his teeth. Arriving beside the 7 1/2-foot diameter equatorial base ring he took the pipe into his hand, walked around the instrument looking upwards and saying "Wonderful, wonderful....Just beautiful..." What better welcome could a newcomer to Stellafane hope for?

When I returned to the hill after setting-up my camp I noticed a small sign made with a felt-tip marker displayed on Phoenix II:

AT 3:30 PM THIS "DEVICE" WILL LAUNCH A LIVE DOG INTO EARTH ORBIT. PERIOD 96 MIN THE DOG'S BARKS CAN BE HEARD ON 96.071 MHZ FM. (Three Toed Pete)

As noted on page 566 of Sky and Telescope for May 1987 Walter Scott Houston has many nick-names, including "Scotty" and "Three-Toed Pete"! I am still saving the sign as a Houston souvenir.

The next day the hill was full of telescopes and Stellafane was at full buzz. Often on sunny Stellafane Saturdays participants will notice an airplane or two full of sight-seers buzzing Breezy Hill. This time a small single-engine high-wing plane was circling the hill with the engine throttled back. I decided to see if the pilot would notice me! I grabbed the lower end of Phoenix II's tube and swung it around, then raised it up like an anti-aircraft cannon to point directly at the plane. It leveled out, roared to life at full throttle, and disappeared into the distance!

Over the next five years thousands of people looked through Phoenix II at dozens of sites throughout Northeastern North America. On October 11 we had the first public viewing of Halley's Comet through Phoenix II at a conservation area near home base in Sudbury Ontario.

By then I had acquired a 29-inch pyrex blank from Coulter. In fact the 8-meter-radius spherical shape was rough-ground into the pyrex to within 5 inches of the edge. This piece of glass will eventually displace the 22-inch from its place on the mobile mounting of Phoenix II. Of course I will have to find a new name for this fourth telescope in the "dynasty".

The new scope will be quite unusual in its combination of size, sidereal track-

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ing, and one-man mobility.

The 29-inch glass lay unworked for over a year until a very special visitor arrived at Science North, the public hands-on Science activity centre where I coordinate Physics and Astronomy programing and exhibits. The visitor was John Dobson, who drove through the night with me and Phoenix II in tow to get to Sudbury from Hamilton Ontario, where John had addressed a Physics Teacher's Convention and I had set-up a star-party for the participants. John laid eye on the big pyrex disc and said "we've got to get busy and start grinding!"

By the next afternoon we had acquired a custom-cut 29-inch by 1-inch thick steel plate and some coarse white silica abrasive from a terrazzo company. Under John's direction we set-up shop outdoors on a strong backless bench and began to grind the back of the blank flat against the steel plate. John did the first wet by himself! It was quite a sight seeing one person heaving 100 pounds of glass back and forth on top of a steel plate. It was quite difficult too because the original pyrex sheet had surface ripples up to 1/8-inch deep. There was a raise lip starting 3 inches from the edge that went "clunk" when it hit the edge of the steel tool.

The next day we got some better coarse abrasive from a tomb-stone artist, and finished grinding the lip off. Then it was time to start grinding the curve. After three days of hard work the front of the mirror was in good contact with the glass and we expected that the curve would soon be evident. However John has to continue his odyssey and I drove him to the David Dunlap Observatory, which was an interesting half-way point at which to meet his next host-driver. We had a nice tour of the beautiful 74-inch reflector.

Before the Sudbury TM enthusiasts and myself had ground on much further on our own we realized that the steel plate, unlike a glass, ceramic, or even a cast-iron tool, was wearing down as fast at the centre as at the edge. It was simply too tough to develop a curve in the normal way. That meant that before the mirror acquired a deep enough curve it would have lost a lot of thickness at the edge as well (It was 1 7/8-inch thick at the edge when received).

Fortunately the shops of the nearby nickel giant INCO, who provided the steel disc, were ready to help us out again.

(NEXT MONTH: Progress on the 29 inch mirror to date)

The Reviewer

by David Knisely

CHALLENGER: The Final Voyage

by Richard S. Lewis
Columbia University Press

After the horror of Americas first space disaster, after the hearings and the publicity, there finally comes a down-to-earth book that deals with the final flight of the orbiter Challenger. "CHALLENGER: The Final Voyage" is a well written account that fills the gaps left by the news media while at the same time leaving out much of the technical excess baggage that appears in the Rodgers Commission Report.

Beginning with an account of the flight, Richard Lewis tells of the hopeful mission that Challenger was to undertake and profiles its crew. Lewis then gives the reader the chance to listen in on the crew via the written transcripts from the flight recorders as they enter the orbiter to prepare for launch. The talk between crewmembers was upbeat as they joked ironically about the ice on the pad and the cold weather. You "hear" them complain about how long they have been sitting on their backs, and you fell their excitement as the main engines ignite and send them flying off toward their destiny. And lastly, you hear the "uh ohh" that pilot Michael Smith utters as Challenger begins to disintegrate high over the Atlantic. Included with the account are the pictures taken by the ground cameras of the infamous black smoke comming from the side of the right booster, as well as the shots of the jet of flame that later pierced the external tank and caused the explosion. Two pictures of the falling debris clearly show the nose section of the orbiter tumbling down towards its fatal impact in the ocean.

The reaction from the families and the country is covered well, along with an interesting account of the lost feeling of those who had launched Challenger and now could find no apparent reason for its demise. The the book shifts into the

salvage efforts with a bit too extensive account of the equipment used in the search for the remains. It does a good job of showing how NASA began its own investigation only to be pushed into a secondary role by the formation of the Rogers Commission. The hearings are covered well, especially those concerning the solid rocket boosters and the infamous "O" rings. The recovery of the crew compartment and the "smoking gun" portion of the right booster are presented in high detail, along with some interesting discussion of how long the crew remained alive after Challenger broke up. The pressure to launch, the memos, the missed communication, and the final results are well covered, portraying NASA as a confused and budget-pressured agency that may only now be coming back to what it once was. In short, this book is an excellent account for those who really want to know just what happened to the Challenger and why.

How To Support a Telescope Mirror

by Steve Dodson

Imagine an empty telescope tube and a fine straight line passing directly down it's centre (the tube axis). For simplicity let's assume that the optical axis o#!e telescope will lie along the tube axis. Now imagine a parabolic curve cutting across the tube axis near its lower end, its own axis exactly aligned with the tube axis. In your mind rotate the parabolic curve about the tube axis and you will have a perfectly aligned "ideal" paraboloidal surface.

For excellent telescope performance we want the reflecting surface of our mirror to lie precisely along this imaginary "ideal" paraboloidal surface. Any deformation of the mirror's surface away from the ideal paraboloid should be a very small fraction of a wavelength (1/8 or less) since reflection makes each error count twice. Here we are talking about precision levels amounting to a couple of millionths of an inch or so. Any tilt of the mirror's axis away from the optical axis of the telescope should be less than a tenth of a degree for long-focus mirrors and even smaller for faster systems.

Obviously mirror positioning and supporting system for a high performance reflecting telescope has to hold the mirror precisely in position without forcing it in any way that would distort its shape.

The magnitude of the problem can be visualized by seeing the mirror disc as mechanically resembling a disc cut out of a foam mattress! When bends and bumps on the order of small fractions of a wavelength of light are important glass behaves exactly like that. If you can design a support system that doesn't allow a floppy mattress disc to flop visibly out of shape you probably have a good mirror support system.

In the past a common approach has been to make the mirror so thick that it had enough rigidity to cover-up the sins of the support system. Mirrors up to 12 1/2 inches in diameter with thicknesses equal to at least 1/6th of the diameter can safely be mounted in a simple manner. But lighter mirrors have been increasingly in favour. Consider the example of the 5 meter mirror of the Hale Telescope at Mount Palomar, and the sophisticated support system that was employed to allow the glass to be

lightened. If the mirror disc were solid glass 5/6 of a meter thick it would have weighed well over 30 tons, and even a simply support system would have contributed significantly to a snowballing escalation of the overall weight of the telescope and mounting.

Continuing the analysis started above a mirror support system must perform the following functions:

A) It must keep the centre of the mirror from moving off the optical axis of the telescope. RADIAL OR EDGE SUPPORT takes care of this.

B) It must keep the reflecting surface from moving up or down the tube axis. BACK SUPPORT (Also called SUSPENSION) takes care of this.

C) It must keep the reflecting surface squared-on to the optical axis. BACK SUPPORT takes care of this too.

D) It must do all the above WITHOUT creating enough unequal pressure on the mirror to distort it! (Remember the foam disc!)

(continued next month....)

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