the focal point

Monthly Notices of the Atlanta Astronomy Club, Inc.

FROM:
Leonard B. Abbey, Editor
1002 Citadel Drive
Atlanta, Georgia 30324

The Atlanta Astronomy Club Inc., the South's largest and oldest astronomical society, meets at 8:00 p.m. on the third Friday of each month at Agnes Scott College's Bradley Observatory. Occasional meetings are held at other locations (check the hot line for details). Membership is open to all. Annual dues are $20 ($10 for students). Discounted subscriptions to *Astronomy* ($18), and *Sky & Telescope* ($20) magazines are available. Send dues to: **Clay McHann, Treasurer, 3450 Jones Mill Rd., #708, Norcross, Ga. 30092**

Hot Line: Timely information on the night sky and astronomy in the Atlanta area is available on a twenty-four hour basis on the Atlanta Astronomy Club hot line: 621-2661.

BBS: The Atlanta Astronomy Club operates a computer bulletin board at 455-3089. The BBS, which is free and open to the public, provides contact with both amateur and professional astronomers around the world.

First Class

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W. Tom Buchanan
105 Carriage Station Circle
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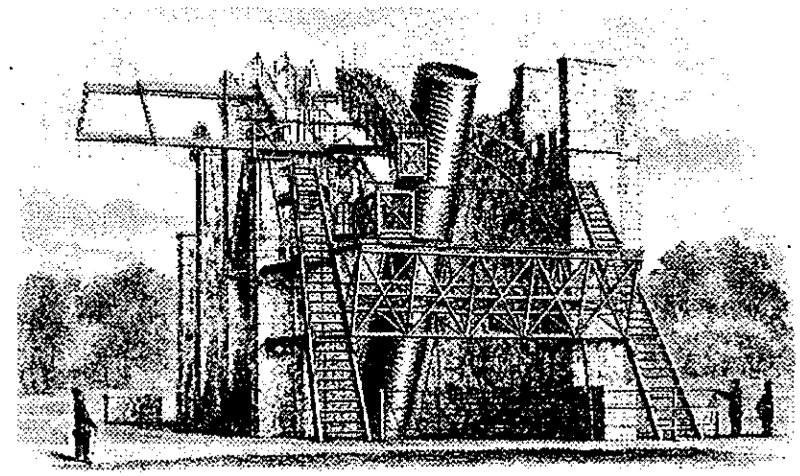

Why is this telescope famous?
See page 11

IN THIS ISSUE

NEXT MEETING – JANUARY 21

NOTICE ON PAGE 17

COLOR IMAGING WITH A CCD CAMERA
A PROJECT FOR AMATEURS

by Dominique Beauchamp, Quebec

For a number of years now, CCD imaging has been both a growing new hobby and a real challenge for amateur astronomers. This technology has long been reserved for professional use but now CCD devices are available at a reasonable cost.

Recording and keeping data objectively is very important in science, especially at the amateur level. Drawing is a subjective way to record data and it has been the only one for available for millennia. By about the end of the last century photography enabled us to keep objective records, but photographic emulsions are not very sensitive (astronomically speaking) and it is necessary to handle toxic chemicals for many hours in the darkroom in order to obtain good results. Now, with the advent of computers and the electronic detector known as the CCD, the recording and analysing data has become a simple task, even for the amateur. In this article, I would like to introduce to you a new way to use the CCD: colour imaging.

> *CCD's are like our eyes, they detect light over the entire spectrum...*

The CCD (charge-coupled device) is an array of photodetectors, each of which produces one pixel (picture element). Many of you might have heard about the pixels on computer monitors. For example, a VGA screen has a resolution of 640 X 480 pixels. That means there are 640 pixels horizontally and 480 vertically for a total of 307,200 pixels. Each of them can be set to a different intensity and colour to produce a pattern over the entire screen.

Now, let us imagine the opposite: take an array of pixels which is detecting light rather than producing it. When we place this array at the focus of a telescope, where the image is produced, the array will actually respond to the light of this image! The intensity of the light falling on each pixel will be transduced by the electronics (a preamplifier and an analog-to-digital converter) into values which will be stored in the computer's memory. The astronomer will then be able to manipulate and display the image on the screen.

CCD's are like our eyes. they detect light over the entire spectrum. So when we take pictures without using filters, we get a kind of "white light" image which is composed of all the wavelengths. It is comparable photography with black and white film. If we want to separate the colours and analyse the structure of an object by comparing the different images (as we do unconsciously with our eyes), we need to analyse many images taken through different filters in order to isolate the various wavelengths.

Our eyes have cones that detect red, green and blue light (the colours which make up the so-called "RGB" set). There are three primary colours because our eyes have three kinds of cones which detect light in these three colours. So, to render an image with its true colours, we have to combine red, green and blue images. Dogs, like many other animals, have only one kind of cone; so, they would be satisfied with any black and white picture!

Colour films have three layers of a light-sensitive compound to detect the three primary colours. Even TV-CCD cameras have three kinds of pixels to detect those wavelengths. But in CCD

WHAT'S UP

Date	SUN Rise	SUN Azi	SUN Set	SUN Azi	MOON Rise	MOON Azi	MOON Set	MOON Azi	Age
1/15/94	7:42	115.0	17:52	245.0	9:42	94.5	21:49	268.3	4.1
1/16/94	7:42	114.8	17:53	245.2	10:12	88.9	22:44	273.8	5.0
1/17/94	7:42	114.5	17:54	245.5	10:42	83.6	23:38	279.1	5.9
1/18/94	7:42	114.3	17:55	245.7	11:13	78.5	-----	-----	6.8
1/19/94	7:41	114.0	17:56	246.0	11:45	74.0	0:32	284.0	7.7
1/20/94	7:41	113.8	17:56	246.2	12:20	70.0	1:27	288.3	8.6
1/21/94	7:40	113.5	17:57	246.5	12:59	66.9	2:22	291.9	9.5
1/22/94	7:40	113.2	17:58	246.8	13:43	64.8	3:17	294.5	10.4
1/23/94	7:40	112.9	17:59	247.1	14:32	63.9	4:11	295.9	11.4
1/24/94	7:39	112.6	18:00	247.4	15:26	64.6	5:03	295.9	12.4
1/25/94	7:39	112.3	18:01	247.7	16:26	66.7	5:53	294.4	13.4
1/26/94	7:38	112.0	18:02	248.0	17:29	70.4	6:39	291.4	14.4
1/27/94	7:37	111.7	18:03	248.3	18:35	75.3	7:21	287.0	15.5
1/28/94	7:37	111.4	18:04	248.6	19:41	81.2	8:01	281.5	16.5
1/29/94	7:36	111.1	18:05	249.0	20:48	87.6	8:39	275.5	17.6
1/30/94	7:36	110.7	18:06	249.3	21:54	94.2	9:15	269.0	18.7
1/31/94	7:35	110.4	18:07	249.7	23:01	100.7	9:52	262.7	19.8
2/1/94	7:34	110.1	18:08	250.0	-----	-----	10:31	256.7	20.9
2/2/94	7:34	109.7	18:09	250.4	0:08	106.3	11:12	251.5	22.0
2/3/94	7:33	109.3	18:10	250.7	1:14	110.9	11:57	247.5	23.1
2/4/94	7:32	109.0	18:11	251.1	2:19	114.2	12:47	244.9	24.1
2/5/94	7:31	108.6	18:12	251.5	3:20	115.9	13:42	244.0	25.2
2/6/94	7:30	108.2	18:13	251.8	4:17	115.8	14:40	244.7	26.2
2/7/94	7:30	107.9	18:14	252.2	5:08	114.1	15:40	247.0	27.2
2/8/94	7:29	107.5	18:15	252.6	5:53	111.1	16:41	250.6	28.2
2/9/94	7:28	107.1	18:16	253.0	6:33	107.0	17:41	255.1	29.1
2/10/94	7:27	106.7	18:17	253.4	7:08	102.1	18:40	260.3	0.6
2/11/94	7:26	106.3	18:18	253.8	7:41	96.9	19:37	265.8	1.5
2/12/94	7:25	105.9	18:19	254.2	8:12	91.3	20:33	271.4	2.4
2/13/94	7:24	105.5	18:20	254.6	8:42	86.0	21:27	276.8	3.3
2/14/94	7:23	105.1	18:21	255.0	9:13	80.8	22:22	281.8	4.2
2/15/94	7:22	104.7	18:22	255.4	9:44	76.1	23:16	286.3	5.1

OFFICERS AND OTHER DIGNITARIES

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First Vice-President: (Program)	Hal Crawford	242-9995
Second Vice-President: (Observing)	Alex Langoussis	429-8384
Recording Secretary:	Terry McHann	441-9097
Corresponding Secretary:	Leonard Abbey	634-1222
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Facilities	Leonard Abbey	634-1222
Light Pollution:	Tom Buchanan	587-0774
Membership:	Terry McHann	441-9097

OBSERVATORY REPORT

by Alex Langoussis

This month the heavens provide us with a reminder: Enjoying astronomy and making valuable observations do not always require huge telescopes or lots of gizmos. On Dec. 7, Kazoyoshi Kanatsu discovered Nova Cassiopeiae 1993. What did he use?: an f/2.8 55-mm lens and some T-Max 400 film!

Located near the prominent "W" in our northern sky ($23^h 42^m$, +57° 31'), Nova Cas was an 18th magnitude star. Four days after discovery, it had brightened to magnitude 6.5, then remained at just below naked-eye visibility for almost a week. On the night of Dec. 16th, when I viewed the nova at 10 p.m., it was still at magnitude 6.3. It's too bad I didn't check it one more time that evening. In the next 2 hours it quickly brightened to magnitude 5.3, an easy naked-eye object! Since then, its brightness has varied dramatically, dropping to near 8th magnitude, and now brightening again to magnitude 6.5. This is a very easy object to find in binoculars, especially being in Cassiopeia high in the northern sky. Go out on your back porch and take a look to see what it's doing at this particular hour!

A note to readers who have access to a computer and modem at work or at home: The news of this discovery was posted on this club's BBS less than 24 hours after it was announced to the world. A finder chart is also available there. This is a fast, easy, and fun way to get late-breaking astronomical news. It pays to log on from time to time!

OUR NEXT OBSERVING SESSION AT VILLA RICA WILL BE SATURDAY, JAN. 8. The following Saturday, the moon will set by 10 p.m. Thus, the 15th should be an excellent observing night for those among us who enjoy several hours of observing before a Waffle House breakfast!

OUR FEBRUARY OBSERVING NIGHT WILL BE ON THE 12TH, and will feature Jerry Armstrong, Tim Puckett and their CCD equipment. Please join us on these evenings to enjoy the wonders of the winter sky. For additional information, call 429-8384.

YOUR EXPIRATION DATE

Remember....the date of your last membership renewal appears at the upper right corner of your mailing label. Add one year to this date to get your expiration date. This date will be highlighted in color for those members who are past due.

COMING ATTRACTIONS

In February, Dr. Hal McAlister, director of the Center for High Resolution Astronomy (CHARA) at Georgia State University will speak.

We also look forward to hearing Dr. Ron Tilford, noted Atlanta ophthalmologist, who will describe the effects of the eye's anatomy on what and how we see through telescopes.

astronomy, if we want to separate colours, we have to split the image in time rather than in space. What I mean is that we can't use a "normal" colour CCD detector because its poor resolving power degraded the image to an unacceptable level (in colour CCD, pixels must be three times larger in order to enclose a red, green and blue detector). We will have to take three pictures through the three primary colour filters and combine them later on a computer. Fortunately, computers are very good at this.

For several reasons, we have chosen M57, the Ring Nebula, as our target. First, it is well located in the summer sky (in the last week of June). Second, its size fits well in our CCD's field (we have used a SBIG-ST4 from Santa Barbara Instrument Group which covers 4' X 4' with our telescope). Third, M57 has nice colours which can be well separated with filters. Fourth, we had a comparison image [1]. And finally, M57 is a planetary nebula and such objects don't emit too much infrared. CCD's are very sensitive to IR and those wavelengths are not blocked by our filters. If we had chosen another type of object, perhaps a galaxy, the colour balance would have been distorted, (notice that on our image, the stars are deep red because they are strong IR emitters).

For the actual exposures, we need a good telescope with a steady mount and an accurate tracking system. Any telescope which is good for photography is fine for CCD work. However, there is one problem you may encounter with a Schimdt-Cassegrain: while focusing, the primary mirror moves enough to shift the object out of the CCD's tiny field of view! So, rack-and-pinion focusers are best!

The filters we used are the standard Wratten W25 (red), W58 (green) and W38A (blue). We knew that the CCD would be more sensitive in the red so we took only 4 images in red light. Each image is an exposure of 90 seconds. For the green and blue images, we took 6 images through each filter, each 90 seconds long, in order to get a good signal. An image was taken with a cap on the CCD opening. This image is the "dark frame" which is used to correct the real images for the thermal noise.

Figures 1 to 3 show the three images taken trough the different filters. Each has been enhanced with a gamma correction of 1.35. This increases the contrast, so that the fainter features easier to see. Notice that the red image is brighter than the others. An interesting feature is the central star which is relatively bright in the blue image because it is a white dwarf.

At the computer, we subtracted the dark frame from each image, and then registered and combined all images of the same colour. This was done with an image processing program named "TIAstro" which should be available as a shareware for English speaking users sometime in August 1993. (only the French version was available when these lines were written in July).

Once we had the three images, one red, one green and one blue, we registered them together. But we had an unexpected problem. Because we had to remove the CCD from the eyepiece holder in order to change the filter, there was a slight field rotation and we had to "derotate" our images. This was not easy, because we had to locate the centre of rotation and the program we were using (PhotoStyler for Windows), only allowed rotation in integral degrees. However, we did achieve satisfying results!

The images were then combined into a RGB true-colour image. We used a calibration curve to reproduce the response of the CCD. For this we used the ratio 1 : 1.5 : 4 (R, G, B) as suggested in *Sky & Telescope* but our technique will be more accurate in the future. We plan to determine our own calibration factors by taking exposures of a neutral gray card (as suggested in the article). Thus we will be able to maintain an accurate color balance by of controlling the exposure instead of by varying the number of superimposed images. But this us our first try, and we wanted to save some of the fun for our next session!

first try, and we wanted to save some of the fun for our next session!

We now have a full-colour image of M57 (see Figure). What useful information can we derive from it? First of all, an RGB image is a wonder to behold and that is sufficient reward for the amateur exploring the beauty of the universe. But we can use the image for scientific investigation too. The colours are related to the composition of the gas, the pressure, the temperature and other physical parameters in the nebula.

For example, if the colours in our image were well-calibrated, the nebula would appear greenish, the clue of the presence of doubly ionized oxygen, [O III] (O I is oxygen in fundamental state, i.e. with all its electrons. O II is singly ionized oxygen, i.e. oxygen atoms which have lost one electron, and so on. The brackets mean that this is a "forbidden" line, i.e. impossible to produce in laboratory.). Red colour indicates the presence of hydrogen (H alpha). (Photographic pictures make this nebula appear red because colour photographic emulsions seem to be more sensitive to red.)

Colour imaging is a kind of extremely low-resolution spectroscopy. With a spectrograph, one can separate the spectrum down to images which are only a few angstroms wide; with CCD imaging, we separate the spectrum into images many hundreds of angstroms wide. The two little blue dots in the lower left part of the image are due to bad registration. They correspond to the nearest star which should be whiter than it appears.

Of course, the colour CCD images are not as powerful as the spectroscope in determining the physical characteristics of a nebula. But it is within the reach of a large number of amateur astronomers. And it is far from boring!

Few amateurs have tried this new hobby. We, in Quebec City, are still beginners. In the future we will try to use an IR-blocking filter and a better software

M57 B/W Version of
Color CCD Image

to do the data reduction and registration. After that, we plan to extend our exploration to other types of objects: clusters, galaxies and why not quasars? Isn't the universe infinite?

I strongly suggest to all CCD camera owners to try colour imaging. Obtaining really good pictures is a challenging and rewarding experience.

[1] diCicco, Dennis, "The Universe in Color", *Sky & Telescope*, vol. 85, no. 5, p.34

Dominique Beauchamp is a member of the Groupe d'observateurs of the Societe Royale d'Astronomie du Canada, Centre de Quebec. Dominique is currently doing Ph.D. research on spiral galaxies. He says that in spite of his professional activities, he still loves AMATEUR astronomy!

WE MEANT TO SAY....

Last month's excellent by Carolyn Collins Petersen on the inner workings of planetariums is copyrighted by Carolyn Collins Petersen. It first appeared on CompuServe Information Service.

AAC ACTIVITIES

OCTOBER MEETING

The January meeting will be held at 8:00 p.m. on **Friday, January 21**, at Bradley Observatory. Our speaker will be **Doug Chesser** who will speak on **"Accessing the AAC BBS"**.

This presentation will be focused at new users, and those not familiar with how to access and use the club's Bulletin Board System. The presentation will also give insight into some of the more advanced features of the BBS including offline mail Readers, and RIP Graphics Connections.

Free copies of a shareware terminal program which can be used to access the system will be available.

PROPOSED BYLAWS CHANGES

Several changes to our bylaws have been proposed. These changes are intended to make the administration of our current schedule more convenient, and to make the club's structure more flexible in meeting future needs. No substantive change in the club's structure or method of operation is proposed.

The purpose of these changes is:

1. To change the wording of the Club's purposes so as to insure eligibility for non-profit mailing status. This is a cosmetic change only.

2. To allow the meeting dates and locations to be set by the Board of Directors. They are presently set by the bylaws.

3. To allow the Board of Directors to set the different types of membership. Membership types are presently defined by the bylaws.

4. To change the schedule of our elections so that the incoming officers take office in the month following the election. When our club was formed our meeting schedule was tied to the school year of Agnes Scott College. This meant that there was a three-month hiatus between the election of officers (May) and their taking office (September). The proposed change would allow the new officers to assume their duties in June, the month following the elections.

5. The President will preside at special as well as general meetings of the membership. Currently this duty is not provided for.

6. The Second Vice-President (Observing Chairman) will be responsible for training club members in the use of all club-owned observing equipment. Currently he is responsible only for training members in the use of club-owned equipment at the Walter Barber Observatory.

Copies of the bylaws, including the proposed changes, will be available at the January meeting. Voting on the changes will take place at the February meeting. In order for the changes to pass, a majority of the members present must vote for them, provided the quorum of twenty-five members is present.

OVERHEARD ON THE

INTERNET

A SIRIUS QUESTION

Prelude: While reading Patrick Moore's book *Astronomers' Stars*, an excellent book that I can highly recommend, by the way, I learned that several ancient astronomers wrote about Sirius as a red star. Moore offered several explanations, then concluded that these ancient writers were simply wrong. Ancient texts are more or less my field, so I started playing with ideas as to why the ancient testimony was so consistent about Sirius being red, when it obviously isn't now. I came up with one idea: suppose that there is enough eccentricity in Sirius B's orbit that, in antiquity, it was transiting Sirius A and bending enough light to make the star appear red? I wrote to Moore and asked him about this. He replied that, no, Sirius B doesn't have enough mass to have this effect on the light from Sirius A. Unfortunately, he was obviously pressed for time and space, and so didn't elaborate (I'm honored that he answered a nobody like me at all).

Question: Can anybody give me more information on this topic? How much mass would be required for an eclipsing binary to make the primary star appear reddish, and is there any possibility that such a thing could have happened in a previous age? Moore still simply discounts the ancient records; for obvious reasons, I can't do that so easily. Can anybody help me on this subject, either to tell me where to look for more information in pursuing this idea or to tell me to shut up and get off the wall?

Conclusion: Thanks in advance!

David Washburn
University of Denver

DAVID PALMER RESPONDS

Gravitational lensing cannot change the spectrum of light because the amount of bending does not depend on the wavelength of the light, unlike in a dispersive prism or chromatic lens made out of glass.

If Sirius were very deep in a gravity well (the surface of a neutron star is not deep enough, you would probably have to be near to the event horizon of a black hole) the light emitted there would be gravitationally redshifted as it climbs out of the well. However, it would take a BIG black hole to fit a significant part of Sirius A's radiating surface at the proper depth. (If the black hole were that big, WE would be in orbit around it.)

The only practical way to change the color of a star is by changing its temperature, which is easiest to do by changing its size. (I assume that changing its convective patterns might also work. Unfortunately I was sick the day we did that in the stellar engineering lab :-).) Sirius B might have some effect, but probably not much. The orbit is well-known and does not pass that near Sirius A.

Also, I seem to remember that Sirius B's orbital period is short enough that the last time it made a close pass, there were astronomers who wrote in English and who would have used the word 'red', rather than a Greek word which is thought to mean red.

David M. Palmer
California Institute of Technology, Pasadena

CAPTURE A CONSTELLATION

By Mark J. Coco, *Astronomy* Magazine

It's late autumn and the winter constellations are beginning to make their appearance in the east shortly after dark. The constellation Orion dominates the scene, its bright stars forming a pattern that clearly resemble the mythological figure they represent. You want to photograph it, but you don't have a telescope. Well, don't let that get you down – you don't need one to get started photographing the heavens.

> *Create your own photographic star atlas. All it takes is the simplest equipment and the fastest film.*

You can photograph the constellations with the equipment you may already own. All you need is a camera, lens, tripod, and some fast film. You can concentrate on the bright constellations such as Orion or, for a rewarding year-long project, you can produce your own photographic sky atlas by capturing each constellation.

CAMERAS FOR CONSTELLATIONS

First you need a camera, but not just any camera. You need one with a "B" or "Bulb" setting which allows you to lock open the shutter for time exposures. This rules out most point-and-shoot cameras. The best choice is a 35-mm format single-lens reflex (or SLR) camera.

Second, the shutter should not be electronically controlled, at least while using the B setting. Many of today's cameras use battery power to keep the shutter open during time exposures. Once the batteries are drained, usually after a few minutes, the shutter closes, whether you were finished with the exposure or not. Look for a camera that has a mechanical shutter that does not require battery power when operating at the B setting.

The camera should also have interchangeable lenses. A wide-angle lens such as a 28-mm will take in over 60° of sky, enough to frame some sprawling constellations such as Pisces and Cetus. A short telephoto such as a 135-mm has a 15°-wide field, suitable for framing smaller constellations such as Lyra and Triangulum. By far the most useful lens for constellation portraits is a normal 50-mm. Its 40°-wide field is ideal for containing most constellations. In fact, if you embark on a constellation atlas project, you might want to use a 50-mm lens exclusively so that every constellation appears the same size on each frame. The big constellations would need two or three frames to capture their entire extent.

You will also need a rigid tripod. Avoid the lightest-weight models – they will prove too flimsy, especially when extended to a comfortable height. The final piece of hardware you need is a cable release with a locking function to hold the shutter open.

FAST FILM FINALISTS

The secret to successful constellation shots is fast film. You can use ISO 100 to 400 speed film but you'll record the most stars in a given exposure time by using a film with a speed of at least ISO 800. If you like to shoot slide film, good choices include Ektachrome P800/1600, Fujichrome P1600D, Agfachrome 1000, ScotchChrome 1000, and ScotchChrome 400 push-processed to 800 or even to 1600. One word of caution when using color slide film: because the background sky is dark, the processor can have a tough time determining where each frame starts and ends. You might find that they have sliced your constellation shots right down the middle. Ask that your constellation roll be developed only and not cut. You will then need to cut and mount the slides yourself. Or shoot one or two normal daylight scenes at the beginning and end of each role to guide the processor when cutting the slides.

If you prefer color prints, you have some outstanding films to select from. Ektar 1000, Fujicolor 1600, and the speed champ, Konica SR-G 3200, provide high sensitivity with minimal film grain for their speed. The cautionary word with print films is that the processor may not see anything on the negative and, as a result, not print any pictures. If they do print the pictures, the sky could turn out looking like daytime. You may have to tell the processor to purposely print for a dark sky, something they aren't used to doing with normal snapshots.

If black-and-white film is your choice, use Kodak's T-Max P3200. It has an excellent combination of speed and fine grain.

SHUTTER SPEED SUMMARY

There is a limit to your exposure time if you want to keep the star images round. If you expose too long, the stars become streaked, a characteristic caused by the Earth's rotation. How long you can expose before star trailing shows up depends on what part of the sky you are photographing and the focal length of the lens you are using. To determine the maximum exposure without elongated stars, use the following formula:

Time (in seconds) = 1000/(F x cosine d)

F is the focal length of the lens and d is the declination of the sky area you are photographing. For medium-format cameras the formula is:

Time (in seconds) = 2000/(F x cosine d)

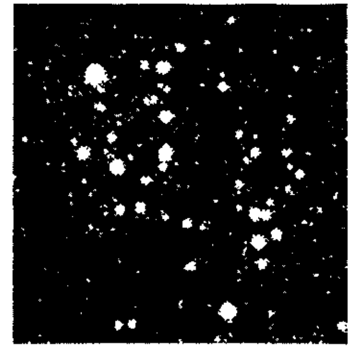
Your exposures near the celestial poles (90° declination) can be longer than those near the celestial equator (0° declination) because the distance the stars move across the film in a given time is much smaller for stars near the poles. If you don't have a calculator with trigonometric functions, see the table for specific recommendations.

To take your constellation portrait, focus the lens to infinity. Initially, set the f/ratio to its lowest setting – it might be f/2 or f/1.4. Take a series of different exposures. Also try stopping the lens down one and two f/stops. You may find that you record just as many stars at f/2 as you do at f/1.4 and that the stars will look smaller. When used "wide open" most lenses exhibit optical aberrations that distort stars into large blobs or seagull-shaped images. It may take a little trial-and-error to determine the best exposure and aperture combination for your lens and film.

KEEP ON TRACKING

Using a fixed camera, fast film, and exposures of only 30 seconds, you'll be able to pick up stars fainter than you can see with your unaided eye. To record even fainter stars you need to use exposures of several minutes. To prevent the stars from trailing one inexpensive technique is to use an device called a camera tracker. You can buy them commercially but one design, the "barn-door" tracker, is easy to build yourself. To learn how, see "Build an Astrophoto Platform" on page 64 of the November 1992 issue of *ASTRONOMY* magazine.

A barn-door tracker consists of a pair of hinged boards. The camera attaches to the top board with some type of tripod head such as a ball-head mount. The hinge joining the boards is pointed up to the celestial pole (near the North Star for Northern Hemisphere astronomers), the point around which all the stars appear to revolve. As the top board of the tracker pivots it allows its camera payload to follow the stars as they arc across the sky, keeping the stars pinpoints on the film. No-frills trackers



The α Persei Group

fainter version of either of the clusters in the Double Cluster.

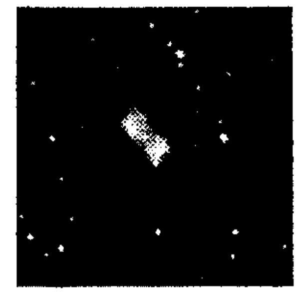
M76 This interesting planetary nebula is composed of two lobes, each given its own NGC number, and is commonly known as the Little Dumbbell Nebula, as it resembles a smaller version of the famous planetary nebula in Vulpecula. M76 handles magnification well, and appears to be rectangular in shape. The southwestern lobe, NGC 650, is the brighter of the two, and is separated from the fainter lobe by dark lanes of material. A remarkable object.

NGC 869 & 884 The Double Cluster. Best seen in binoculars, these bright open clusters are easily visible to the naked eye as nebulous patches of light in northern Perseus. NGC 869 is the brighter and more concentrated of the two. It is about 30' - 35' in diameter, and is dominated by two bright orange stars near its center. NGC 884 is slightly larger, but more scattered, and has a bright orange star a little bit off-center. Each of these clusters contain about 100 to 150 stars. While scanning this area in binoculars, be sure to check out Stock 2. This large cluster of stars lies slightly north of the Double Cluster, is about one and a half degrees in diameter, and contains about 100 moderately faint stars.

NGC 1023 A relatively bright galaxy, about 6' X 2', oriented E-W, with a very bright core. It is sharply brighter to the center, with a stellar core. A rather pretty looking galaxy.

NGC 1491 A delicate nebula, best seen with a UHC filter, but definitely seen with direct vision. A 10 -11 magnitude star illuminates a 5' X 3' fan-shaped nebula which sweeps away from it to the west.

NGC 1499 The California Nebula. This is a very large, and faint object, which I was only able to see as a slight brightening of the background sky. It is about 3 degrees long and about 1 degree wide, and thus its light is spread over a large area. I was unable to see any detail, but in photographs, it is a remarkable object.



M76 Planetary in Perseus

Mel 20 The Alpha Persei cluster. This is one of my favorite targets for binoculars. To the naked eye, it appears as a rather granulated region around and south of the brightest star in Perseus. Through binoculars, it is composed of about 50 bright white and bluish stars taking up the whole field of view. A fantastic sight.

Abell 426 This is a very distant cluster of galaxies, of which only a couple were visible in my scope. Maybe some of you owners of light buckets can give me a better view sometime! The only galaxy I was able to see well was NGC 1275, which was about 1.5' X 1', sharply brighter to the center with a stellar core. NGC 1277 and 1270 appeared as merely out of focus stars, with 1277 being the brighter. This cluster of galaxies is easily found only about one degree east of Algol (β Persei).

CONSTELLATION OF THE MONTH -- ORION

by Rick Raasch, Dallas

ORION

One of the most easily recognized constellations, Orion lies near to the Milky Way, and thus contains many open clusters and some of the best nebulae in the heavens. Led by the bright stars Betelgeuse and Rigel, this constellation holds many fine telescopic and binocular objects, along with some of the most photographed regions of the sky. Its arrival in the night sky signals the beginning of the winter observing season, with its crisp, clear nights and fine "seeing". So bundle up, make some coffee or hot chocolate, and get out under the stars for some of the finest observing of the year!

M-42 The Great Nebula. One of the finest sights in the sky, this nebula is easily visible to the naked eye as the "fuzzy" star in the middle of Orion's sword. It appears distinctly nebulous in binoculars or finder scopes, and shows an amazing amount of detail through the telescope. It is fully a degree in extent, with a wealth of fine curling wisps of nebulosity curving out from the brightest region surrounding the four relatively bright stars known as the Trapezium. On good nights with low power, I have even been able to see colors in this object. The region around the Trapezium appears as a cold steel blue color, wile the wispy regions further away can appear as a soft ruddy pink. Slightly separated from the main nebulosity, is M43. This nebula is seen as a comma shaped cloud surrounding an eighth magnitude star just north of the Great Nebula. The more time you spend in this area, the more fine detail can be seen.

M-78 This is another fine area of nebulosity. It is about 6' in diameter, and surrounds two magnitude 10 stars. It is somewhat fan shaped, and appears comet-like at low powers. NGC's 2064, 2067, and 2071 lie in very close proximity to M78, and are all nebulous regions as well.

NGC 1973-75-77 Dubbed the "Running Man" nebula by our President and illustrious leader Jason Ware, this is a relatively bright region of nebulosity just north of the M42 complex. It is large, about 15' X 10' and surrounds several relatively bright stars. The "Running Man" is seen as the dark region between the areas of nebulosity, and often shows up in wide angle photographs of the Great Nebula. It would be observed more often if it weren't located so close to M42, and greatly deserves more attention.

NGC 2022 This is a small, but relatively bright planetary nebula about 20" in diameter. It is slightly brighter at the center, and fades gradually to the edges.

PERSEUS

The constellation of Perseus straddles the Milky Way, and thus offers a wide variety of celestial targets. Here are found an abundance of open clusters, several planetary nebulae, and even a variety of galaxies. Many of the star fields here are best seen while sweeping with binoculars, or with a low power eyepiece. At the other extreme, Abell 426, the Perseus Galaxy Cluster, is really only well seen with large amateur instruments.

This variety makes observing this constellation a worthwhile experience, Even for owners of fork mounted telescopes such as myself, who will end up with their heads jammed into their fork arms all night!

M34 Large, bright open cluster, easily seen in the viewfinder, and best seen in binoculars. Composed of many bright stars, and a sprinkling of fainter stars, it is about 40' in diameter, and moderately concentrated at its center. About 100 stars were counted. It looks like a slightly

can be hand-driven (see "A Portable Photographic Platform," July 1987 *ASTRONOMY*) but the design in the November 1992 issue uses a stepper motor for hands-off tracking.

To use a tracker you begin by polar aligning the mount. A small finder or pointer attached to the top board helps you aim the hinges at the Pole. Once aligned, you don't move the tracker -- to point the camera you use the ball head to aim the camera and to frame your constellation. Before beginning an exposure, you need to wind back the tracker mechanism so that the boards are closed. During the exposure, the turning of the long bolt between the boards will slowly open the boards and provide the tracking motion.

Because the camera is now following the stars, your exposures can run much longer without producing streaked images. You can also try zooming in on small constellations, interesting starfields, and large regions of nebulosity by using short telephoto lenses (under 200-mm focal length). Or you can switch to a wide-angle lens for sweeping vistas of the Milky Way.

With ISO 800 to 3200 film and with your lens set at f/2 or f/2.8 start with a one minute exposure and go all the way to five minutes. With films in the ISO 400 range, you can expose longer than five minutes but you may have trouble keeping the star images round (especially when using a telephoto lens) because of inaccurate polar alignment and imperfections in the tracking motor. Keep in mind that barn-door trackers are designed for relatively short exposures -- you shouldn't go over 15 minutes.

COLLECTING CONSTELLATIONS

Whether you use a fixed tripod or a barn-door tracker, you'll get the best results by photographing from a dark sky site. You can capture the brighter constellations from urban areas, but the bright sky background will wash out the faint stars.

As a final tip, be sure to keep records of each shot. Without notes, you'll almost certainly end up with mystery constellations you may never be able to identify!

As you can see, capturing the constellations takes a minimal investment in equipment. However, creating your own constellation atlas will require a modest investment in time. It may take you a year to cover the sky. But during that year you will have had the rewarding experience of learning the sky in a way few other backyard astronomy projects can accomplish.

Mark Coco is a technical writer and amateur astronomer living in southern California. This article is reprinted, with permission, from the November, 1992 issue' of *ASTRONOMY* magazine. © 1992, Kalmbach Publishing Co. Club members can subscribe to *ASTRONOMY* at a discounted rate. See back cover for details.

LIMITS FOR PINPOINT STARS

To keep stars from trailing when using a fixed camera, be sure to keep your exposure times shorter than these upper limits. Because you have a limited exposure time with a fixed camera, use a fast ISO 800 to 3200 film to capture as many stars as possible during that exposure.

Focal Length	Equator	Dec. 45°	Poles
28-mm	25 sec.	40 sec.	90 sec.
50-mm	12 sec.	20 sec.	45 sec.
135-mm	5 sec.	7 sec.	16 sec.

The Large Aperture Dobsonian Experience

By Walter MacDonald, Ontario

INTRODUCTION

In its original form, this article was published in the RASC Kingston Centre's newsletter, Regulus, under the title "My First Six Months With a 17½" Dobsonian." It described my experiences as a first-time user of a large aperture scope.

THE STORY

On Friday, January 27, 1989 my observing horizons were expanded greatly, and a dream was finally realized. This was the day I purchased a used (or should I say previously enjoyed?) Coulter 17½" Dobsonian. No longer would I have to use averted vision to the limit in order to detect more deep-sky objects. No longer would I have to dream about better, brighter views of the more familiar deep-sky objects. Now all my observing wants would be fulfilled. Of course, with such progress there are some new problems created too. As I have found in using other large telescopes, there is an initial adjustment period during which you make a number of discoveries about the new instrument and how it works (or doesn't work!). The following are some of my discoveries – the good and the not so good – along with some observations made during my first six months with the new scope.

"The 17" (as I call it) is a large red tube 20" in diameter and 74" in length which rests on a 27½" square rocker box. The tube assembly weighs 140 pounds, the box 90 pounds, and the mirror 29 pounds. The 17 weighs in at a hefty 259 pounds total. The focuser is of the 1¼" variety and there is no finderscope (I use the hex bolt at the top end of the tube!). The entire telescope was mounted on three wheels by the previous owner and this allows the scope to be moved around on smooth, level surfaces by only one person. Unfortunately, such surfaces rarely occur in nature, so this is not of any use in the field. This was my first discovery about the 17: without such a surface, it becomes a two-person telescope.

Initially, I took the 17 back home to Oshawa so it would be close at hand, and so I could roll it in and out of the garage and up and down the driveway as required, totally unassisted. Strangely enough, although it looks gigantic indoors, once it is rolled outside it looks rather small!

No longer would I have to dream about better, brighter views of the more familiar deep sky objects.

The f/4.5 focal ratio gives a focal length of 2000-mm – the same as my C8. The quality of the images in the 17 is not bad in spite of some of the stories I've heard about similar scopes.

The skies the first night home were clear until about 23:30. I rolled the 17 half way down the driveway. Within an hour the mirror and scope had equalized thermally with their surroundings. Despite the light pollution (Oshawa has a population of 150,000), those first views were still very good! M42/3 was strikingly blue-green in colour with abundant mottling clearly visible. Detail was also visible in M82 and M81 both of which were brighter and more extensive than in my C8. M44 in Cancer showed several colourful binaries. Sirius, quite simply, should be left until after your deep sky observing is finished!

I used the 17 on a total of three nights in Oshawa. By this time the initial excitement was beginning to wear off and I longed to unleash its full potential under a dark sky. So on April 8, with a clear Saturday night looking imminent (how about that for a

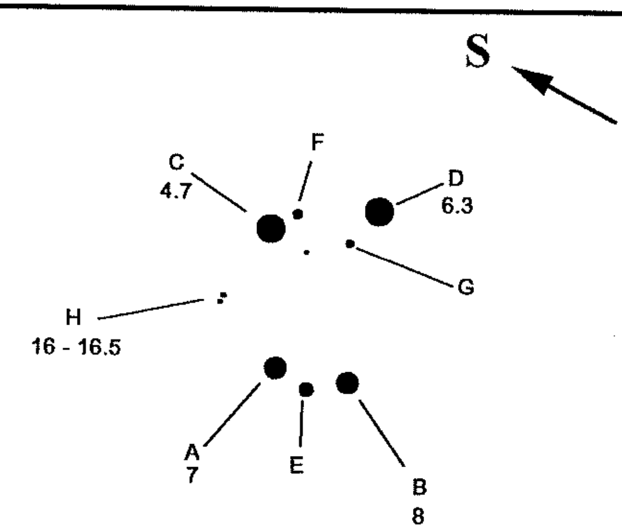
After the Earl's death in 1867, his son, the Fourth Earl of Rosse continued his father's work. He fitted the telescope with a clock drive, and expanded the research with other (smaller) special-purpose instruments. Research on the heat content of the Moon was carried out over a 22-year period.

The last observations were made with the 72" in 1878, and it was dismantled in 1908. It is interesting to note that this instrument was not surpassed in size until the 100" Hooker telescope at Mt. Wilson was placed in service in 1917.

There are two interesting footnotes to the story of the Leviathan. The third Earl's youngest son, Charles, inherited his father's interest in massive engineering projects. In the early 1890's he invented the steam turbine, which had a profound influence on the history of the Twentieth Century – it made the modern battleship possible.

In 1935 Charles (by that time Sir Charles) bought out Sir Howard Grubb's optical shop. Since that time, Grubb - Parsons has manufactured many very large telescopes, including the 98" Isaac Newton Telescope. Thus, the two largest telescopes to be constructed in the British Empire, the 72" at Parsontown, and the 98" (now relocated to the Canary Islands) were the fruit of one family's genius.

Unlike the other telescopes described in this series, the Leviathan has a future! The present Earl (the sixth) has established an astronomical museum at Parsontown, and a fund which has as its goal the reactivation of the 72" telescope. If this goal is achieved, the telescope will be made available to amateur astronomers who would appreciate this opportunity to participate in the unique and important history of Birr Castle.



Theta Orionis -- The Trapezium

Letters represent the accepted star designations
Numbers represent the magnitudes, where known.
H is a faint double.

Compiled by L. Abbey

The Fourth Earl, Standing at the Mouth of the Tube.

available. The problem was solved with a type of mounting which had not been used before (and has not been used since). Two parallel 70-foot high masonry walls were erected in a North-South direction, and the tube was slung between them. On the bottom of the mirror cell was a large steel ball which fit into a socket set into the ground midway between the walls. The top of the tube was maneuvered by cables and wooden supports strung from one wall to the other. The cables, struts, spars, and supports were constructed so that equatorial tracking motion was possible. The space between the two walls was adequate for tracking objects for one hour before and one hour after meridian passage.

The project began in 1843, but had to be suspended in 1845 due to the Great Potato Famine. By 1847 conditions had improved, and the telescope was finally placed into service.

The team of professional astronomers which the Earl had engaged was headed by Sir Robert Ball. When Sir Robert left, the position was taken by J. L. E. Dreyer, who began to compile the NGC catalog while at Parsontown.

The telescope proved to be of amazing optical quality. But its light-gathering capacity was beyond all expectation. For the first time it was possible to detect stars as faint as 18th magnitude.

The first subject of detailed examination was the Moon. Minute craters and rills which had never before been glimpsed were charted. Delicate new details were seen on Jupiter, Saturn, and Mars.

After about one year of intensive study of the solar system, the telescope was turned to the stars. The big question which astronomers were asking in the mid-Nineteenth Century was "Are the nebulae composed of minute stars which we cannot resolve because of their extreme distance?" The great telescope provided the first opportunity to try for a meaningful answer. It was not known at this time that there were different kinds of nebulae – some composed of stars, and some composed of gas and dust. Examination under high powers at Parsontown revealed that some hitherto unresolved nebulae were indeed composed of faint stars, but some continued to resist every effort at resolution.

During this research, the telescope's great discovery was made. Some nebulae which were seen as dim blobs in lesser instruments were revealed to be giant spirals. The first of these spiral nebulae to be revealed was M51 – known today as the Whirlpool Galaxy. The Earl was the first to suggest that these spirals could actually be rotating masses of stars. Within a few years, over a hundred more spirals were observed. Of course, none of them were resolved into stars. That would have to wait on yet larger instruments.

Other important observations with the telescope were the confirmation of the satellites of Mars (which had been discovered by Asaph Hall in Washington), and the beginning of Dreyer's observations of the NGC objects.

After the Earl's death in 1867, his son, the Fourth Earl of Rosse continued his father's work. He fitted the telescope with a

change!) and with Doug Clapp and Randy Hendriks going out to observe (they could help me move the 17) I decided to take the scope to the family farm 25 km north-east of Belleville. I also took along my C8 in order to facilitate direct comparison of the performance of the two scopes.

Although Orion was sinking in the west, the Zeta Orionis Nebula was easily visible in the 17 but only barely in the C8. M42/3 were even more beautiful with the dark sky than they had been in Oshawa. Many objects seen in the 17 were eye-popping to say the least. It was like starting the hobby all over again! In Leo, M65 and 66 were great. M65 was noticeably larger than M66 which appeared to have "wings" running off it (spiral arms!). All of the detail in M65 and 66 was especially impressive since both of them were visible in the same field of view. A dust lane could be seen in nearby NGC 3628 and the supernova in M66 was just visible. NGC 2371 in Gemini showed some mottling.

Just as nebulae and galaxies were breathtakingly transformed by the 17, so were the globular clusters. To say that M13 was a knockout is an understatement! My views of M13 were the most incredible I have ever had. Nicely resolved, each individual in this incredible blizzard of stars stood out plainly with direct vision. It was like looking at a Palomar photograph. M92 was very good, again showing lots of well-resolved stars, and M5 in Serpens was excellent.

When looking at the brighter globulars in the 17 I got the feeling that if I cranked up the magnification a little, it would be possible to see through them! M22 was well resolved and gave the impression of having a "sheet" of stars draped in front of a more distant and condensed core – an interesting effect. I finished the night going through Sagittarius and Scorpius and being similarly amazed by the views afforded by the 17. One in particular, the Trifid Nebula, was outstanding with the trisection jumping out at me. It was a very exciting night.

Throughout all of this observing, I slowly acquired a feel for how to use this telescope. Having used the 13.1" Coulter, I initially thought that the 17 would be as easy to use. While this is largely true (if you'll pardon the expression), the sheer size and weight of the 17 make it somewhat more difficult to handle. For one thing, you can't put your arms around it and push (unless you have very long arms!). Neither can you push as hard if

When looking at the brighter globulars in the 17 I got the feeling that if I cranked up the magnification a little, it would be possible to see through them!

you're standing on a ladder! And, as it turns out, the scope is a wee bit tipsy in certain orientations with the three-wheel setup. Fortunately this is only a problem near the zenith. By using a sturdy ladder and gripping diametrically opposite sides of the top of the tube, the 17 can be muscled around. A better way still is to have someone on the ground do the steering. Of course the latter only works when you're not alone.

I could go on and on about the wonders opened up to me by the 17 but I'll wrap it up with just a couple more. On the Canada Day (1989) weekend I had the 17 out again with Paul Markov (who helped me move it!). M110 was astonishing in its extent and naturally M31 was amazing (as I was expecting by then!). But my most recent big thrill came when I checked out NGC 7331 in Pegasus. Immediately next to it were four galaxies, three of them easily visible. If you compare the charts for NGC 7331 in SkyAtlas and Uranometria you will get an idea of the difference between the universe as seen by an 8" scope and that seen by a 17" – an exciting difference!

So what is to become of my C8? It will continue in active service for many years to come. I have yet to exhaust its photographic potential, and it is better suited for lunar, solar, and planetary observation. This is an interesting situation: the merits of the 8 and 17 are mutually exclusive! Therefore, just as Leslie Peltier divided his time equally between his 6" and 12" scopes, I will divide mine evenly between the 8 and the 17. At least until I can get a 36".

THE EPILOGUE

Incredibly, it has now been almost 4 years since I purchased the 17 from an NYAA member in, of all places, Cobourg. I would like to thank the NYAA for NOT buying this telescope!

During its three month stay in Oshawa, the 17 eclipsed Mike Sherba's 16" as the largest telescope in Oshawa. Tony Ward reports that this corresponds exactly to a strange period of humility and quiescence on Mike's part!

After spending a year dominating the living room of the family farmhouse, the 17 was moved into a 9' X 11' Sears garden shed about half a kilometre to the south in February, 1990. A few months later I added a 10' X 10' matrix of patio stones in front of the shed. To use the 17 I simply unlock the shed and roll out the 17 onto the patio, all by myself!

I have since added a TelRad and a Celestron 6 X 30 finder (just like the one on my C8!) to make finding objects easier. The current focuser, while adequate, becomes difficult to adjust at sub zero (Celsius) temperatures. Eventually I plan to add a 2" focuser, or at least a better 1¼" focuser.

From this story it may appear that I have succumbed to aperture fever. Well, I have, I'm loving it, and I am beyond cure! But what about the optical and mechanical quality of this scope? Much ado has been made about these topics recently. Mechanically, the azimuthal pivoting action is rather stiff which makes for some difficulty near the zenith (as I mentioned earlier). I plan to install a BKD (Bill Kelly Device) by next spring (finally!). Other than this, I have been quite happy with the mechanics of this scope. Optically it looks OK to me (except for planetary viewing, which I don't use it for anyway), especially when TeleVues are used instead of my own crappy eyepieces!

While The 17 continues to thrill me with its deep sky views, I use it now mainly for variable star observation. In this department, it has allowed me to follow my variables through minimum without breaking a sweat. Stars at magnitude 13.5 stick out like a sore thumb! This takes getting used to, since it's just like seeing constellations from a dark sky instead of a light polluted one. I have been able to do several "inner sanctum" estimates (13.8 or fainter) thanks to the awesome light gathering power. The faintest star I have seen so far (that I have a listed magnitude for) with the 17 is 15.2 (not much better than my C8). However, I anticipate seeing 16.0 or fainter once I get the 17 housed in an observatory where I can get truly dark-adapted! But that's a story for another time (and one which will have your head spinning).

So how would I sum up the large aperture Dobsonian experience? I think Caesar would have said it best: Veni, vicidobsonus, vidi — "I came, I got a large aperture Dobsonian, I saw!"

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THE EARL OF ROSSE AND THE LEVIATHAN OF PARSONTOWN

by Lenny Abbey, Atlanta

With the advent of stellar astronomy (an event which took place in the front yard of the greatest amateur astronomer of all, William Herschel), it became clear that a telescope's most important quality was its ability to gather light. Herschel built telescopes up to 48" in aperture, but the largest of these behemoths was difficult to operate, requiring the assistance of several well-muscled workers. Understandably, these helpers were not necessarily interested in staying up all night to turn the crank of a windlass. The 48" made several important discoveries, but Herschel soon returned to his favorite, a 24" instrument.

The real race for aperture was launched by William Parsons, the third Earl of Rosse. The Earl was a man of vast wealth, who owned extensive estates in Ireland. He was a passionate amateur astronomer, and like most amateurs, he needed a larger telescope. Money was not a hindrance for the Earl. He wanted to build the world's largest telescope, and he wanted it to be used by professional astronomers who would be able to properly access the discoveries which would be made. He decided to attempt a mirror six feet in diameter.

There were two great engineering roadblocks which had to be overcome. First, the mirror would be very heavy. Modern methods of coating glass surfaces with silver or aluminum were yet to be invented, and speculum metal was the only known material with all of the properties required for a precision reflecting optical element. In order to produce such a large and heavy piece of metal, he had to build a foundry with three peat-fired furnaces on his rural estate at Birr Castle, near Parsontown. His workers were successful in casting and polishing a 3½ ton mirror on the third try. Two mirrors were made, so that one could be used in the telescope while the other was being resurfaced. It was necessary to repolish one of the two giant mirrors every six months due to the tarnishing effect of the damp Irish climate.

M51 The First Known Spiral Galaxy as it Appeared in the 72" Telescope. This drawing is by Lord Rosse himself.

The second problem was that the tube had to be 58 feet long in order to accommodate the f/10 optical system. Lord Rosse's first efforts in amateur telescope making had produced instruments which were mounted along the lines of Herschel's design – monstrous scaffolding supported by a rotating platform. This gantry arrangement would not do for such a long and heavy tube. Bearings capable of supporting such tremendous weights were not