June
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1996

Volume 6
Number 3

The Royal Astronomical Society of Canada

BULLETIN

La Société Royale d'Astronomie du Canada

Supplement to Volume 90/3 of the Journal of the Royal Astronomical Society of Canada

Reflections: Has Astronomy Lost Its Innocence?

Charles Shahar
Montreal Centre
reprinted from *Skyward*

There are few hobbies as gadget-happy as astronomy. The technology has progressed at a frantic rate. Flip through *Sky & Telescope*, and there seem to be more pages of ads than articles. A new product appears with each issue as manufacturers try to outdo one another and satisfy demanding enthusiasts. The hobby itself has turned glossy and fast-paced.

The trend simply mirrors what is going on in the rest of society. Technology is not only meeting many of our needs, it is defining new ones. It is pushing the bounds of the possible. What was considered frontier astronomy three decades ago is now routine for the average backyard astronomer.

Consider the fact that a device which costs less than most used cars can now image galaxies fainter than twentieth magnitude in less than three minutes. These images can then be stored and manipulated at the whim of the user. Brighter, flatter, more colourful—no problem. The image can be sent across the world in seconds. What a hobby! The vast expanse of the heavens can now be stored in a computer chip that sits nicely on the tip of your pinky.

Astronomical news travels quickly. On the Internet, the latest coordinates for a new comet are flashed in a "newsgroup". Amateurs can now converse instantly with one another. An amateur complains about the weather in Australia; a person who claims to be an extraterrestrial insists that Hale-Bopp is actually an exploding star, not a comet. Apparently, he was born not far from that stellar neighbourhood.

Astronomers now talk in code. EDF, CCD, NGT, and OTA have become routine parts of the astronomical lexicon. Fads still come and go, but keeping up can cost thousands of dollars. The economically-challenged can now only watch and drool as their richer counterparts train increasingly more sophisticated equipment at the sky. The ads in the magazines rub it in.

> **"Perhaps what is missing in astronomy is awe and mystery... Now we look at the pictures in the magazines and expect much more."**

It has all been quite dizzying. Recently, I dragged out some old diaries I kept when I first started to pursue astronomy at the age of thirteen. It was a refreshing change of pace. Perhaps what is missing in astronomy is awe and mystery. We felt this as children whenever we stared with wonder at something new. Now we look at the pictures in the magazines and expect much more.

There were two revelations I had when reading my old diaries. The first was that I was always a bad speller! The more important insight was that one can do amazing things with that simplest of instruments—the human eye! During my first year the most amazing experience was watching the constellations rise and set. Unlike some other aspects of my life, these patterns were dependable. They beat the same path through the sky day after day. I came to rely on them as old friends.

It did not discourage me that for two weeks I mistook Vega for Venus, or that because of my slight myopia and poor city skies, I could only make out stars to fourth magnitude. These were times for simple pleasures. I could not wait for Aldebaran to pass its point of culmination so that I could spot it from my bedroom window. I thought Corona Borealis was the most beautiful thing I had ever seen.

My first scope was a two-inch Tasco refractor, with a wobbly tripod. The first object I saw through it was Betelgeuse. The image was uneven and certainly not colour-corrected, but the sight just blew me off my feet. At last I could reach out and touch other worlds. Alcor and Mizar were stunning. Saturn excited me for weeks. Now, as I try to decide whether to get an ST-4 autoguider or a Lumicon hypering kit, I think about the times when astronomy was viewed through the eyes of a child. Maybe astronomy has not really lost its innocence. Maybe I am the one who has.

Shun no toil to make yourself remarkable by some talent or other; yet do not devote yourself to one branch exclusively. Strive to get clear notions about all. Give up no science entirely; for science is but one.

Lucius Annaeus Seneca (the Younger)
Roman philosopher/statesman (4 BC?-65 AD)

BULLETIN

is a publication of the Royal Astronomical Society of Canada and is distributed together with the society's *Journal*. It contains articles on current activities of the RASC and its centres across Canada, as well as articles from members and non-members which are of general interest to members of the society. Inquiries about the society should be directed to its national office at 136 Dupont Street, Toronto, Ontario, Canada M5R 1V2 (416) 924-7973.

Cover Picture: History comes to life at historic Fort Edmonton Park.

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Printing: University of Toronto Press

Printed on paper containing 50% pre-consumer recycled paper and at least 5% post-consumer de-inked fibre.
August issue deadline is July 31st.

Letters to the Editor

What About Setting Circles?

[Editor's Note: The following letter was received in response to the article "Should CAT Owners Receive Certificates" which appeared in the December issue. In this article, it was noted that, under the current rules, computer-aided telescopes could not be used to obtain the society's Messier Certificate or Finest NGC Certificate.]

The issue of setting circles needs to be addressed too. Using my permanently mounted telescope that has old fashioned setting circles, I could observe all of the Messier objects in a few hours spread over two seasons of the year without needing to know anything about the sky to do it.

We should specifically require that star hopping be used for the observations that lead to these certificates. Hopefully some certificate will evolve in the future for those that show major skills in the use of automated telescopes, and perform a non-trivial task with an automated telescope.

Paul Boltwood
1655 Main Street, Stittsville, Ontario K2S 1N6 ✪

Astro Ads

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Everything in space obeys the laws of physics. If you know these laws, and obey them, space will treat you kindly. And don't tell me man doesn't belong out there. Man belongs wherever he wants to go—and he'll do plenty well when he gets there.

Wernher von Braun
German/American rocket engineer (1912-1977)

Annual Report Update

1. In the section for the Windsor Centre council for 1996 the correct electronic mail address for John Hurley is: jhurley@net**c**ore.ca, not jhurley@net**m**ore.ca. Also, his correct mailing address is 42**9** County Road, not 42**7**.

2. Due to an oversight in checking the minutes of the national council meeting from November 25th, 1995, three additional award winners should have been listed. Messier Certificates: Donald Dunn (Ottawa) and Kevin Black (Winnipeg); Finest NGC Certificate: Fr. Lucian J. Kemble (Calgary).

3. In the centre financial statements, while the Ottawa probably wishes that their membership revenue was $66,961, it was actually $6,691. Also the notations at the bottom of the table on page 31 should read, "Balance from 1994" and "Balance to 1995". ✪

More Planets Found!

The San Francisco State University planet search team has announced the discovery of two more extrasolar planets. The first planet is orbiting the star τ Boötis. It has an minimum mass of 3.86 times that of Jupiter and orbits in a circular orbit with a semi-major axis of 0.05 AU and a period of 3.3 days. τ Boötis has a spectral class of F7 V, making it slightly hotter than the Sun, and is only 19 parsecs from our star.

Even closer to home, Proxima Centauri appears to have a planet! Astrometry with the Hubble fine guidance system indicates a planet of 0.8 Jupiter masses at 0.17 AU with an orbital period of 80 days. Similar work with Barnard's Star gives no indication of a planet.

For more details on all extrasolar planets found to date, browse the extrasolar planetary encyclopedia, which has just been updated. It is found on the web at: http://www.obspm.fr/departement/darc/planets/encycl.html ✪

Galileo On Stage

There is an exciting event touring across Canada that your readers will be very interested in. Theatrefolk will be presenting "Galileo: The Starry Messenger," a play about the late, great astronomer at Fringe Festivals across Canada this summer. Galileo was the first person to use a telescope to explore the heavens. What he found there changed the face of science forever. Do not miss Galileo's incredible story. It is a journey you will never forget.

The play was written by Lindsay Price who recently won first prize in the Ottawa Little Theatre's National One-Act Play Competition. She was also honoured this year by Nipissing University, placing first in the one-act category.

The tour itinerary, for the rest of the summer season is:

Winnipeg Fringe Festival
July 19th-28th
Call (204) 956-1340

Saskatoon International Fringe Festival
August 2nd- 11th
Call (306) 664-2239

Edmonton's Fringe Theatre Event
August 16th- 25th
Call (403) 448-9000

Theatrefolk:
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Our whole approach to looking for life on Mars has changed in recent years. We are no longer looking for extant life. Rather, we are looking for evidence of extinct life.

Christopher McKay
American astrophysicist (1986)

A Factor of Two

Dr. Jan (John) Bron
Winnipeg Centre

To start, I must admit that I am only an armchair amateur astronomer or cosmologist. Ever since childhood, astronomy has fascinated me. Rather than becoming an astronomer, I became a physical chemist with research interests in kinetic isotope effects, isotope separation and applications of radioisotopes in reservoir engineering as used in crude oil production. After thirty-five years of chemistry, it was time to retire so I could finally pursue my lifelong interest in astronomy and cosmology. As most of my published research was in the field of theoretical chemistry, I decided to study also the theoretical aspects of astronomy and cosmology and so, like Alice, I entered Wonderland.

The best way, I felt, was to study on my own and just buy the books I thought I needed. It was not easy to master the required mathematics such as tensor analysis and Riemannian geometry on my own but it was a lot of fun and I learned to handle Christoffel symbols and the curvature tensor. I was now ready to tackle Einstein's general theory of relativity, physical cosmology and the theory of gravity.

The deflection of light by the Sun, the perihelion advance and the gravitational redshift are often called the classical tests of relativistic gravity (Rastall 41). The book by Bergmann called *Introduction to the Theory of Relativity*, with a foreword by Einstein, was the first text I studied carefully and it took quite some work before enough background was obtained to discuss the deflection of light (Bergmann 218). The magnitude of the deflection of light by the Sun's gravitational field is known experimentally and with great precision (Ohanian 194) and is equal to 1.75 arc-seconds. It is said (Peebles 272) that Newtonian mechanics predicts only half this value and the agreement of theory and experiment can be considered, together with other criteria, as proof for the validity and utility of a particular theory. Bergmann showed that the general theory of relativity can be used to obtain the predicted and observed value of 1.75 arc-seconds but not without pulling a factor of two out of the hat (Bergmann 221). This appeared to me as somewhat unsatisfactory and I decided to investigate the matter further by going to Einstein's original papers to determine if the factor of two is "two be or not two be".

English translations of the early key publications related to relativistic theory have been published in book form (Einstein et al.) with notes by Sommerfeld. Einstein discussed the influence of gravitation on a light ray for the first time in 1911 and he estimated that a ray of light going past the Sun would undergo a deflection of 0.83 arc-seconds. This differs by a factor of two from the observed value.

After the contributions of Lorentz, Minkowski's proposal that "henceforth space by itself and time by itself are doomed to fade away into mere shadows, and only a kind of union of the two will preserve an independent reality", and Einstein's study of Riemannian geometry (Clark 255) and tensor analysis, the famous paper on the foundation of the general theory of relativity was published by Einstein in 1916. In this paper Einstein introduced, after a long introduction, his powerful and beautiful field equations. Also in this paper, he deduced that a ray of light going past the Sun will undergo a deflection of 1.7 arc-seconds, in agreement with the observed value. Obviously Einstein had changed his mind by a factor of two after five years of reflection.

By using Einstein's field equations, other authors have used different methods to derive the expression for the angle of deflection of a light ray in a gravitational field. It is most interesting to check these authors methods of derivation carefully, and hence, to follow their reasoning. Stephani ended up with a second order differential equation which had several solutions and choosing a particular linear combination of these solutions, he forced the correct expression for the angle of deflection to follow (Stephani 103). This brute force approach is not very attractive. By far the most easily understood derivation is presented by Ohanian (188) in his interesting and useful book. His approach is similar to that taken in the exciting and encyclopedic text written by Peebles (272).

Well, everybody got his factor of two in the end although the amount of introductory theory and algebra needed to obtain the results was always formidable. Contrary to previous ideas, Rastall (38) used the modified Newtonian theory, which allows in a simple way for the influence of a gravitational field, to show that all the formulas and predictions that serve as the classical tests of relativistic theory can be obtained in a much simpler way. By applying the philosopher's criterion called Occam's Razor, the much simpler modified Newtonian theory, also called theoretical gravity, should be the true gospel. The fact is that it cannot match the compact and predictive power of Einstein's theory. Although theoretical gravity is less forbidding, it is less noble (Rastall 175) at this point.

My journey through Wonderland has been most enjoyable and I will continue to explore but I am getting tired now. Perhaps I should take my chair outside and search the star-studded sky for the wonders predicted by all these wonderful theories. There are many more theoretical adventures ahead which will make a factor of two much less important.

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Interstellar Forecast: Increasing Cloudiness

reprinted from *SpaceViews*, Boston Chapter, National Space Society

Astronomers reported this week that the solar system is approaching a cloud of interstellar gas that will, over the next 50,000 years, alter the solar environment and shower Earth with more cosmic radiation.

The solar system is currently in an empty area of space between two spiral arms of the Milky Way galaxy, according to astrophysicist Priscilla Frisch of the University of Chicago. However, the motion of the solar system around the galactic center will soon bring us into a cloud up to a million times denser than the current cloud.

A denser interstellar environment would damp out the solar wind. As the solar wind carries harmful cosmic radiation away from the Earth, any decrease in the solar wind would expose the Earth to more radiation. Also, the increased density of gas and dust from the cloud would absorb more solar radiation at visible wavelengths, dimming the Sun as seen from Earth.

The cloud, about sixty light-years in diameter, is still more than four light-years from the Earth and moving at speeds far smaller than the speed of light, so there are no immediate effects expected on the Earth.

The research was presented at the meeting of the American Astronomical Society in Madison, Wisconsin. ✪

Another Successful Messier Marathon

Paul Markov
Toronto Centre

On the evening of March 16th, 1996 we embarked on a "dusk till dawn" astronomical race called the Messier marathon. The "runners" were Toronto Centre members Stephen Keefer, Guy Nason, and myself. The event entailed viewing as many of the 110 Messier Catalogue objects as possible in one night. For Stephen and myself this would be a second attempt at the marathon—back in March 1992 we saw 100 objects (see the October 1992 issue of the *Bulletin*).

A Messier marathon is only possible in late March or early April, a time when the Sun is located in a part of the sky devoid of Messier objects. Within this span of time it is also preferable not to have the Moon in the sky as it may interfere with some of the fainter objects. Our choice of March 16th was based on the following facts: it was a Saturday night; it was two days before New Moon; it was close enough to that special time of the year; and, most importantly, we expected a clear sky all night.

This year I prepared a little better for the event by previously scouting for a good site east of Toronto. Site selection is probably the most important factor in a Messier marathon. It is imperative that the observing site allows for a completely clear view of the western, southern, and eastern horizons. Even if there is one tree blocking part of your sky, chances are a Messier object will be hiding behind it just before setting for the night. You should also be as far away from light pollution as possible, especially towards the western and eastern horizons. I did find a good site on top of a hill, or at least it seemed good during the daytime, near the small village of Garden Hill, 100 km northeast of Toronto. Although the sky was quite dark, we quickly found out that the site was not the greatest because the many street and house lights from the village were shining directly in our eyes, even from a distance.

We planned to begin observing at 8:00 PM and end at 5:00 AM, giving us a total of nine hours to find the 110 Messier objects. This equated to an average of one object every 4.9 minutes! Several days before the marathon I decided to make it a little more challenging for myself by trying to observe a couple of dozen NGC objects that I had not seen before.

Here is the relevant Sun data for the night of March 16th/17th:

Sunset	6:25 PM
End of twilight	8:10 PM
Beginning of twilight	4:45 AM
Sunrise	6:30 AM

We arrived on site at scattered times during the evening, some as early as 6:00 and others as late at 7:30. As twilight faded in the west, the night looked quite promising, but first we had to get our equipment from the parking lot to the top of the hill, where we nearly had a 360° view of the horizon. Lugging the equipment up the gentle, but very long slope proved to be quite a challenge. I had an 8-inch Schmidt-Cassegrain telescope, Guy had a 10-inch Newtonian on a very solid and heavy equatorial mount, and Stephen had a 16-inch Dobsonian! We eventually got them to the top of the hill, and just before 8:00 we were ready to begin observing. The critical evening Messier objects we observed first are listed in Table 1.

The first object we all spotted was M77. I am not sure why, but we started with the second object on the list, perhaps sabotaging ourselves. This galaxy was not terribly difficult to see in the telescopes, however it took some effort to star-hop to it as few guiding stars were visible at such low altitude. Next was M74 which was not seen for certain. The exact position was at first difficult to determine because there were such few visible stars to use for star-hopping. We even thought a blazing Venus was blocking the view, but that was not the case since the planet was a generous 12° east of M74. Eventually we all arrived at the correct part of the sky and began sweeping. We spent a good half-hour looking for M74, and eventually we all thought we could see something there—a slightly brighter patch of light in the field of view best seen with averted vision. Then again, we were not one hundred percent sure. Did we really see M74 or was averted imagination getting the better of us?

I would not hesitate in labelling M74 as the most difficult object in the Messier Catalogue—it was in fact the very last object I observed in completing my Messier list due to its difficulty. Although the *Observer's Handbook* labels it magnitude 9.2, I have seen it listed at 10th magnitude in other sources, and as faint as 11th magnitude in *Burnham's Celestial Handbook*, which describes it as "one of the faintest and most elusive of the Messier objects". The reason this face-on galaxy is so difficult to spot is because it is quite large and its total brightness, may it be magnitude 9, 10 or 11, is spread over a large area, giving it a low surface brightness. Furthermore, at low altitudes the effects of atmospheric extinction become quite relevant, making the object appear even dimmer, probably by one magnitude or more. In hindsight I am not surprised we did not see M74.

By 8:30, M74 had sunk to just 8° above the western horizon and that was when we thought it was time to move on. The remaining critical evening objects were not that critical after all, especially M31, M32, M33 and M110 which were all visible in my 8x50 finder scope!

From this point forward the marathon took on a more relaxed and steady pace. The order in which we observed Messiers was not really important as long as we observed them from west to east so that none were missed before they set. As Messier objects are fairly bright and large, a small telescope is quite adequate and easier to use when rushed for time. In fact, of all the Messiers I viewed through my telescope, 60 were visible in the 8x50 finder!

The night remained clear and cold with a low temperature of -7°C and a persistently sharp

Table 1

Object	Type	Magnitude	Altitude at 8:00	Time Seen	Altitude When Seen
M74	Galaxy	9.2	13°	not seen	—
M77	Galaxy	8.8	14°	8:03	14°
M79	Glob. Cluster	8.0	16°	8:39	12°
M31	Galaxy	3.4	21°	8:42	15°
M32	Galaxy	8.2	21°	8:42	15°
M110	Galaxy	8.0	21°	8:42	15°
M33	Galaxy	5.7	22°	8:35	16°

Table 2

Object	Type	Magnitude	Altitude at 4:30	Time Seen	Altitude When Seen
M15	Glob. Cluster	6.4	13°	4:14	10°
M2*	Glob. Cluster	6.5	3°	4:30	3°
M75	Glob. Cluster	8.6	3°	-	not seen
M72	Glob. Cluster	9.4	2°	-	not seen
M73	Open Cluster	9.0	1°	-	not seen
M55	Glob. Cluster	7.0	0°	-	not seen
M30	Glob. Cluster	7.5	-13°	-	not seen

* observed only through 10-inch and 16-inch scopes.

wind from the east. Starting around 12:30 AM we had a nice view of Comet Hyakutake while still only third magnitude in Libra. I also spent a few minutes looking at a couple of bright stars in Centaurus. These were only 3° above the horizon given their declination of -42°. Omega Centauri was only a few degrees south of those stars, but I sadly knew it would never make it above the horizon. By 2:00 AM we started feeling the effects of the previous long and cold six hours. I could have taken several breaks throughout the night, but whenever I had ten minutes to spare in between Messiers I opted to keep busy hunting down unseen NGC objects.

By 4:00, we entered the home stretch. It was a tense 45 minutes until the beginning of twilight. We knew that the whole night had come down to the last few objects as listed in Table 2.

M15 was not difficult to see, in fact I had to use 16x50 binoculars because a lonely tree in the east was blocking my telescope's view. M2 however was a little more difficult to spot, mostly because there were hardly any stars visible that could be used for star-hopping to it. I did not find M2 in my 8-inch scope, but fortunately Guy and Stephen did spot it around 4:30 at an altitude of only 3°. The last five objects were not seen and in hindsight I do not think there was much hope of seeing them. M30 was definitely out of the question because by 4:30 it was still 13° below the horizon. M75 was at the same altitude as M2, however it was two magnitudes fainter. M72 and M73 were barely above the horizon at magnitude nine and fainter, while M55 was still right on the horizon. Atmospheric extinction made the effort even more difficult. We waited an extra half-hour till 5:00 but anything we had gained in altitude we had lost in the brightening dawn sky. By 5:05, twenty minutes into morning twilight, the stars in the east had vanished and we unwillingly crossed the finish line. We had seen 104 of the 110 Messier objects.

Quite exhausted after being on-site for more than ten hours, we spent a little over one hour packing and transporting all the equipment back to our cars. Shortly after leaving the site, driving westbound back home, the Sun rose, casting long shadows ahead of us.

Would I do a Messier marathon a third time? You bet! Here are the things I would do differently. Only one object was missed in the evening sky, while five were missed in the morning sky. The solution could be to do the marathon later in the spring, perhaps during the first week of April. The problem is that in that case more objects in the evening sky would not be visible. Fortunately M31, M32 and M110 rise again in the

(continued on page 8)

Sketching Globular Star Clusters

Mark Bratton
Montreal Centre
reprinted from *Skyward*

Astronomers estimate that the Milky Way has a retinue of at least 140 globular star clusters. These massive groups of stars form a halo around the core of our galaxy and because of this most of the clusters that are visible to northern hemisphere observers can be found in the summer sky.

If we take away the score or so globulars with designations such as "Terzian" or "Palomar", clusters that were, for the most part, identified from visually studying photographic plates of the night sky, we arrive at a rather unique situation in terms of visual amateur astronomy. Due to their size, brightness and mass, almost all of the Milky Way's family of globular clusters can be observed by the amateur with a moderate-sized telescope. Compare this situation with the number of planetary nebulæ, emission and reflection nebulæ, and open star clusters in our galaxy visible in amateur instruments. In each case, although the individual number may be great, the percentage of objects visible is a small fraction of what the Milky Way has to offer.

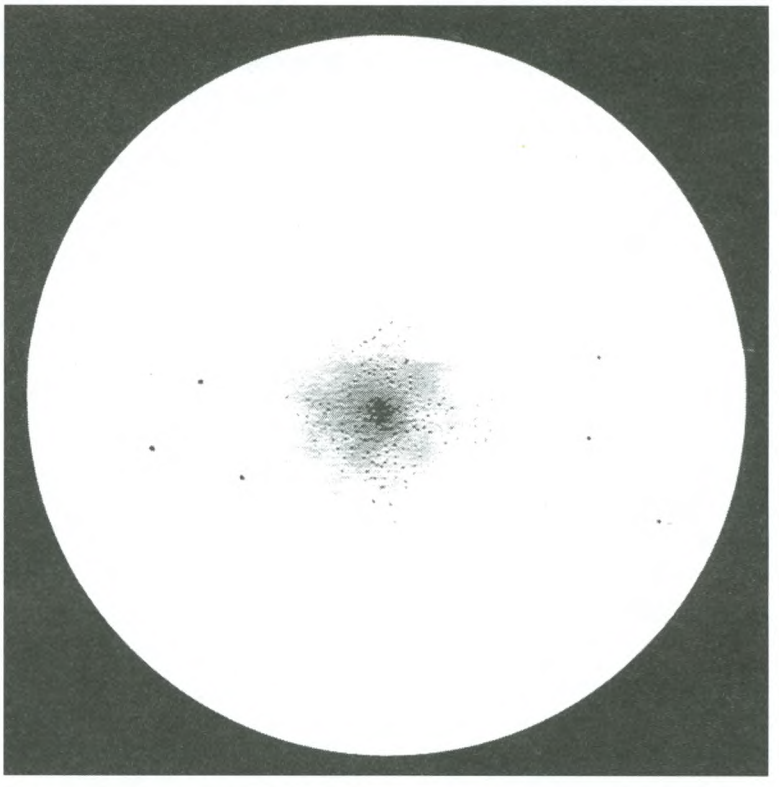
Like all classes of deep-sky objects, globular clusters offer special challenges to the amateur looking out to accurately portray these celestial wonders. The main challenge involves the nature of the object itself. Globular clusters are groups of stars numbering anywhere from several thousand to over a million members. How can one accurately plot that number of stars? Anyway, judging from photographs, they all pretty much look alike, or do they?

This is one of those instances where the great dynamic range that the naked eye has is a definite advantage over the rather limited range of photographic emulsions. When one gets the opportunity to study a large sample of these objects through a telescope, it becomes obvious that each globular cluster is, morphologically, quite unique.

Both the pen and the pencil come into play when sketching globular clusters because they are rarely fully resolvable. It is not the amateur's ability to accurately plot individual stars that leads to a pleasing portrayal, but rather his ability to capture the overall form of the cluster.

It is important to study the globular cluster in question, fully, at the telescope before beginning your sketch. Some clusters, like M80, are small, quite round and brighter to the center, but display little, if any, resolution into individual

(continued on page 8)



M92: Harbinger of Summer. Sketched by the author on June 24th, 1992 with an 8-inch Schmidt-Cassegrain at 161x.

Lightwaves: Light Pollution Questions And Answers

Bill Broderick
Kingston Centre
Chair, National Light Pollution Committee

In previous essays in this series I talked about such subjects as "Why Be Concerned About Light Pollution?", "Good Lighting—Bad Lighting: What's The Difference?" and "Getting Started as a Light Pollution Activist". Still, I am sure many of you still have a lot of questions, so I thought that this time we would look at some of these questions and try to answer them.

What can I do? Is the problem just too big for one person?

Of course it is! That is why I urge centres and other astronomical groups that are concerned about light pollution to form a light pollution committee. There is an old saying: "The longest journey begins with but a single step." Forming a committee or joining an already-existing committee is the logical "first step" to doing anything about light pollution.

Do not be intimidated by the "one person" obstacle, either. History is full of examples of how one person managed to make a difference or helped in some way to make the world a better place. We can look to them for inspirationEven today, individuals in many places are doing wonderful things. But in this "committee- oriented" world, individuals must surmount incredible obstacles in order to achieve even modest goals. Success favours groups.

Is it too late to do anything about light pollution?

This question refers to the sheer enormity of the problem. Of course the problem is enormous, but if nobody tries to do anything about it, it is surely going to get bigger. In point of fact, various groups and individuals in many places have succeeded in "doing something" about light pollution, so the problem is not insurmountable. Finally, if you never try, you will never know what you might have been able to accomplish.

Does lots of lighting help to prevent crime?

There is not much evidence that it does. There is considerably more evidence that people "feel" safer when there is a lot of light. In the past, utility companies and electric companies have "sold" the idea that lots of light somehow increases safety and security. Most people do feel more comfortable in a lighted environment so it was a pretty easy sell.

Cutting light pollution does not necessarily mean that we have to have darkness. Cutting light pollution means putting the light where we want it. It means getting rid of glare and clutter. It means, possibly, using lower wattage lamps and perhaps fewer lamps because, having got rid of glare, it is now easier to see.

The association of crime with darkness arises more out of our psyches than out of any reality. There is just as much crime in the daytime as at night. More, probably, as criminals can see what they are doing. More light simply increases the criminals' hours of operation. Cutting light pollution in some instances has actually been shown to reduce certain types of crimes, for example, vandalism. Vandals like to see the damage that they cause.

Why not just go out of town to get away from the lights?

Sure you can. Now. However, sooner or later the lights will follow you. Cities and towns get bigger. Development is going on all the time. Maybe you have a nice, dark observing site at the moment, but what happens when someone builds another shopping centre or sports complex a kilometre or two down the road from it. Running away from our problems never solves them.

Does light pollution affect only astronomers?

Do not believe it! Sure, astronomers are inconvenienced by light pollution. Sure, observatories have been closed because of it, and sure, amateur astronomers in many cases must travel long distances to a suitable observing site. Still, light pollution affects other people too.

Since light pollution is a waste of a resource, it costs all of us money. We have to pay for the wasted energy out of our tax and utility dollars, and if oil or coal is used to generate the wasted energy, we have to pay for that too. The old maxim still holds true: "There is no such thing as a free lunch."

There is evidence that light pollution impacts on the environment in various ways. The cycles of certain plants are affected by it, causing them to be weakened and less hardy. Certain animals and birds have their behaviour patterns altered by it, to their detriment. Baby sea turtles in Florida, for example, are lured up onto the land at night and are crushed to death by the thousands on the roads and highways. Migrating birds are attracted by the lights of towers and buildings, particularly in certain kinds of weather, and killed in great numbers by flying into the structures. There may well be other kinds of environmental problems we do not know anything about simply because we have not sufficiently studied the problem of light pollution in enough depth.

More and more non-astronomers that I talk to are somehow disturbed or upset because they cannot see the stars or the northern lights or the Big Dipper any more. There are lots of people for whom these things still matter. They are not amateur astronomers but they have seen a dark sky sometime or other and they resent that modern life has taken it away from them. If someone would start speaking up about light pollution, I think there are a lot of potential allies out there—naturalists, birders, environmentalists, and people who just enjoy being able to see the stars—who would gladly lend their support. After all, the stars do belong to everyone!

How can I find out more about light pollution?

Join the International Dark-Sky Association, or if you do not want to join it, at least get your hands on the IDA's information sheets. There are at the present time some 102 of them; by the time you read this there may be more as new ones are coming out practically all the time. I have said it before but it bears repeating: The IDA information sheets are the fastest and easiest way of becoming informed about light pollution, besides being the least expensive. If you hope to do anything useful about light pollution, you have to be informed. Beyond that, get on a committee—even if you have to form it yourself. (See my previous article about things to do as a committee.)

Will fighting light pollution make me look eccentric?

Business people who feel that certain proposed plans or developments would impact unfairly on their enterprises are not shy about registering their protests. Homeowners who feel that certain business operations or developments would be detrimental to their neighbourhood often exercise their right to object. Certainly, astronomers and others who enjoy the heavens have a right to defend their turf too.

Why be defensive about taking a stand for responsible lighting? Light pollution robs you not only of your view of the sky but also of your hard-earned tax and utility dollars for unnecessary and irresponsible lighting practices. You have a right to expect that your elected and appointed public officials will spend your money more wisely than just to light up the sky!

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Got some Julian Time on Your Hands?

Dan Collier
Vancouver Centre
reprinted from *NOVA*

At 4:11 PM PDT, Friday, September 29, 1995, the Julian Date is 2449990.46597 according to the RASC *Observer's Handbook*. With Julian Dates it is easy to keep time over thousands of years. Every day has a unique serial number to which is added a fraction representing Universal Time. To determine the time difference between any two events, simply subtract their respective Julian Dates.

A Julian Date does smell of revolution, n'est-ce pas, like the ten-hour clock or the 400-degree circle. Still, the $64 question which visitors to the Southam Observatory are constantly asking me is, "What is so special about Julian Date Zero?"

Et Tu Caesar?

How the Julian Date system came to be named after Julius Caesar takes a little explaining, beginning with the fact that July (the month) comes straight from Julius (the emperor). Only the Romans could pull such a stunt as renaming a month after their leader; it is truly a *monumentum aere perennius*, a monument more lasting than brass.

It is difficult, even for Canadians, to imagine politicians and the civil service undermining the integrity of such a basic institution as the calendar, but this had in fact happened in the time before Caesar. Imagine what would happen today if the Queen said, "Christmas is a nice holiday. I hereby decree a month of Christmases!" Worse, and more to the point, a prime minister could try to add a few months to circumvent his or her term limit. As with all things perfected by the Romans, political patronage has never since approached such elegance.

In those days the year began with the spring equinox and lasted ten months of 29 or 30 days each, in step with the 29.5-day lunar cycle. (Their Roman names were Martius, Aprilis, Maius, Junius, Quintilis, Sextilis, September, October, November and December.) The priests who were in charge of the calendar added enough "intercalary" days so that the equinox returned on the Ides of Martius (March 15th). The extra days were eventually collected into two intercalary months named Januarius and Februarius and added at year's end. In practice, however, the priests carried out the intercalation only if it suited them. When Caesar took power, their tampering was causing the equinox to fall as much as three months into the calendar year.

Like all dictators, Caesar sought prestige by surrounding himself with artists and intellectuals. He was particularly influenced by Sosigenes, an astronomer from Alexandria who had made the most accurate determination of the length of the year to date, 365.25 days. Sosigenes also devised a radical 12-month calendar without intercalary days, but he had to lengthen the old lunar months to bring it up to 365 days. To cancel the 0.25-day advance of the equinoxes, a single intercalary day was to be added to the last month of every fourth year, that month being February, of course. This invention of Sosigenes came to be known as the Julian Calendar.

Having named himself *pontifex maximus*, head of the Roman religion, and as such the "czar" of the calendar, Caesar added 90 leap days to 46 B.C. (80 days in some accounts), abolished the lunar calendar, and imposed the new solar calendar. Imagine the upheaval associated with lengthening a fiscal year—unhappy Romans called 46 the Year of Confusion.

After the death of Caesar, matters deteriorated anew. According to one story, his grandnephew Augustus had to suppress four leap days between 9 B.C. and 4 A.D. to set things right. "That's a good enough reason to name a month after myself," said Augustus, and for good measure he had a day transferred over from February. If not for this vanity, we might have had to call our eighth month "Sexuary"!

A Proleptic Fit

Back in 1583, Joe Scaliger wanted to start a new chronological system with an origin so far in the past that all events in recorded history took place after it. He had read that some chronologists before him had tinkered with a cycle of astronomical time lasting 7,980 years. This he called the "Julian period" after either the Julian calendar or his own father, Julius Caesar Scaliger.

Each year in the Julian period can be identified with a unique combination of three numbers, each signifying a year in a particular cycle. These cycles are:

1. A 28-year solar cycle, after which weekdays and dates repeat in the Julian Calendar;
2. A 19-year Golden Number cycle, after which the moon's phases recur on roughly the same calendar dates; and
3. A 15-year Roman tax indiction cycle.

Observe that 28 x 19 x 15 = 7,980. Scaliger's research showed that the years 9, 1 and 3 B.C. had long been accepted as a beginning year of each of the three cycles. He then looked for a number that, when divided by 28, 19 and 15, left the remainders 9, 1 and 3. That number is 4713, so the date January 1st, 4713 B.C. became the origin of Scaliger's chronological system.

Needless to say nobody uses this system for civil chronology today, but astronomers did take up the practice of numbering their nights with it. In keeping with an old observatory custom, Julian days start at noon. That would seem to be that. Wait, what about time zones? Though local time was often used in the past, the professionals now start Julian days at noon Greenwich time, or, more properly, Universal time.

January 1st, 4713 B.C. is usually specified as a date on the Julian proleptic calendar, proleptic being an obsolete word meaning "retroactive". (There was no such thing as the Julian calendar, nor Romans, for that matter, in 4713 B.C.) To be able to fix the starting date of the Julian period, we have to extend the Julian calendar back thousands of years.

January 1st, 4713 B.C. was not the date of creation worked out by Archbishop Ussher back in the seventeenth century, that being October 23rd, 4004 B.C. This date, appearing on page one of his massive biblical chronology, was the culmination of a long life's labour and was, for centuries, taken very seriously. The unfortunate Ussher has been jeered at for sticking his neck out, though the patronizing tones have strangely died away in the last few years.

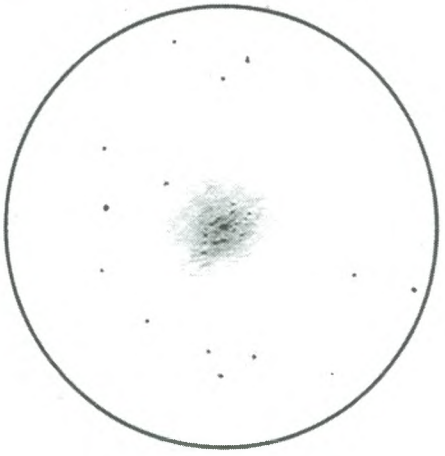
"If the world was thought to have been created in 4004 B.C.,", you may be asking, "what would anyone want with a calendar starting in 4713 B.C.?" I do not know, and frankly, the topic of chronology is far beyond the scope of this article. One example will have to do.

The Romans dated events in history from the Anno Urbis Conditae (A.U.C.), the year of the founding of their metropolis. That date is usually taken to be 753 B.C. so 1 A.D. is 754 A.U.C. In 1288 A.U.C., Dionysius Exiguus decided that the birth of Christ occurred in 754 A.U.C. and initiated our year-numbering system in that year (thus 754 A.U.C = 1 A.D.). Unfortunately Christ is now believed to have been born in 750 A.U.C., four years "before Christ" on our scale. If you wish to probe further, read the excellent summary of ancient eras and calendars in reference 4. I have always been curious about these arbitrary dates, reference points and adjustable parameters. What others would dismiss as trivia are, to me, outcroppings of true value. ✪

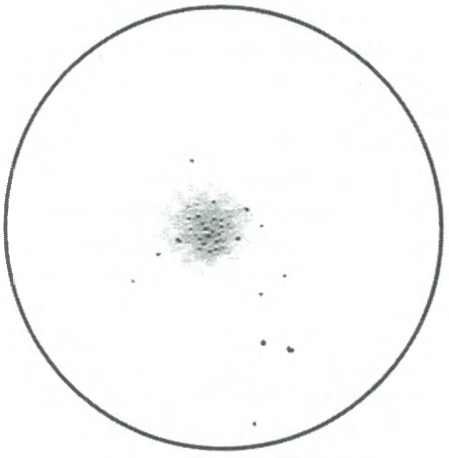
References

1. Asimov, I. *Of Time and Space and Other Things*, Doubleday, 1965.
2. Moyer, G. "The Origin of the Julian Day System" *Sky & Telescope*, April 1981.
3. Reese, R.L., Everett, S.M. and Craun, E.D. "The Chronology of Archbishop James Ussher" *Sky & Telescope*, November 1981.
4. "Calendar" *Columbia Encyclopedia*, 1942. ✪

stars. Others, like M62, are rather oblate in form. Clusters like M107 display a rather irregular, unresolved outline while bright clusters like M92 are a good combination of a bright, unresolved mass, surrounded by innumerable resolved stars. Finally, we have objects like the faint and challenging NGC 5466, in Boötes, which in a moderately large amateur telescope appears fully resolved with no background glow.



NGC 6712 in Scutum. Sketch by author, using a 15-inch reflector at 295x.



M9 in Ophiuchus. Sketch by author, using a 15-inch reflector at 272x.

The best place to start is with the pencil. Lay down a light base of graphite and use your pencil to smudge this into the desired shape. Go easy. It is best to lay down the graphite in light layers and gradually darken the outline using your finger. This gives you a lot of control and the ability to lighten or darken different parts of your sketch. Once this stage is complete, you can use a pen to plot individual cluster members, if they are visible. Try to be accurate at this stage, but it is not really critical. Occasionally, some cluster members are quite bright compared to most of the other resolved members and it is fairly important to plot these stars accurately. For most of the rest of the resolved members, a rough idea of how these stars are distributed in the outer halo may be all that is necessary. For a cluster like M92, which blazes toward the center, I like to repeatedly "dot" the center of the drawing until individual spots fuse into larger and larger clumps.

Personally, I like to use a pen like the Pilot Hi-Tecpoint, which is easily available at pharmacies or stationary stores. These pens, available with black ink, allow you to control the size and darkness of your markings, an important feature when trying to portray the brightness of a star. For backgrounds, I use a pencil like the Berol FUNd'Mentals, designed for young kids but with heavy, coarse graphite that is quite easy to manipulate.

Summer is almost here. Clear skies and good luck to you sketching under the stars. ✪

Another Successful Messier Marathon

(continued from page 5)

morning sky if missed, so the net effect may still be positive. If the marathon were done April 1st, for example, I would expect to miss M74, M77, and M33 in the evening sky, and M30 in the morning sky, resulting in 106 objects. Not much better, but worth a try. Of course, by early April the nights grow shorter, perhaps cancelling out the advantages mentioned above. My conclusion remains the same as after the 1992 Messier marathon—I seriously doubt anyone can see more than 106 Messier objects during a marathon from Toronto's northerly latitude. So, if you want to make it more challenging you will have to add a few of your own NGC objects. That was what I did this year by observing twenty-seven previously unseen NGC objects to give me a total of 130 deep-sky objects. I would be interested in hearing from other marathoners via e-mail at bc194@torfree.net. ✪

Reflections: Questions and Answers

(continued from page 6)

Let others call you "eccentric" if they want to. That is their problem, not yours. We have so much to gain and so little to lose by taking a stand for responsible lighting. If standing up for our interests as astronomers, taxpayers, and naturalists of the night, is eccentric, by all means let us have more of it! ✪

Send correspondence to:
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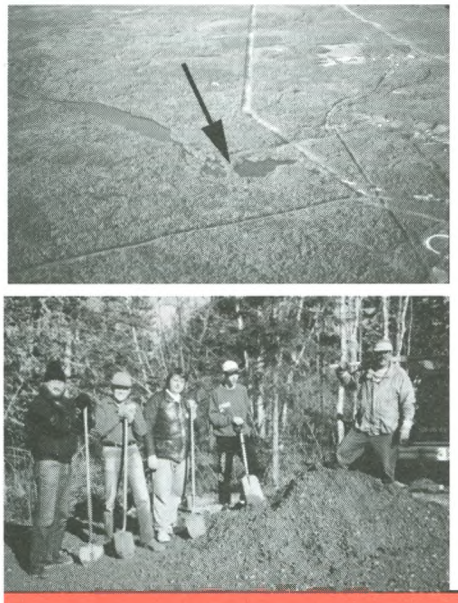

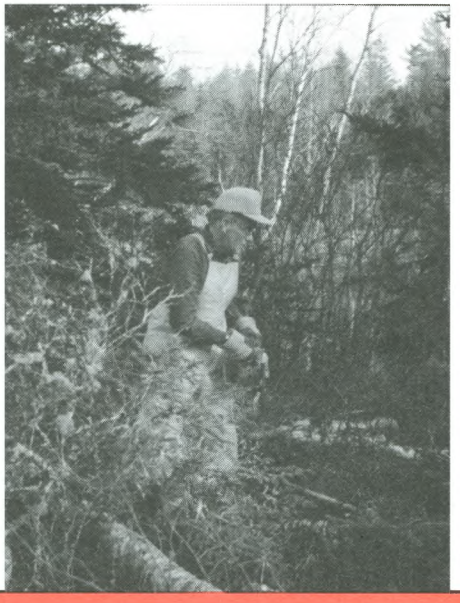

Construction Begins on Halifax Observatory

Construction permits are in hand and the work has begun! By the time you read this, the concrete slabs for the warm room and roll-off shed should be in place and work should have begun on both structures. Upper left: the arrow indicates the location of the site, between the two dams on the St. Croix River. The northern end of Lake Panuke is to the left of the arrow. Lower left: A work crew ready to start spreading gravel. From left: Ian Anderson, Roy Bishop, Shawn Mitchell, Paul Gray and Doug Pitcairn. Right: Roy "The Beaver" Bishop in action. When it comes to clearing brush, you want this guy on your side! ✪